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Dental Assistant Journeyman

Volume 3. Applied Dental Sciences



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In this third volume of CDC 4Y051C, *Dental Assistant Journeyman*, you are provided with information in applied dental sciences that will enable you to provide quality care to your patients. Remember that a dental assistant in the Air Force not only assists a dentist but is also a dental health provider, who works without the constant, direct supervision of a dentist. This increased responsibility requires you to be aware of oral lesions you may see in the patient's mouth, medication the patient may be taking, and materials you may use during patient treatment.

Unit 1 contains a comprehensive study of oral pathology including inflammation; dental plaque, calculus and stains; caries, pulpitis, and periapical disease; and anomalies and pathology of the oral cavity.

Unit 2 introduces the basics of elementary chemistry as a foundation for more specific applications of chemistry in therapeutics, materials, radiology, and dental health. It also covers dental therapeutics starting with drug administration and actions of drugs. This unit will also cover therapeutic agents and therapeutic aids.

In Unit 3 you will study dental materials. This unit includes factors affecting dental materials, restorative uses of materials, and miscellaneous dental materials.

A glossary of terms abbreviations is included at the end of this volume.

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NOTE: In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

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Unit 1. Oral Pathology

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PATHOLOGY IS THE STUDY of all diseases. Oral pathology is the study of diseases of the oral cavity. This unit will acquaint you with many common oral diseases or infections. If you recognize any of these conditions, call it to the attention of the dentist. If a condition is discovered during its earlier stages, treatment is usually easier and quicker. While the dentist treats most diseases, there are many instances where you may treat or assist in the treatment of oral disorders. As you are studying the common pathological conditions, refer to the figures in this volume.

1–1. Dental Plaque, Calculus, and Stains

Before you can educate a patient about proper oral hygiene, you must have a thorough understanding of dental plaque and calculus. If patients are to have good oral health they must control plaque and the resulting calculus daily. While stains are seldom harmful to the patient (except for cosmetic reasons), you also should know about the various types of stains. Before we discuss specific dental conditions you need to have an understanding of the underlying basis for them—inflammation.

401. Characteristics of inflammation

Inflammation is the sum of the body's reactions to injury—either physical or invasion of a pathogenic organism. Inflammation is an active process. Before an injury invokes an inflammatory reaction, necrosis (death) of at least some cells must occur. Inflammation's initial purpose is to destroy the irritating and injurious agent and to remove it and its by-products from the body. If this is not possible, the inflammatory process limits the extension of the causative agent and its effects within the body. Finally, inflammation is also a mechanism for repair or replacement of tissues damaged or destroyed by an offending agent.

There are five classic characteristics of inflammation—rubor (redness), calor (heat), tumor (swelling), dolor (pain), and functio laesa (loss of function). Any or a combination of all these characteristics may be present in inflammation.

| Characteristics of inflammation | |
|---------------------------------|---|
| Rubor | <i>Redness</i> is caused by an increased amount of blood in the area of inflammation or irritation. This is the initial response by the body to fight off or limit the injury inflicted by a causative agent. |
| Calor | <i>Heat</i> is a result of the increased amount of blood in the area. Complicated chemical changes occur in the infected sites and may contribute to the warmth in inflamed areas. As the blood arrives in the area, the vessels constrict, allowing the blood to remain in the area and the body's defense mechanisms to initiate the destruction and/or the repair phases of inflammation. |
| Tumor | <i>Swelling</i> or edema is caused by accumulated fluids and engorged blood vessels. As the blood flow slows, leukocytes, the white blood cells principally involved in the active response to an acute inflammation, constantly arrive and make their way to the area of damage. Here they engulf (phagocytize) the foreign body, including invading bacteria. Those leukocytes killed in the fight against the invading organisms become pus cells. |
| Dolor | <i>Pain</i> warns us that something is wrong. The tissues stretch, due to the increased blood flow and the body's defensive reaction to the local irritant or causative agent. |
| Functio Laesa | <i>Loss of function</i> or altered function is caused by damaged or injured tissue plus swelling. This dysfunction results from the injury to cells, swelling and stiffening of the part or area involved. |

The characteristics of inflammation are easily illustrated if you have experienced a sprained ankle: first the area becomes red, and starts to feel warm, swells, and then, most definitely, pain—especially when you try to walk. Pain while attempting to walk indicates the clear loss of function associated with inflammation.

The classic signs and symptoms of inflammation—swelling, redness, pain, increased heat, and sometimes-altered function—characterize gingival tissue inflammation. The gingiva reacts to inflammation in two phases:

1. Fighting or destructive phase—characterized by edema or swelling.
2. Repair phase—characterized by a fibrous growth (*hyperplasia*) at the site of irritation.

The edema is a result of a change in the amount of blood near the site of injury. The repair phase involves enlargement or proliferation of the connective tissue which gives the tissue a firm, leathery, fibrous consistency. This fibrous tissue cannot shrink or be reduced by elimination of edema since fluids in these tissues are normal.

The destructive and repair phases appear to happen simultaneously. But in order for a periodontal condition to occur, the destruction must exceed the repair. The extent to which destruction predominates over repair may vary within a local area. Gingival irritants can cause inflammation's destructive phase to proceed on the side of the gingiva next to the tooth while the repair phase is in process on the outer surface of the gingiva. This means that hemorrhage (bleeding) may occur in the sulcus while the visible surface of the gingiva might be fibrous and firm in appearance.

Now that we have an understanding of inflammation and its characteristics, let's turn our attention to areas more familiar to the dental field, beginning with plaque.

402. Dental plaque

In general terms, dental plaque can be described as a tenacious yet soft deposit consisting primarily of living bacteria and bacterial by-products. Proper oral hygiene can prevent the plaque from reforming and organizing.

Composition

Dental plaque is a mass of colonizing bacteria that adheres firmly to the teeth. An analysis of dental plaque has identified over 300 types of bacteria in the oral flora. In addition to the bacteria, the intermicrobial matrix contains dietary by-products, mucin (mu-sin), a byproduct of saliva, and desquamated (des'-kwah-may-ted, meaning sloughed off) epithelial cells that have sloughed off the oral mucosa. This gives the plaque "body." There are also some leukocytes (white blood cells) and red blood cells. Organic and inorganic solids constitute approximately 20 percent, and water accounts for 80 percent of plaque composition. Microorganisms account for 70 to 80 percent of the solid matter. Composition differs between individuals and different tooth surfaces of an individual. As plaque matures, it changes and evolves from facultative organisms dominating the early colonization to anaerobic organisms dominating in more mature plaque.

The role of plaque in oral disease

Evidence clearly indicates that bacteria colonized in dental plaque, is a primary factor in dental caries. However, the means of soft tissue destruction as a result of plaque accumulation is not as well known.

It is generally accepted that toxic agents are produced as a result of the plaque bacteria's metabolism and directly cause tissue destruction. These toxic agents include ammonia, hydrogen sulfide, acids, amines, and a variety of enzymes. Other toxic agents, such as endotoxins, produce reactions involving immunopathologic processes that enhance tissue breakdown, bone resorption, and periodontal pocket formation.

Plaque formation

Plaque is primarily differentiated in two categories—supragingival and subgingival—based on its relationship to the gingival margin. As plaque develops and accumulates, it becomes a visible globular substance that ranges in color from gray to yellowish-gray to yellow. It has been proven conclusively that plaque is the primary etiological factor in caries and periodontal disease and that in the absence of plaque, these diseases rarely occur. Additionally, though a disclosable layer of plaque can form in 4 to 6 hours, it takes a full 24 hours for plaque to form once it has been thoroughly removed.

Supragingival plaque formation

Supragingival plaque develops on tooth surfaces, restorations, and other dental appliances such as dentures. It accumulates primarily on the gingival third of the teeth and in surface cracks, defects, or rough areas. In order for plaque to adhere to the teeth, an acquired pellicle must be present. The acquired pellicle is a nonbacterial matrix composed of complex sugar-protein molecules that are a product of the saliva. The pellicle forms within minutes after cleaning a tooth and is colorless and transparent. When stained with a disclosing agent, the pellicle appears as a pale staining surface sheen.

Supragingival plaque formation begins with bacteria sticking to the acquired pellicle or tooth surface. Disclosable amounts of plaque usually form within 4 to 6 hours. The plaque mass continues to grow with the addition of new bacteria, subsequent multiplication of bacteria, and accumulation of additional bacteria and host products.

The molars accumulate significantly more plaque than all other teeth. Mandibular molars tend to have more plaque on the lingual surface whereas maxillary molars tend to have more plaque on the facial surface.

Subgingival plaque formation

Subgingival plaque formation is found below the gingival margin, between the tooth and the gingival sulcular tissue. If allowed to accumulate, plaque microorganisms and their toxic products penetrate into the gingival sulcus and become subgingival plaque. The morphology of the gingival sulcus and periodontal pocket make them less subject to the natural self-cleansing effects of the cheeks, lips, and

tongue. The “protected areas” form a relatively stagnant environment in which bacteria that cannot readily adhere to the tooth surface may have a chance for colonization. Additionally, bacteria within these areas have direct access to the nutrients present in sulcular fluid. Because of the nature of the gingival sulcus or periodontal pocket, only bacteria that can live with little or no oxygen can survive in these subgingival areas. Unfortunately, it is exactly these types of bacteria that are primarily responsible for periodontal destruction.

403. Calculus and stains

Simply stated, dental calculus is calcified or calcifying bacterial plaque. Calculus can be found either on a single tooth or in a generalized area. It can completely fill an interproximal space between two teeth. Calculus appears most frequently in salivary duct areas where cleaning has been inadequate. This adherent, calcified mass is classified according to its location within the mouth. Our knowledge of calculus may be changed as the result of ongoing research is publicized.

Composition

Calculus is made up of inorganic and organic compounds and water. Although the percentage will vary depending on the age, hardness of a deposit, and the location from which the analysis was taken, mature calculus usually contains between 75 and 85 percent inorganic components; the rest is organic components and water. The chemical content of supra- and subgingival calculus is similar.

Compared to teeth and bone, calculus can be significantly harder. The enamel is approximately 96 percent inorganic salts and the most highly calcified tissue in the body, dentin is approximately 70 percent, cementum and bone contain approximately 50 percent. As stated earlier, mature calculus has approximately 75 to 85 percent inorganic content.

Formation

Calculus formation varies from individual to individual. Formation time depends on individual tendency but is strongly influenced by the roughness of the tooth surface and the care and diligence of personal plaque control efforts. However, the average number of days required for the soft deposit to mature and change is 12 days, with a range of 10 days for “rapid” calculus formers and up to 20 days for “slow” formers. Initial mineralization of the plaque layer begins anywhere from 24 to 48 hours *after* the formation of the plaque layer.

Supragingival calculus

Supragingival calculus is formed above the margin of the gingiva. Its color is cream or yellow. Since supragingival calculus is above the margin, it is visible on the tooth found either on a single tooth or in a generalized area. It can completely fill an interproximal space between two teeth and appears most frequently in salivary duct areas. It is clay or bricklike in consistency and becomes extremely hard as it ages.

Subgingival calculus

Subgingival calculus forms below the crest of the gingival margin. The color of subgingival calculus is dark brown, black, or dark green caused by staining from blood pigments. Its consistency is harder than supragingival calculus. Subgingival calculus has flint-like hardness and is more firmly attached. Subgingival calculus is always covered by masses of active plaque bacteria. The bacterial mass is in contact with the diseased sulcular epithelium and promotes gingivitis and periodontitis. With its rough surface and permeable structure, calculus acts as a reservoir for tissue, and tissue and toxic microbial by-products.

Stains

Stains are not as important as plaque and calculus because they do not cause disease. However, since stains are important to the patient for cosmetic reasons, you need to know about them. The various

dental stains are classified by location: extrinsic or intrinsic—and by source: exogenous or endogenous.

Location

Extrinsic stains occur on the external surface of the tooth and may be removed by brushing, scaling, and/or polishing. Examples of extrinsic stains are smoking or coffee stains.

Intrinsic stains occur within the tooth substance and cannot be removed. Intrinsic stain examples are fluorosis and tetracycline staining.

Source

Endogenous stains develop and originate from within the tooth. They are always intrinsic and usually are discoloration of the dentin reflected through enamel.

Exogenous stains develop or originate from sources outside of the tooth. They may be extrinsic and stay on the outer surface of the tooth or intrinsic and become incorporated within the tooth structure.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

401. Characteristics of inflammation

1. Define inflammation.
2. Briefly describe the characteristics of inflammation in each of the following:
 - (a) Rubor.
 - (b) Calor.
 - (c) Tumor.
 - (d) Dolor.
 - (e) Functio Laeso.
3. What are the two phases of gingival reaction to inflammation?

402. Dental plaque

1. Of what is plaque composed?

2. Where does supragingival plaque develop and accumulate?
3. What must be present for plaque to adhere to the teeth?
4. Which teeth accumulate more plaque than all other teeth?
5. Which type of bacteria can live in the gingival sulcus or periodontal sulcus?

403. Calculus and stains

1. What percent of calculus is inorganic substance?
2. How old must plaque be in order for calculus to initially form?
3. Where is supragingival calculus formed and where can it be found?
4. What is the normal color of supragingival calculus when it is free of stains?
5. What is the consistency of supragingival calculus?
6. Where does subgingival calculus form?
7. What is the color of subgingival calculus? Why?
8. Describe the consistency of subgingival calculus.
9. How are stains classified?
10. What type of stain may be removed by tooth brushing, scaling, and/or polishing?

11. What are endogenous stains?

1-2. Caries, Pulpitis, and Periapical Diseases

As Sergeant Ryerson bit into a candy bar he felt pain in his tooth. The pain was mild and short. Later, as he drank cold water he felt the pain again. This was the first time the tooth had bothered him. Most likely his pain was caused by dental caries—the most common pathology of the teeth. If dental caries are not treated, they may advance toward the dental pulp, causing inflammation. This condition is called *pulpitis*. With pulpitis, the severity of the pain is only partially related to the severity of the inflammatory response. Other factors include whether drainage has been established and the patient's previous experiences, including emotions and other traits. Untreated pulpitis can result in the death of the pulp. A periapical abscess may form as the pulp dies. The abscess could advance to many severe oral or physical conditions. Our discussion of the stages of pathology of the teeth starts where the pathology usually begins, with dental caries.

404. Dental caries

Caries is the local decalcification and disintegration of the enamel, dentin, and cementum leading to the formation of open lesions—commonly known as cavities. This destructive process is commonly referred to as decay. Caries is said to be the most prevalent chronic disease in humans.

Etiology

The etiology or cause of dental caries is bacteria, specifically *streptococcus mutans* and *lactobacillus*. Normally, these bacteria are present in the mouth of every individual. All dental caries begin with a plaque deposit on the tooth surfaces that become laden with bacteria. Tooth decay most commonly occurs in the pits, fissures, grooves, interproximal, and gingival areas—locations where bacterial plaques are most readily found since they are not easily cleaned. When primary sugars and fermentable carbohydrates are ingested, the bacteria in plaque feed and produce acid. The acid is held in contact with the tooth and protected by the mass of plaque. The acid attacks the enamel, causing its demineralization and destruction. The amount of decalcification depends on the abundance of plaque, carbohydrates available for conversion to acid, and the frequency that the acid has to act.

Depending upon the food source, the bacteria will produce acid anywhere from 20 minutes to well over 2 hours—with a single exposure to its food source! On average, our teeth are able to withstand these acid attacks, which usually occur for approximately 20 minutes after each meal. However, frequently snacking or drinking something with sugar throughout the day causes a constant acid attack on the teeth. These acid attacks show up as “white” spots or decalcified areas, which eventually progress to cavitated lesions if the caries cycle continues.

Cavity formation—from the time decalcification starts until there is a cavitated lesion—varies between persons and is influenced by diet, oral hygiene, salivary flow, tooth susceptibility, and fluoride intake. There are additional factors but, in general these factors stand out as the most important:

- Caries in primary teeth—approximately 36 months, +/- 6 months.
- Caries in permanent teeth—approximately 48 months, +/- 6 months.

Signs and symptoms

A *sign* of a disease is an objective manifestation. The examiner can positively diagnose a sign, such as swelling. A *symptom* of a disease is a subjective manifestation. Only the patient can positively identify a symptom, such as pain. The signs and symptoms of dental caries are quite specific. Often, the very early signs of dental caries can be detected by a thorough examination of a patient's teeth,

including radiographs. The appearance of a carious lesion depends on the rapidity of the process along with other influencing factors.

Sometimes you will find indications of small areas of decalcification of the enamel. The process of dental caries can be reversed in the early stages. Early lesions can recalcify given the right conditions. However, the process of dental caries usually continues through the enamel toward the dentin. As the carious process continues, you can see a discoloration of the tooth structure, an increase in the translucency of the tooth structure, and the formation of a cavity (fig. 1-1).



Figure 1-1. Caries.
(Reproduced by permission from Oral Lesions).

Quite often, dental caries presents a combination of signs and symptoms that must be evaluated to arrive at a correct diagnosis. Generally, the tooth becomes sensitive to cold foods and liquids first, and then becomes sensitive to foods and liquids containing high concentrations of sugar. Pain may also occur because of local irritations from food particles trapped in the cavity between the teeth which exerts pressure on the interdental papilla. These symptoms comprise what is normally termed “simple tooth decay.” The *signs* of simple tooth decay are discoloration, increased translucency, a break in the surface continuity of the enamel, and inflammation of the interdental

papilla. If no treatment is given for this condition, the carious lesion continues to get larger which, in turn, creates additional complicating factors.

Caries control

As caries progresses beyond the early stages, the disease cannot be reversed (self-repaired) and, often, continues to progress. Occasionally, it may be self-limiting—a condition known as arrested caries—but the destroyed area is never self-repaired. Repair can only be accomplished by restorative dentistry.

There is a correlation between the lactobacillus and streptococci count and the amount of carbohydrates consumed by an individual. The higher the lactobacillus and streptococci count, the greater the number of carious teeth. If you decrease the carbohydrate intake, you will also decrease the bacterial count, thereby reducing caries incidence. A proper diet is necessary to ensure adequate intake of vitamins and minerals. Correct intake of vitamins and minerals during tooth development is especially important. For this reason your patients should understand that what they do today, for example home care and diet, can influence how many cavities they will get years from now. Effective home care, minimal snacking or drinking between meals and fluoride intake are the most important factors in the prevention of caries.

405. Pulpitis

The term “pulpitis” means an inflammation of the pulpal tissue. When dental caries progresses through the dentinal tubules and enters the pulp, inflammation sets in and a toothache results. Pulpitis can also result from thermal, toxic, and traumatic injuries of the pulp and/or its chamber.

Etiology of pulpitis

Previously, you studied the cause and effect relationships that result in inflammation and learned that it is nature’s way of fighting infection. This defensive mechanism usually provides the means for neutralizing the irritants and eliminating tissue debris. However, within the confining walls of the pulp chamber, the pulp’s ability to recover is limited.

Dental pulp is a delicate type of connective tissue that is protected by being completely surrounded by dentin. Despite this protection, the pulp may be injured by thermal changes, invasion of microorganisms from extensive carious lesions, or mechanical trauma by a physical blow. Two types of pulp inflammation are possible—(1) reversible and (2) irreversible.

Reversible pulpitis

Reversible pulpitis is when the pulp will recover. The pulp becomes slightly inflamed from irritation by restorative procedures, periodontal curettage, or cervical erosion.

Irreversible pulpitis

Irreversible pulpitis occurs when the pulp cannot heal itself. With irreversible pulpitis the inflammation can range from mild to severe. Depending on the severity of the inflammation it results in irreversible pulpal damage and, eventually, pulp death (necrosis of the pulp). The most common cause of irreversible pulpitis is when bacteria from a carious lesion passes through the dentinal tubules and invades the pulp.

Signs and symptoms

The active growth of the microorganisms produces rapid pulp destruction and a build-up of pressures. These are accompanied by correspondingly severe, pulsating pain. *Acute pulpitis* has a short and relatively severe pain and usually occurs in a tooth with a large cavity or defective restoration. *Chronic pulpitis*, which occurs in both a closed and an open form, has a protracted course and relatively mild symptoms. The chronic form, unlike acute pulpitis, is characterized by a mild, dull ache, and a mild reaction to thermal stimuli. Since the pulp is contained in hard and unyielding walls, the swelling produced by such inflammation causes pressure and may soon result in irreversible pulpitis.

Treatment

Pulpitis in its early stages may be reversible if the irritation or cause can be removed. This treatment, usually done in the restorative section, may consist of removing the irritation and inserting a sedative filling. In the later stages of pulpitis, the inflammation is irreversible and treatment is normally performed in the endodontic section. The treatment at this stage is called a *pulpotomy* (removal of the coronal portion of the pulp). When pulpitis leads to necrosis of the tooth pulp, the tooth is said to be *nonvital*. A nonvital tooth is treated in either the endodontic or oral surgery section. Endodontic treatment of a nonvital tooth essentially entails a *pulpectomy*—involving complete removal of the necrotic pulp and replacement with a suitable root canal filling. A nonvital tooth that cannot be treated by endodontics is usually extracted.

406. Periapical diseases

When the infection in the pulp reaches the apex of the tooth, it continues into the periapical area. The intensity of the inflammation and the host's response determine the extent of the infection. Pulp infections lead to periapical diseases which include dental granulomas and periapical abscess.

Dental granuloma

A dental granuloma is a mass of granulation tissue usually surrounded by a fibrous sac (fig. 1–2). It is a sequel (continuation) to chronic inflammation of the periapical tissues. This chronic inflammation may be the result of necrosis of the pulp cells, or it may be caused by nonpyogenic (non pus producing) bacteria. The *apical granuloma* is at the apex of the root, and the membrane that surrounds the granuloma often remains attached to the tooth as it is extracted. The tooth may be sensitive to percussion and feel slightly elongated; also, there may be a dull but persistent pain. However, in other instances, this condition may be present and offer no symptoms. If there is an increase in the number or virulence of the microorganisms or a decrease in host resistance, an abscess can arise within the granuloma. In fact, this is the usual way in which a periapical abscess develops. There are two types of abscess that occur at the apex of a non-vital tooth: the more common *apical*



Figure 1-2. Periapical dental granuloma. (Reproduced by permission of *Oral Lesions*).

granuloma which consists of granulation tissue but no surrounding fibrous sac and the *apical cyst*, which is a fluid filled sac around the apex of the tooth.

Periapical abscess

The periapical abscess is the most common condition following untreated pulpitis. A periapical abscess is the localized collection of pus at the apex of a tooth and is classified as either acute or chronic.

After the pulp becomes inflamed and minute abscesses form in it, the inflammation spreads down the pulp canal and out through the root end (apical foramen) into the hard and soft tissues of the jaw. An *abscess* by definition is a localized collection of pus in a cavity formed by the disintegration of tissue. As the abscess forms, pressure from swelling and pus causes the tooth to be pushed up in its socket. The tooth feels high and is very sore to touch. The acute stage is marked by local bone and soft tissue destruction, which appears as a dark spot or radiolucency on periapical radiographs.

An *acute* periapical abscess is a rapidly progressive inflammatory process. Usually, pus forms within 24 hours. The area becomes extremely painful and the abscess rapidly increases in size, with pus searching for an outlet. The tooth may be extruded slightly from its socket. The periodontal ligaments that are damaged due to the abscess may cause the tooth to become loose. The tooth is very sensitive to percussion and the body temperature may be elevated. Percussion is a valuable diagnostic test when the patient has a periapical abscess. The *chronic* periapical abscess is a condition of much longer duration but is less painful and has little tendency to spread. As a rule, the pain occurs only when pressure is placed on the tooth in a certain direction. Normally, no readings are obtained when a pulp tester is used to check this condition.

Frequently, the acute apical abscess transforms into a *chronic apical abscess*. This usually occurs soon after drainage is established and the acute symptoms quickly subside. If an abscess remains untreated, it continues to progress in the direction offering the least resistance. Eventually, a fistula forms and allows the pus to drain. The accumulated pus eventually penetrates the cortical plate emerging into the gingival tissue and forming a parulis or gum boil (fig. 1-3). Often, the face swells in the area of the abscess. If the infection does not localize, a hard, boardlike swelling called *cellulitis* spreads through the tissue and wide areas of the face and neck. A constant, pulsating pain is usually experienced while the abscess is forming, though the pain is almost instantly relieved when drainage is established. People have been known to have a draining abscess for years and experience little or no pain or swelling.

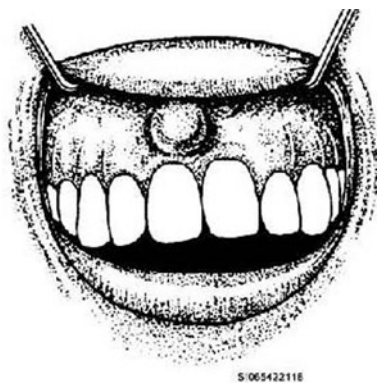


Figure 1-3. Parulis.

407. Cysts, cellulitis, and alveolar osteitis

Cysts, cellulitis, and alveolar osteitis are some of the abnormal conditions that can exist in the oral cavity and cause patients to request treatment. *Cysts* are oral lesions extending below the mucosal surface; *cellulitis* is a disease of the soft tissues; and *alveolar osteitis* is a postsurgical complication. You might be the first to observe these pathologic conditions in the patient's mouth. While identifying them is important to make a diagnosis, always notify a dental officer when you suspect one of these conditions. *Never make a diagnosis or tell a patient what you think he/she might have.* That is the sole responsibility of the dental officer.

Cysts

While there are many types of cysts, the most common types you encounter in the treatment of dental patients are inflammatory and developmental cysts. For both, the normal treatment consists of having a dentist surgically excise the cyst in combination with a thorough curettage of the area to eliminate the rest of the cells that could lead to its recurrence.

Inflammatory cysts

The inflammatory cyst is usually caused by some irritant that can be identified. A chronic periapical abscess may cause the cells to proliferate (to reproduce in quick succession) and surround the abscess. If this epithelial sac successfully surrounds the chronic abscess, it prevents further bacterial growth by cutting off the nutrient source. The pus gradually turns to a clear liquid. This sac or cyst may continue to enlarge by increasing the fluid inside the sac due to the exchange of fluids through the cyst wall. Figure 1-4 is a radiographic illustration of a periapical cyst. Cysts can form around retained roots or any foreign chronic irritant that may be buried in the tissue. A cyst is usually asymptomatic. The periapical cyst is the most common type of inflammatory cyst and is usually associated with necrotic pulps.

Developmental cysts

Developmental cysts usually are composed of the cells that were left behind after performing a particular function. A good example is the dentigerous cyst (fig. 1-5) in which the tissue that formed in the developmental sac during tooth formation causes this fluid-filled sac. Usually this sac disappears after its job is finished. However, sometimes parts of it remain embedded in bone or attached to the tooth. Years later, the epithelial cells of the follicle begin to multiply and cause a follicular cyst. Additionally, remnants of this sac may be left behind during the third molar extraction. Since the third molar erupts comparatively late in life, it still may have some follicle attached. Although healing appears normal at the time, a cyst may appear some years later.



Figure 1-4. Periapical cyst.
(Reproduced by permission of *Oral Lesions*).

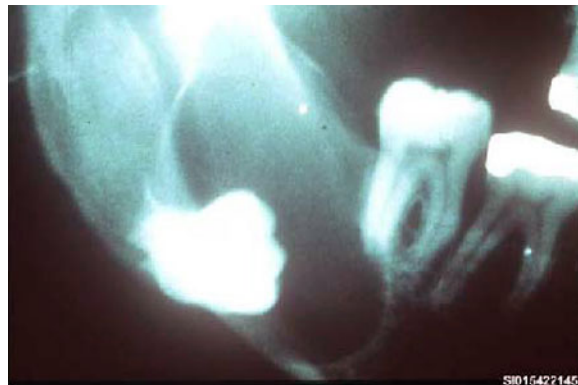


Figure 1-5. Dentigerous cyst.
(Reproduced by permission of *Oral Lesions*).

Cellulitis

Cellulitis is a diffuse generalized inflammation that is not contained or localized within a limited area. Cellulitis is characterized by rapidly developing swelling with high fever. Typically the skin becomes very red and severe throbbing pain occurs as the inflammation localizes (fig. 1–6). The condition is



Figure 1–6. Cellulitis.

often associated with periapical, periodontal, or pericoronal infections. Pus may then pool in this area, imparting a yellowish-white color. Sometimes, rather than localizing, the cellulitis may spread to deeper tissues and become a life-threatening infection.

Cellulitis is a serious infection where extensive swelling can close off the airway in the neck. It is important to establish drainage where pus accumulates. These patients must be seen daily until their condition improves. Cellulitis is treated by incision and drainage to change the internal environment, cultured to determine what bacteria is causing the infection to choose the correct antibiotic, and irrigation. The patient is placed on antibiotics. If the patient is having trouble swallowing due to the swelling, the patient should be admitted to the hospital for further treatment.

Alveolar osteitis

The blood clot that forms following surgery normally closes the tooth socket and protects the alveolus from the food, cold air, and fluid. *Alveolar osteitis*, commonly known as a “dry socket”, is an extremely painful condition that may occur several days after the extraction if the blood clot doesn’t form or is dislodged. The patient is usually in severe to persistent pain because of the exposed bone in the open socket.

Although treatment of a dry socket may vary, it often consists of irrigating the socket with a warm solution and packing it with squeeze-dried eugenol-iodoform gauze. The gauze is packed tightly into the socket to provide sedative action without interfering with healing. Analgesics may be prescribed to relieve pain and possible insomnia.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

404. Dental caries

1. Define caries.
2. What is the cause of dental caries?
3. What is the role of dental plaque in tooth decay?
4. Where does tooth decay most commonly occur?

5. How can early signs of dental caries be detected?
6. What are the signs of the continuing carious process?
7. Generally, what are the first symptoms of tooth decay?
8. What is the only way dental caries can be repaired?
9. How does the reduction of carbohydrates consumed by an individual affect caries incidence?

405. Pulpitis

1. What is pulpitis?
2. What are the two types of pulp inflammation?
3. What is reversible pulpitis?
4. With irreversible pulpitis, what happens to the pulp depending on the severity of inflammation?
5. How is pulpitis treated during its early stages?
6. Explain the difference between a pulpotomy and a pulpectomy.
7. What treatment would be performed on a tooth that has become nonvital as a result of pulpitis?

406. Periapical diseases

1. What is a dental granuloma?

2. A granuloma is sequel to what condition?
3. Where are apical granulomas usually located?
4. What symptoms may be noticed by a patient having an apical granuloma?
5. Name the types and location of periapical abscesses.
6. Define an abscess.
7. Briefly differentiate between an acute and a chronic periapical abscess as to pain.
8. How is the pain associated with a periapical abscess relieved?

407. Cysts, cellulitis, and alveolar osteitis

1. What usually causes an inflammatory cyst?
2. What happens to pus trapped inside a cyst?
3. Where can an inflammatory cyst form?
4. Developmental cysts are composed of what?
5. Summarize the signs and symptoms of cellulitis.
6. Under what conditions is alveolar osteitis likely to occur?
7. Why is the patient usually in severe pain?

8. What treatment is often used to treat a dry socket?

1-3. Periodontal Disease

Periodontal disease causes the loss of more adult teeth than any other condition. While it commonly affects people over 35 years of age, it is a serious threat to the dental health of patients of all ages. Inform your patients who are parents that periodontal disease begins in childhood (as early as 4 to 6 years of age) and progresses through life unless stopped before damage is done. You can compare advanced periodontal disease to a strong house with a weak foundation. A patient may have teeth that are free from decay, but they may be supported by weak, diseased, degenerated tissue. In this section we discuss two forms of periodontal disease: gingivitis and periodontitis.

408. Gingivitis

The term “gingivitis” refers to inflammation of the gingiva. This is the most common form of gingival disease treated in the dental clinic. There are several methods of classifying gingivitis. It can be treated according to etiology factors or degree of inflammation. It also can be classified according to its anatomic location and distribution or clinical features. Enlargement of the gingiva is one common clinical finding. Our discussion of gingivitis is based on the anatomical location and distribution and gingival enlargement.

Anatomical location and distribution

Gingivitis may vary in severity in different sites in the mouth and show varying patterns of distribution within the mouth. *Localized gingivitis* is confined to the gingiva of a single tooth or group of teeth while *generalized gingivitis* involves the entire mouth. *Papillary gingivitis* involves the interdental papillae and often extends into the adjacent marginal gingiva. Most gingivitis develops first in the interdental papilla and spreads to marginal gingiva. *Marginal gingivitis* primarily involves the free gingival margin and the papillae and may include a portion of the attached gingiva. *Diffuse gingivitis* involves inflammation of all gingival tissues including interdental papillae, marginal gingiva and attached gingiva. The distribution of gingivitis in a patient is described by combining the following terms:

| Gingivitis | Description |
|----------------------|--|
| Localized papillary | Is limited to one or more interdental papillae in a confined area. |
| Localized marginal | Is limited to one or more areas of the marginal gingiva. |
| Localized diffuse | Extends from the margin to the mucobuccal fold in a limited area. |
| Generalized marginal | Involves the gingival margins of all teeth with the interdental papillae usually affected as well. |
| Generalized diffuse | Involves the entire gingiva. The alveolar mucosa is usually also affected, causing the boundary between it and the attached gingiva to be obliterated. |

Chronic generalized marginal gingivitis (simple gingivitis)

This condition is often labeled simple gingivitis because the etiology was originally believed that to be local irritants only. Subsequent research has shown that there also are predisposing (making susceptible) and systemic factors involved.

Etiology factors

Primary etiology factors include plaque and calculus accumulations. Secondary factors include mechanical irritants (improper brushing and flossing techniques, mouth breathing, occlusal trauma), and rough or sharp tooth edges caused by caries or defective restorations. Other predisposing factors that may further aggravate an already irritated periodontium include tooth anatomy, tooth position,

the occlusal plane relationship, width of the attached gingiva, the crown-root ratio, and the contour of the alveolar bone. When any of these factors exists as an irritant, explain to the patient the anatomic problems that interfere with cleaning the mouth and allow the gingiva in those areas to be more susceptible to gingivitis. While systemic diseases may allow the gingiva to respond exaggeratedly to local irritants, there are no systemic diseases that actually cause gingivitis.

Signs



Figure 1-7. Marginal gingivitis.
(Reproduced by permission from Oral Lesions).

The clinical picture varies from case to case, but normally certain signs are present (fig. 1-7). The classic signs of inflammation, discussed earlier, characterize gingivitis: swelling, redness, possible pain, increased heat, and a possible disturbance in function. The earliest sign of this condition is a change in the color of the free gingiva as it turns a darker, deeper red or blue-red color. Eventually, inflammation involves changes in the gingival morphology which affect both the gingival margins and the interdental papillae.

Treatment

Treatment of marginal (simple) gingivitis is directed toward elimination of the etiological factors. This includes a removal of supragingival and subgingival irritants, oral prophylaxis, and oral hygiene instructions. A dentist and/or a physician should treat predisposing or systemic factors.

Hyperplastic gingivitis (gingival hyperplasia)

Hyperplastic gingivitis causes the gingiva to look fibrous in nature (fig. 1-8, view A). The gingiva is neither red nor painful, but grossly enlarged. The cause is often idiopathic (unknown) but it may be associated with severe mouth-breathing problems. Certain drugs also may cause hyperplastic gingivitis. For example, Dilantin taken for epilepsy could cause Dilantin hyperplasia (fig. 1-8, view B). It may even be hereditary. The treatment may require surgical excision by a dentist.



A. Hyperplastic gingivitis



B. Dilantin hyperplasia

Figure 1-8. Hyperplastic gingivitis and Dilantin hyperplasia.
(Reproduced by permission from Oral Lesions).

Hormonal gingivitis

A hormone imbalance is responsible for this type of gingivitis—the cause giving the condition its name: hormonal. It occurs during those phases of life when there is alteration of sex hormones—adolescence, pregnancy, and menstruation. It is caused by poor oral hygiene and usually found in the

anterior part of the mouth. It may involve a few or many teeth. This condition can usually be controlled by the removal of any irritants and good oral hygiene.

Necrotizing ulcerative gingivitis

This disease has many names. It has been called Vincent's infection and trenchmouth (from World War I soldiers who developed this mouth disease during trench warfare, hence "trenchmouth"). The American Academy of Periodontology refers to this condition as *necrotizing ulcerative gingivitis* or "NUG." In this type of gingivitis, the tissue of the interdental papilla is either dead or dying. The gingiva is swollen, red, and bleeding and the dead interdental papilla is covered with a gray-white pseudo (false) membrane (fig. 1-9). If you wipe the tissue with a gauze or cotton swab or if you squirt water on the membrane, it peels off and leaves a raw, bleeding surface. A fetid odor is always present. In the acute stage, the patient has fever, the other gums may be painful, and the patient may be unable to eat because of sore gums. The cervical lymph glands may be swollen. The patient may suffer from malaise (a general feeling of illness). The ever-present symptoms and signs vary in intensity.



Figure 1-9. Necrotizing ulcerative gingivitis (NUG).
(Reproduced by permission from Oral Lesions).

409. Periodontitis, periodontal abscess, and pericoronitis

Periodontia is a generalized term used to describe the many disorders affecting the surrounding and supporting structures of the teeth. Some of these disorders are: periodontitis, periodontal abscess and pericoronitis.

Periodontitis

This is an inflammation of the periodontium, including both the gingiva and tooth attachment apparatus (fig. 1-10 and 1-11). The main difference between gingivitis and periodontitis is in the anatomical parts involved. In gingivitis the marginal and papillary tissues are inflamed. When the inflammation extends beyond the free gingival margin and destroys the transseptal fibers and supporting structures of the tooth, the condition is called *periodontitis*.



Figure 1-10. Periodontitis.
(Reproduced by permission from Oral Lesions).



Figure 1-11. Severe periodontitis.
(Reproduced by permission from Oral Lesions).

Plaque is responsible for the initiation of periodontitis. Although it's known that calculus is not responsible for initiating periodontal disease, there is no doubt it contributes significantly to the maintenance and progression of the disease. Secondary irritants may be food impaction, overhanging margins of restorations, roughened or cracked restorations, or sharp edges of carious teeth. This condition also can be aggravated by systemic factors such as low resistance, fatigue, stress, diabetes,

blood problems, and hormone imbalance. If a patient has diabetes, for example, you shouldn't expect dramatic healing.

Periodontal abscess

An abscess may form in a periodontal pocket; however, unlike periapical abscesses, the vitality (pulp) of the tooth is *not* affected. Periodontal abscess can cause toothaches, mobility of the tooth, and eventual loss of the tooth.

Usually, the etiology of the abscess stems from a foreign body irritant that becomes embedded in the space between the tooth and the soft tissue or completely within the soft tissue next to the tooth. The most common cause of a periodontal abscess is the bacteria in plaque that is attached to calculus formations and overhanging fillings. Foreign body irritation such as popcorn husks is another significant cause of abscesses.

Pericoronitis

This is an inflammation of the soft tissue around the crown of the tooth (fig. 1-12). It occurs most frequently around the crowns of partially erupted teeth and, more specifically, the third molars or wisdom teeth. However, any partially erupted tooth may be affected. Figure 1-12 shows pericoronitis of the third molar. In this condition, a flap of gingival (gum) tissue called an operculum (o-per-kye-lem) extends over the unerupted portion of the tooth and establishes an ideal pocket for the accumulation of food debris and growth of bacteria. As the bacteria multiplies the infection starts. It causes pain, pus formation, swelling, and, at times, trismus of the muscles of mastication in that particular area. With *trismus*, the patient has difficulty opening his or her mouth. Although this condition is usually due to a partially erupted tooth, it may be aggravated by mechanical trauma and, as mentioned, by a secondary bacterial infection.



Figure 1-12. Pericoronitis.
(Reproduced by permission from Oral Lesions).

Pericoronitis has many signs and symptoms associated with it. The gingiva around the tooth is inflamed and swollen, and it may extend into the adjacent tissue. There may be an accumulation of pus along with severe throbbing pain and trismus of the muscles in the affected area. Sometimes fever and generalized cellulitis may develop.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

408. Gingivitis

1. Define gingivitis.

2. Match the anatomical location and distribution terms in column A with the descriptive response in column B. Column B items may be used only once.

| <i>Column A</i> | <i>Column B</i> |
|---|---|
| ____ (1) Marginal gingivitis. | a. Confined to a single tooth or group of teeth. |
| ____ (2) Localized gingivitis. | b. Involves the entire mouth. |
| ____ (3) Papillary gingivitis. | c. Involves the interdental papillae and often extends into the adjacent marginal gingiva. |
| ____ (4) Generalized gingivitis. | d. Primarily involves the free gingival margin in addition to the papillae and may include a portion of the attached gingiva. |
| ____ (5) Diffuse gingivitis. | e. Involves all gingival tissues including interdental papillae, marginal gingiva and attached gingiva. |
| ____ (6) Localized papillary gingivitis. | f. Limited to one or more interdental papillae in a confined area. |
| ____ (7) Generalized marginal gingivitis. | g. Limited to one or more areas of the marginal gingiva. |
| ____ (8) Localized diffuse gingivitis. | h. Extends from the margin to the mucobuccal fold in a limited area. |
| ____ (9) Localized marginal gingivitis. | i. Involves the gingival margins of all teeth with the interdental papillae usually affected too. |
| ____ (10) Generalized diffuse gingivitis. | j. Involves the entire gingiva and alveolar mucosa. |

3. List four factors that can cause marginal gingivitis.
4. What are the classical signs of a patient who has marginal gingivitis?
5. What is the treatment of marginal gingivitis directed toward and how?
6. Who should provide treatment for the predisposing and systemic factors related to marginal gingivitis?
7. What is hyperplastic gingivitis?
8. What drug could cause gingival hyperplasia and why is it taken?
9. How can you control hormonal gingivitis?
10. What are the other names for acute necrotizing ulcerative gingivitis?
11. What are the signs and symptoms of necrotizing ulcerative gingivitis?

409. Periodontitis, periodontal abscess and pericoronitis

1. What is periodontitis?
2. Explain the difference between gingivitis and periodontitis.
3. What role does calculus play in periodontal disease?
4. What are some of the systemic factors that can aggravate periodontitis?
5. Summarize the usual etiology of a lateral periodontal abscess.
6. What are the most common causes of periodontal abscesses?
7. Give a brief description of pericoronitis.
8. What causes the pain, pus formation, and swelling associated with pericoronitis?
9. What is trismus?
10. What may develop as a result of pericoronitis?

1-4. Anomalies and Pathology of the Oral Cavity

Because there are so many manifestations and there is little you can do about them, you may ask why you should be concerned with the anomalies and pathology of the oral cavity. Remember, your purpose for being in the dental clinic—to give the best possible service to each of your patients, assisting them in any way you can. One way is to recognize any unusual condition in the mouth and to know when to refer them to a dentist for further observation and treatment.

There are many magazines, journals, and commercial books on dentistry available. Read these publications seriously. By being observant and studying, you can be a valuable asset for both the patient and the dentist. Your personal reward is self-improvement. In this section, we can only give you a start toward a deeper understanding of your career field. We will briefly discuss a few manifestations that you may encounter.

It is important to check out any lesion in the patient's mouth. We cannot overstress the importance of observing and noting every lesion found in a patient's mouth. If you have any doubt about a lesion, have the dentist answer your questions before the patient leaves your care. When you identify abnormalities, at a minimum, document an accurate description that includes size, shape, color consistency, and location.

In the following lessons you will study the more common lesions you may encounter. For convenience we have grouped the discussion into three categories: lesions confined to the oral cavity, those diseases having lesions on the body and the oral cavity, and those due to nutritional deficiencies. We'll begin with those limited to the oral cavity.

410. Lesions of systemic disorders limited to the oral cavity

These lesions are visible *only* in the oral cavity. Let's look at each one individually.

Leukoplakia

Leukoplakia is a general term meaning "white patch." It may occur in any area of the mouth. The lesions vary in appearance and texture from a fine white transparency to a heavy, thick patch (fig. 1-13).

Typically, no pain is present unless the lesion becomes ulcerated or a secondary infection has developed. To be classified as leukoplakia, the lesion should be firmly attached to the underlying tissue, and rubbing or scraping should not remove it.

Leukoplakia's cause is unknown at this time, but its presence is commonly associated with chronic irritation or trauma, such as cheek biting or smoking. The condition very often precedes development of a malignant tumor. For this reason, early diagnosis and treatment are important.

Hairy leukoplakia

Hairy leukoplakia is a white plaque found unilaterally or bilaterally on the sides of the tongue (fig. 1-14). It is an important early manifestation of the acquired immunodeficiency syndrome (AIDS). If found you should immediately bring it to the dentist's attention, for referral to the patient's physician.



Figure 1-13. Leukoplakia.
(Reproduced by permission from Oral Lesions).



Figure 1-14. Hairy Leukoplakia.
(Reproduced by permission from Oral Lesions).

Mucocoele (mu'-koe-seal)

Mucocoeles are salivary retention cysts that most commonly occur on the lower lip. They may also form in the cheek, upper lip, and lower surface of the tongue. They are rarely found on the palate. Mucocoeles appear as a round or oval translucent swelling. Generally, they are a bluish or greenish color and vary in size from a pea to a bean (fig. 1-15). Mucocoeles are the result of an accumulation of mucus (saliva) that occurs because the excretory duct of a salivary mucous gland is stopped up. Stoppage of the duct may result from lip biting or other similar injuries. The treatment for mucocoeles is excision.

Herpes simplex virus, type 1 (HSV-1)

Transmission of the HSV-1 viral infection is of particular concern to the dental profession. Oral *herpes simplex* is a disease that causes recurrent sores on the lips. Because these sores frequently develop when the patient has a cold or fever of other origin, the disease is more commonly known as fever blisters or cold sores. Herpes simplex is caused by a virus or, possibly several viruses. It affects over half the population and is considered by some to be second only to the common cold in prevalence. Approximately 1 in 70 people carry this virus in their saliva. It can infect unprotected eyes or enter unprotected lesions on any skin surface. A non-oral type of HSV-1, *herpetic whitlow*, is transmitted through contact with the oral types. Herpes simplex can be classified into two groups: primary and recurrent.



Figure. 1-15. Mucocoele.
(Reproduced by permission from Oral Lesions).

Primary herpetic stomatitis

During the first, or primary, attack, the herpes simplex virus causes sores over a widespread area within the mouth. This attack is known as *primary herpetic stomatitis* (fig. 1-16, views A & B). It is most often seen in children (both sexes) between ages 1 and 3. The condition may cause fever, irritability, headache, and pain on swallowing. Within a few days the mouth and gingiva become painful and intensely inflamed. The lips, tongue, buccal mucosa, palate, pharynx, and tonsils may also become involved. Soon numerous yellowish, fluid-filled vesicles (blisters) appear. These rupture and form shallow, ragged, painful ulcers covered by a gray membrane. As the virus progresses a red ring of inflammation forms around the ulcers. The ulcers vary considerably in size—from very tiny lesions to lesions measuring several millimeters or even a centimeter in diameter. The lesions heal spontaneously within 7 to 14 days and leave no scars. Treatment consists of supportive measures to make the patient more comfortable, relieve pain, and prevent secondary infection.



A. Primary herpetic stomatitis



B. Primary herpetic stomatitis

Figure 1-16. Primary herpetic stomatitis.
(Reproduced by permission from Oral Lesions).

Recurrent herpes

Following the initial infection, the herpes simplex virus lies dormant and later recurs. One form is the familiar fever blister or cold sore—known as *recurrent herpes labialis* (Figure 1-17). The lesion usually appears on the outside of the patient's lip, at the vermilion border where the red portion of the lip meets the adjoining skin. The patient may feel an itching or burning sensation 24 hours prior to the sore's actual appearance. Within 2 to 4 days these vesicles break and crust over. The size of the lesions varies from a small pinhead up to .5 cm. The area is usually surrounded by redness and

slightly swollen. Normally, the lesions are painless but become sore when the vesicles break and leave a raw surface.

Intraoral recurrent herpes simplex (IRHS) consists of painful ulcers that occur only on fixed mucosa, such as the hard palate, gingiva, and alveolar ridge (fig. 1-18). Recurrent herpes often occur when the patient's general resistance is lowered. Lesions are sometimes associated with a common cold or fever, upper respiratory tract infection, allergy, gastrointestinal disturbance, prolonged exposure to sunlight, fatigue, or emotional tension. These factors only contribute to the disease, not cause it. The causative organism is identified as the herpes simplex virus. The lesions gradually heal in 7 to 10 days without scarring.



Figure 1-17. Herpes labialis.
(Reproduced by permission from Oral Lesions).

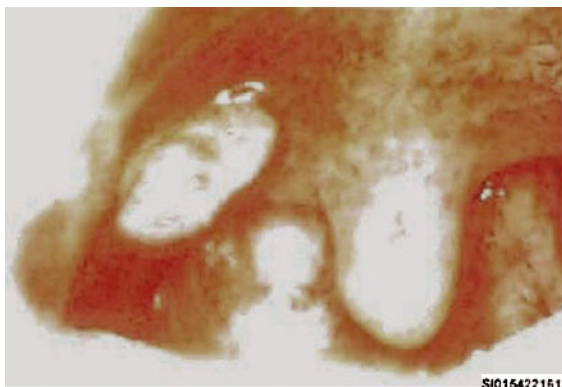


Figure 1-18. Intraoral recurrent herpes.
(Reproduced by permission from Oral Lesions).

Because of the extremely contagious nature of this virus and the associated risk of secondary contamination, elective dental procedures should be deferred until the sores resolve. If you are uncertain, inform the dentist and ask for advice. Instruct the patient to keep irritating drugs and spicy food away from the lesions by coating the lips with Vaseline or another preparation. This is a palliative (soothing) rather than curative treatment.

Aphthous stomatitis

This bothersome ulcer, sometimes called a canker sore, is found in the mouth as depressions on the mucous membrane of freely movable mucosa. It is covered by a grayish-white or a light-yellowish membrane (fig. 1-19, views A & B). Each *aphthous stomatitis* lesion is preceded by a vesicle that normally persists for only a few hours before rupturing and producing the ulcer. The ulcers vary in size from .5 to 3 cm diameter lesions at their greatest dimension. These ulcers may occur in various parts of the mouth, but are most common on the lip, cheek, floor of the mouth, and tongue.



A. Aphthous stomatitis (Large single lesion)



B. Aphthous stomatitis (multiple lesions)

Figure 1-19. Aphthous stomatitis.
(Reproduced by permission from Oral Lesions).

The exact cause is unknown. Factors associated with *aphthous stomatitis* include trauma, hormonal disturbances, allergies, psychological problems, and gastrointestinal disorders. Trauma includes self-inflicted bites, oral surgery procedures, tooth brushing, dental procedures, and needle injections. Hormonal disturbances during the premenstrual period can create a high incidence of the ulcer. Patients with a history of asthma, hay fever, or food or drug allergies may experience an outbreak of the ulcers following the use of certain foods or drugs.

Again, palliative treatment keeps the patient comfortable until the ulcers subside. Soothing rinses and application of surface anesthetics may be of some value. Instruct the patient to avoid spicy or irritating foods.

Fordyce granules

This is a developmental anomaly (a marked deviation from the normal standard). These spots are deep-seated, malpositioned, sebaceous (sah-bay'-shahs) skin glands that appear as numerous white or yellowish, cheesy granules (fig. 1-20). They may appear as clusters or granules and are located just beneath the epithelium on the occlusal plane level of the cheek and on the lip mucosa. This condition is seen in approximately 80 percent of the patients. These spots are not of clinical concern.



Figure 1-20. Fordyce granules.
(Reproduced by permission from Oral Lesions).



Figure 1-21. Nicotine stomatitis.
(Reproduced by permission from Oral Lesions).

Nicotinic stomatitis

This inflammation of the oral mucosa is due to tobacco's tar products and intense heat. It usually is located on the hard palate, particularly around the palatal mucous gland ducts. It starts as a red irritation and later becomes white (fig. 1-21). The disorder predominates in the adult male—especially the pipe smoker. The treatment is to remove the cause. The condition may be premalignant; however, if the patient stops smoking, the prognosis is excellent.

Hairy tongue

This condition is usually located on the top surface or the dorsum of the tongue. You see it as long elongations of filiform (threadlike) papilla (fig. 1-22). The condition is asymptomatic. However, if food debris collects between the "hairs," a secondary infection—resulting in an infected, painful tongue—may follow. Daily brushing or scraping of the tongue helps to prevent the secondary infection. Although the cause of the disorder is unknown, allergies and fungi have been suggested as possible sources. The papilla elongations are white, but they can be discolored black or blue by something the patient ingested—food, medication, tobacco, or liquids.



Figure 1-22. Hairy tongue.
(Reproduced by permission from Oral Lesions).

Geographic tongue

This condition is also manifested on the dorsum of the tongue. The lesions are irregular red patches of desquamation (sloughing). The surrounding area of the tongue remains white because of the elongation of the papilla (fig. 1-23, views A, B). The lesions move from location to location. There is no known cause or treatment. Some believe that vitamin B complex may help.



A. Geographic tongue



B. Geographic tongue

Figure 1-23. Geographic tongue.
(Reproduced by permission from Oral Lesions).

Amalgam tattoo



Figure 1-24. Amalgam tattoo.
(Reproduced by permission from Oral Lesions).

This is a pigmented lesion of the oral mucosa. The pigmentation presents a dark coloring caused by the accidental implantation of amalgam filling material into the tissue or by prolonged contact of the tissue with the amalgam (fig. 1-24). There is no treatment available. Excision may be used for cosmetic reasons.

411. Lesions of systemic disorders not limited to the oral cavity

These disorders have oral lesions and manifestations plus manifestations elsewhere in the body.

Hepatitis

Hepatitis is a serious, sometimes fatal, viral infection of the liver. There are three facets of hepatitis: active, chronic, and carrier. The first facet is active infection: the patient is sick and often hospitalized. Patients are infectious at this stage and can transmit the disease to others. The second facet, chronic, is characterized by a low grade liver infection for the rest of the patient's life. Patients in this stage may get liver cancer or cirrhosis that leads to liver failure. Some types of hepatitis have a third, or carrier state. Patients in this state no longer have the active form of the disease but they can still transfer it to another person.

Although hepatitis is not specifically an oral disorder, it is included because dental providers and assistants play an important part in controlling its transmission. There are four known types of the disease—*hepatitis A (HAV)*, *hepatitis B (HBV)*, *hepatitis C (HCV)*, and *hepatitis Delta*. Of the four, HAV and HBV are of major concern in the dental environment.

HAV

Hepatitis A, also known as *infectious hepatitis*, is usually acquired by ingestion of contaminated food or water. The virus multiplies in the intestinal tract and then invades the bloodstream, subsequently localizing in the liver.

HBV

Also known as *serum hepatitis*, hepatitis B virus is transmitted through contact with body fluids that permeate (go through) the skin and mucous membranes and enter the bloodstream (bloodborne pathogen). A simple paper cut or abrasion will allow the virus to pass into the body. Up to 80 percent of those exposed to hepatitis B don't even know they have it and have few, if any, symptoms. Five percent of patients with hepatitis B become carriers but may not be aware of it, thus, unknowingly transmit the disease to others. Hepatitis B can be easily detected with a blood screening exam. Waiting for the results of a hepatitis test to determine if a patient is infective is not a valid reason to defer elective patient treatment. Remember, all patients are *assumed* to be potential HBV carriers and standard-universal precautions (if properly used) will provide adequate protection from blood-borne pathogens.

HBV organisms are found in saliva and blood. Only minute quantities of these contaminated fluids are required to cause infection. HBV can be transmitted by any object that is transferred from one mouth to another or by any instrument that breaks the skin of an infected person and then is used on another patient. For this reason, HBV is a major occupational risk for dental care providers including the dentist, assistant, hygienist, and laboratory technician. There is the additional risk that infected dental personnel may infect susceptible patients. The greatest risks to dental personnel are from an accidental needle or contaminated instrument puncture. HBV transmission is also possible by spray from the hand-piece while used in the mouth of an infected person and impressions contaminated with blood or saliva could transmit the disease.

Standard-universal precautions for infection control are extremely important because the hepatitis virus is hard to kill and is highly virulent. The best prevention against HBV infection for all dental personnel is vaccination with a hepatitis vaccine. Vaccination requires a series of three injections. One month after the initial injection, a second dose is given, and the third dose is given 6 months after the initial dose. Protection is about 30 percent after 1 month, 77 percent after 2 months, 87 percent after 3 months, and 95 percent after the third dose. Immunity is expected to last at least 5 years in most individuals who received all three doses. Note that this vaccine only protects against hepatitis B.

You may be tested to determine whether or not you've already been infected with the hepatitis B virus. The test and its results are related to the three infective agents capable of producing antibodies and causing the disease—(1) hepatitis B surface antigen (HBsAG), (2) hepatitis B core antigen (HBcAG), and (3) hepatitis B envelope antigen (HBeAG). If your test results yield an anti-HBs—positive result—it means you have an antibody for the surface antigen. This means you're already immune and don't need to be vaccinated. On the other hand, an HBsAG-positive result indicates you're a potential carrier.

Acquired Immunodeficiency Syndrome

This disease causes a defect in a person's natural immunity. As a result, an individual with AIDS becomes ill from diseases that are not normally a threat to anyone with a normally functioning immune system. AIDS is caused by a virus that can infect certain immune system cells as well as nerve cells in the brain and other parts of the central nervous system. This virus is called the human immunodeficiency virus (HIV). HIV infection is spread by sexual contact, needle sharing, and blood transfusions. Infected women have transmitted it to their infants during pregnancy, birth, and breast feeding.

Signs and symptoms

Persons infected with HIV may go for years without showing any signs or symptoms. Although they feel well, they are still at risk of developing AIDS, and can transmit the virus to others. HIV symptoms include tiredness, fever, loss of appetite and weight, night sweats, diarrhea, and swollen glands (usually in the neck, under the arms, or in the groin).

Oral signs of HIV infections

Persons with deficient immune systems may be at high risk for infections from a variety of microorganisms. *Hairy leukoplakia* presents itself as a raised white thickening of the tongue and may be a precursor of AIDS in HIV infected persons. Other oral diseases commonly observed in the AIDS patient are herpetic lesions, candidiasis, Kaposi's sarcoma, and cervical lymphadenopathy. AIDS patients also may exhibit rapid, progressive gingivitis and periodontitis.

Reduce your occupational risk by protecting yourself! Always apply the concept of standard-universal precautions—that is, treat every patient as if they have a communicable disease.

Herpes zoster

This disorder resembles herpes simplex. Both are acute virus diseases marked by watery blisters on the skin and mucous membranes on the border of the lips, buccal mucosa, tongue, or soft palate. The lesions run in lines following the pathway of a sensory nerve, indicating that they are a virus infection of a nerve. The disorder is often called *shingles*. A topical anesthetic application may give temporary relief. It is usually unilateral in appearance, which is one of its most distinguishing features.

Syphilis

This highly contagious disease is a threat to the dental staff personnel who touch infected patients with their bare hands. Syphilis is a venereal disease that may manifest itself in the mouth. Though it is not common, transmission can occur through the hands from lesions in the mouth. Syphilis is caused by a specific bacterium called *Treponema pallidum*, a spirochete. It can enter the body through any break in the skin such as hangnails and blisters. Syphilis is characterized by three stages.

The first stage of syphilis is characterized by appearance of the lesion called the *chancre* (shang'ker) that appears approximately 3 weeks after exposure. The chancre may appear anywhere on the body, but the most common sites are the genitals, lips, or in the mouth. Clinically, in the oral cavity, it is characterized by an ulcer formation with a hard border, having an appearance similar to an aphthous ulcer. Because it is usually painless, the patient is often unaware of its existence. The chancre normally is a single lesion, although rare cases of two or more have been reported. The chancre is highly infectious, and although it is most commonly found on the genitals, its appearance in the mouth is not rare. Dental health providers and assistants should never overlook the possibility of its presence. Call the dentist's attention to any single, painless, untreated lesion appearing on the lips or in the mouth of a patient. It should be viewed with suspicion until laboratory procedures confirm or rule out the disease. The chancre goes away within 2 months, leaving variable scarring.

A dangerous secondary lesion appears 6 to 8 weeks after exposure and is characteristic of the second stage. It is the result of a generalized involvement of the blood and lymphatic circulation. The causative organism enters the bloodstream at the site of the primary lesion, multiplies, and is carried throughout the body by the circulatory system. The secondary lesions may appear in large numbers anywhere on the body. Lesions on mucous membranes are known as *mucous patches*. These are probably the most contagious of all the syphilitic lesions and are seldom absent from the oral mucosa during the secondary stage of syphilis. The true mucous patch is a painless lesion, usually oval in shape with a moist, glistening, grayish-white, slightly raised surface. Other secondary lesions, however, may have radically different appearances; this fact makes the clinical diagnosis of secondary syphilis difficult. As in the case of a single primary lesion, dental health personnel should view with suspicion any painless lesions of the mucous membranes of the mouth and throat. The dentist will take the necessary steps for proper laboratory diagnosis. A latent asymptomatic stage lasting several years may follow this secondary stage in which the person can remain infectious for the first 4 years. After 4 years of untreated syphilis, a patient is no longer considered contagious.

The third stage of syphilis produces a lesion called a *gumma* (gum'-mah). It may appear several years after the initial infection. Usually, there are not very many lesions and often just one. Lesions in this stage are considered noninfectious since they rarely contain the causative organisms. They may appear in the mouth but not with the same frequency as do the secondary lesions. The gummas

normally appear as nodules and slowly increase in size, becoming softer and less dense. Eventually, the center of the nodule becomes eroded and a definite ulcer results. The soft tissue and underlying bone are destroyed. Perforations of the palate often result.

Treatment of syphilis, despite the stage, is a medical problem. The patient's dental requirements are met through close cooperation with the physician treating the systemic infection. You may see malformed teeth in a patient who had congenital syphilis. The spirochetes affect the tooth formation and the resulting teeth may be notched, peg shaped, or barrel shaped, Hutchinson's incisors.

Tuberculosis

The oral lesions in this disease are usually associated with pulmonary (lung) tuberculosis. The primary causative agent is the bacillus *mycobacterium tuberculosis*. It spreads to the oral cavity either through the bloodstream or by direct contamination of an abrasion or wound in the mucosa. The most common site for this secondary tuberculous lesion is the tongue. If the oral lesion is a primary site, it may be caused by an infected instrument and the tissue.

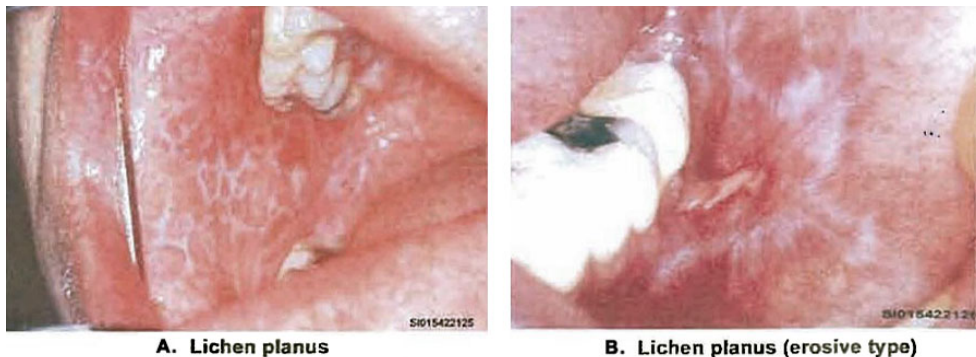
Oral lesions, especially those of the lips, frequently begin as a small tubercle or pimple that breaks down to form painful ulcers. Additional tubercles form as the process repeats over and over and the lesion grows in size. Tongue lesions are particularly painful, as they develop along the tongue's lateral borders where it rubs against rough, sharp, or broken-down teeth and restorations. The pain is severe and continuous, and it interferes with eating. The patient suffering from this disease is in serious trouble. Management is a medical problem. The oral lesions are treated in the closest cooperation with a physician. The primary dental concern is maintenance of good oral hygiene and elimination of all areas that might be a source of irritation to the tissues.

Infectious mononucleosis

This disease, although a systemic problem, is found primarily in young adults. It can manifest itself anywhere on the oral mucosa. It exhibits multiple oral lesions and consists of many pinpoint, purplish-red spots (petechiae). These oral signs normally appear before the general manifestations of the disease or any other symptoms occur. The condition is attended by fever, malaise, sore mouth, lymph gland enlargement, and loss of appetite. It is probably caused by a virus.

Lichen planus

The exact cause of lichen planus is not clearly understood. Some authorities believe that overworking, nervousness, and fatigue may be the underlying causes. Lichen planus may occur at any age. The most common places of occurrence are on the top and the sides of the tongue and on the buccal mucosa (cheek) opposite the upper and lower molars (fig. 1-25, views A & B). Clinically, lichen planus is characterized by small, bluish-white, glossy areas that have a definite lacelike pattern. The lesion is hard and rough to the touch. Usually, no serious consequence results from the lesion. In all cases it should be distinguished from leukoplakia. Always call this type of lesion to the dentist's attention.



A. Lichen planus

B. Lichen planus (erosive type)

Figure 1-25. Lichen planus.

(Reproduced by permission from Oral Lesions).

Candidiasis (kan-did-eye-ah-sis)

Candidiasis is a fungal infection, also known as *candida albicans* or *moniliasis*, and can be located anywhere on the oral mucosa. It appears as multiple white spots or patches (fig. 1-26) and is usually seen in infants and the elderly. When seen in an infant it is sometimes called *thrush* and may occur after taking oral antibiotics. The antibiotics sometimes produce an imbalance of the oral flora. In the elderly, the cause is often debilitation, resulting from age, alcoholism, leukemia, or diabetes. Candidiasis may be one of the most frequent opportunistic infections seen in patients with AIDS. The white patches respond to a topical application of Nystatin.



Figure 1-26. Candidiasis.
(Reproduced by permission from Oral Lesions).

Diabetes mellitus

Diabetes mellitus is due to insufficient secretion of insulin by the pancreas. Insulin is needed by the body for the digestion and use of carbohydrates. The cause may be hereditary, diet, or other diseases. Patients usually experience *xerostomia* (zair-oh-stome'-ee-ah) (dry mouth) and their breath has a sweetish odor. Diabetes mellitus impairs the body's healing ability. This impaired healing ability makes diabetics have an increased tendency to develop periodontitis, glossitis, and gingivitis. They also develop infections easily. Diabetes is a medical problem. While not curable, diabetes can usually be controlled with oral medication, diet, or insulin injection. If the patient is a controlled diabetic, his or her reaction to surgery and healing functions are about the same as those of normal patients.

412. Oral cancer

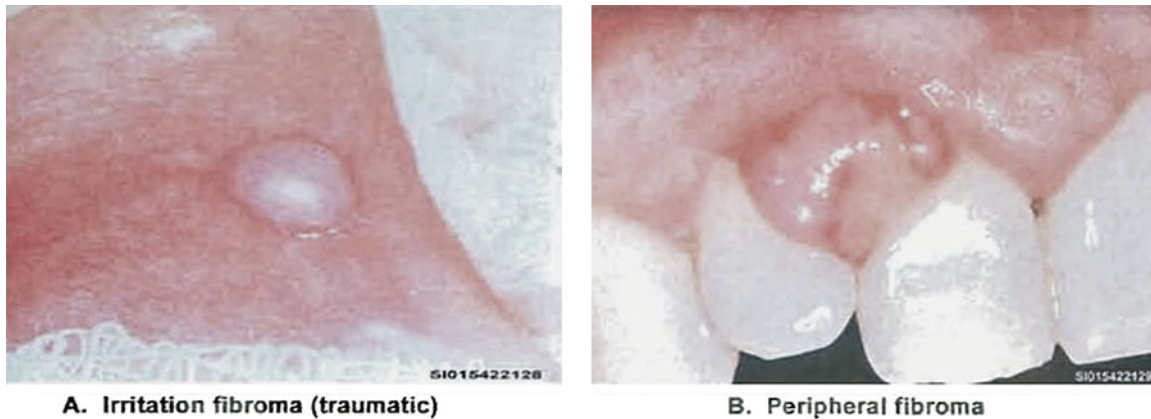
Cancer is a disease that is represented by abnormal growth and spread of cells. Keep in mind that *not all abnormal growths are cancers*. A tumor (or neoplasm) is any growth of tissue that exceeds the normal form and serves no useful purpose to the host. A tumor can be benign or malignant.

Benign tumors

These tumors are not life-threatening. Benign tumors are usually found to be compatible with the host unless they interfere with function.

Fibroma

The fibroma is a benign lesion of the gingiva that develops from the connective tissue or the periodontal ligament. The irritation or traumatic fibroma (fig. 1-27, view A) is among the most common oral soft-tissue lesions. It is nodular or dome-shaped soft tissue, usually of the same color as the surrounding mucosa, and occurs commonly on the lips. The peripheral fibroma (fig. 1-27, view B) appears as a mass of tissue arising from the gingiva next to teeth or between teeth. Lesions between the teeth may separate the teeth and produce pressure resorption of the interdental bone.



A. Irritation fibroma (traumatic)

B. Peripheral fibroma

Figure 1-27. Fibroma.
(Reproduced by permission from Oral Lesions).

Pyogenic granuloma

Pyogenic granuloma is an overgrowth of granulation tissue that appears as an elevated mass (fig. 1-28 views A and B). It can occur on any skin or mucosa surface. The lesion is ordinarily redder than normal mucosa and bleeds easily. The necrotic ulcerated surface often seems to be composed of a white sloughy material. The clinical resemblance of the necrotic material to pus prompted early clinicians to refer to the lesion as a pyogenic granuloma. There is, however, no pus in the lesion.



A. Pyrogenic granuloma

B. Pyrogenic granuloma

Figure 1-28. Pyogenic granuloma.
(Reproduced by permission from Oral Lesions).

Giant cell granuloma

The giant cell granuloma can be either peripheral or central. The *peripheral giant cell granuloma* (fig. 1-29) most often appears dark red and vascular or hemorrhagic and commonly exhibits surface ulceration. It varies in size from 0.5 to 1.5 cm in diameter and seems to originate from the gingiva or alveolar mucosa. The peripheral giant cell granuloma, the peripheral fibroma, and the pyogenic granuloma bear a great resemblance to one another and may require microscopic examination to distinguish between them. The *central giant cell granuloma* is a large benign nodule formed within the bones of the jaws. This lesion is painless and grows slowly by expanding and thinning the cortical bone.



Figure 1-29. Peripheral giant cell granuloma.
(Reproduced by permission from Oral Lesions).

Hemangioma (Hee-man''jee-oh'mah)

Hemangioma is a tumor made up of small blood vessels and is usually congenital, or may appear soon after birth. It usually appears on the cheek, tongue, or lip as an elevated (or partially elevated) lesion and can be any size. It has a smooth surface and is somewhat red or blue in color. The tumor is soft and impressible, and may blanch when slight pressure is applied. The tumor may regress spontaneously, or it may require surgery or electrocautery. The prognosis is excellent.

Papillomas

Epithelial tumors that appear as a cauliflower like attachment to the surface epithelium are called *papillomas* (fig. 1-30). They may occur anywhere on the mucous membrane, especially on the palate, tongue, lips, and gingiva. The etiology of the papilloma is unknown. They may occur at any age; however, they most often are found in patients who are in their fifties or sixties. Until a papilloma is positively identified, it is a good idea to consider it as a *potential* malignancy. Treatment of a papilloma is excision.



Figure 1-30. Papilloma.
(Reproduced by permission from Oral Lesions).

Malignant tumors

Malignant tumors are mutually called cancer and, if left untreated, will kill the host. The good news is that many cancers can be cured when treated early in their development. Pay close attention to the tissues of the oral mucosa when you do a screening examination on your patient and always have a dentist check any unusual findings. You could save your patient's life.

A *carcinoma* is a malignant epithelial tumor that invades surrounding tissue and metastasizes (spreads) to other regions of the body. The *squamous cell carcinoma* is the most common malignant tumor of the oral cavity (fig. 1-31, views A and B). It forms 90 to 95 percent of all mouth cancers. Although no area of the oral mucosa is immune, certain areas are more vulnerable than others. The soft palate, lateral and ventral tongue mucosa, and floor of the mouth are especially prone to develop squamous carcinoma. An *adenocarcinoma* is the second most common malignant tumor of the mouth and arises from the salivary glands. It first appears as a lump or bulge beneath the mucosa.



A. Squamous cell carcinoma

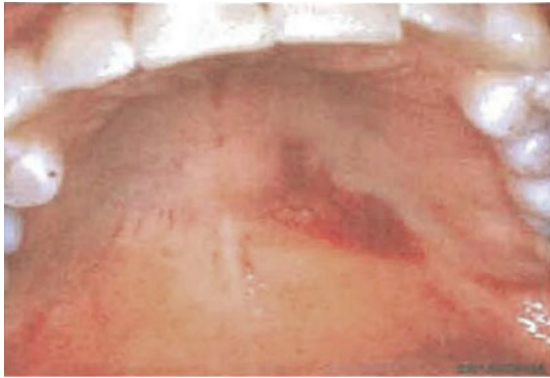


B. Squamous cell carcinoma

Figure 1-31. Squamous cell carcinoma.
(Reproduced by permission from Oral Lesions).

A *sarcoma* is a malignant tumor of the soft tissues arising from supportive and connective tissue, such as bone. *Kaposi's sarcoma* is a common cancer that occurs in AIDS patients. The lesions may appear on the skin or in the mouth. The oral lesions may appear as bluish, blackish, or reddish blotches that are usually flat in the early stages. In later stages, the lesions may become darker, elevated, and ulcerated (fig. 1-32, views A and B). Oral tumors are usually not tender before they

become ulcerated. The most common oral site is the hard palate. However, lesions may be found on any part of the oral mucosa including the gingiva, soft palate, and buccal mucosa. Lesions on the gingiva produce diffuse swelling of the gingival papilla, resembling periodontal disease or may sometimes resemble a parulis (gum boil) (fig. 1-33).



A. Kaposi's sarcoma-early stage in an HIV patient



B. Kaposi's sarcoma-later stage in an HIV patient

Figure 1-32. Kaposi's sarcoma.
(Reproduced by permission from Oral Lesions).



Figure 1-33. Gingival and periodontal lesions—HIV-infected patient.
(Reproduced by permission from Oral Lesions).



Figure 1-34. Traumatic ulcers.
(Reproduced by permission from Oral Lesions).

413. Nonsystemic oral lesions of local origin

Considering the number of functions it performs and its associated structures, the mouth is an important part of the body. The oral cavity is abused with pencils, fingernails, caustic drugs, and hot and cold food. It often inflicts wounds upon itself from lip and cheek biting. All this abuse sometimes causes damage. The damage may be repairable or it may cause permanent defects. Some of the agents of abuse can lead to serious problems and even loss of life. The most common oral lesions are discussed in the following paragraphs. Most of these can be avoided since they are nearly all self-induced.

Traumatic ulcer

This lesion is a localized area on the mucosa in which the surface epithelium has been destroyed (fig. 1-34). The size and shape of traumatic ulcers are so variable they defy a simple description. They are usually painful and of short duration. Common causes of traumatic ulcers include: denture irritation, biting injuries, hard foods, toothbrush, and dry cotton rolls. The treatment is to remove the cause if it is known. Once the cause is removed, the ulcer should heal. An ulcer that does *not* heal within 2 to 3 weeks should be biopsied to rule out malignancy.

Thermal burns

Cases involving severe burns are rare in a dental clinic because the oral cavity is rarely exposed to severe heat hazards. The mucosa also has some built-in protection by virtue of its moist surface. Combat personnel occasionally receive flash burns, and a resultant severe sloughing of tissue occurs. Minor burns occasionally occur from hot foods on the labial and palatal mucosa.

Careless handling of heated dental instruments and materials usually causes thermal burns. If an assistant uses instrument forceps to pass an instrument directly from a hot sterilizer to a doctor wearing rubber gloves, the patient may be injured before the doctor detects the temperature of the instrument. Since it is likely that the patient is anesthetized, the individual is not able to give a warning when this occurs.

Careless manipulation of dental materials, such as impression waxes, cavitron devices, and endodontic instruments is also a hazard. All instruments that generate heat should be manipulated carefully to avoid direct contact with the oral mucosa. Dental waxes should only be placed in the oral cavity when they are within a safe temperature range. Oral mucosa reacts the same to heat, despite the source—liquid, metal, or gas. The tissue protein of the mucosa coagulates and usually turns white and sloughs off, leaving an ugly raw wound that heals with difficulty and pain.

Chemical burns

Many different chemicals are used in dentistry. Many chemicals in the dental office are designed for use on the hard tissue of the teeth and are quite caustic in soft tissues. Handle these chemicals cautiously. While there are many possible sources for chemical burns, the following discussion focuses on the more common ones you may encounter.

Aspirin

Moisture changes acetylsalicylic acid into acetic acid and salicylic acid. Sometimes you will see self-inflicted chemical burns from aspirin. This occurs when the patient places an aspirin tablet in the mucobuccal fold next to a tooth that aches. This effort does not cure the toothache itself. But it does cause the mucosa in the area covered by the tablet to turn white. Then it usually sloughs off, leaving an ulcer that is difficult to treat. In some cases, an aspirin burn can be severe enough to expose bone and open a pathway for a painful infection.

Eugenol

Eugenol is a refined oil of cloves preparation and is quite useful in dentistry. Used properly, it is most beneficial, but it will burn soft tissue—although not as severely as aspirin. When treating dry sockets with gauze packs, it is important to make sure they do not have any excess eugenol on them. The gauze should be squeezed dry to remove excess eugenol to prevent soft tissue irritation.

Phenolic compounds

There are many compounds of phenol (carbolic acid) used in dentistry. Many of them have the same name but are of different strengths. They should be handled with extreme care since they are very caustic.

Other caustics

Most dentists have a selection of compounds needed to support their operations. We will not try to cover all of the different ones in use as they vary from dentist to dentist. When handling caustics follow these general instructions:

- Know the contents of all the medicament bottles in the dental treatment room.
- Be able to describe the properties of these substances and the precautions necessary for handling, neutralizing, and storing them; for example, some require refrigeration, others, the absence of sunlight, etc.
- Label all containers.

- Make a positive identification of all drugs and chemicals.
- Be careful when handling all chemicals.

Denture-related lesions

The oral mucosa is subjected to a variety of irritations caused by wearing artificial dentures. These are discussed below.

Papillary hyperplasia

Papillary hyperplasia appears as numerous, closely arranged, red, pebbly projections of the mucosa (fig. 1-35). Although the lesion is generally confined to the palatal mucosa, any mucosal surface covered by a dental appliance is susceptible, including the lower alveolar mucosa. Papillary hyperplasia is more commonly found in patients who keep their dentures in 24 hours a day rather than just the waking hours. It also is found that poorly fitting dentures are more likely to provoke the disease than dentures that fit well. Treatment may include surgical excision prior to new denture construction.

Inflammatory fibrous hyperplasia

A common reaction of oral mucosa to an overextended denture border is formation of hyperplastic tissue, called *epulis fissuratum*. The lesion consists of two or more flaps of soft tissue separated by a central groove into which the denture border fits (fig. 1-36). Treatment consists of surgical removal of the lesion and reduction of the denture border.



Figure 1-35. Papillary hyperplasia.
(Reproduced by permission from Oral Lesions).

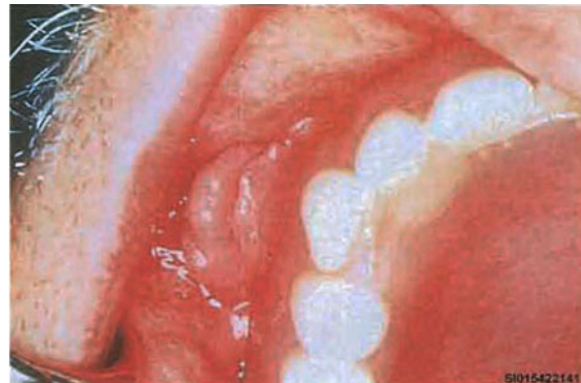


Figure 1-36. Inflammatory fibrous hyperplasia.
(Reproduced by permission from Oral Lesions).

Angular cheilitis

Angular cheilitis is derived from overclosure of the bite due to loss of vertical dimension in an *edentulous* or denture-wearing patient. A fold is produced at the corners of the mouth in which saliva collects (fig. 1-37). The skin becomes softened and is fissured and secondarily infected with a fungus or bacteria. Overclosure is corrected by increasing the vertical height of the dentures and the secondary infection is treated with drugs.



Figure 1-37 Angular cheilitis.
(Reproduced by permission from Oral Lesions).

414. Oral bone fractures

Dental management of fractures deals primarily with the facial bones. Steps must be taken to heal fractures and restore the proper function. Fractures of the jaw and third molar extractions are the most common reasons for hospitalization of dental patients.

Your primary involvement with facial fractures is as an assistant to the dentist treating the patient. As a dental health provider, you must be alert to the possibility of third-party liability and child abuse. To identify the fact that a fracture exists, specific signs and symptoms are noticeable. Patients who exhibit the characteristics discussed in this lesson should be considered fracture patients until determined otherwise.

Trauma and pain

Wounds, swellings, and discoloration of the face, with a history of trauma to the site, suggest the possibility of broken bones. Take necessary precautions to prevent further injury. Bruising and the escape of blood from under the skin or mucosa are indicative of blows that may be severe enough to break bones. Sometimes the broken bones can be seen or felt. Pain, severe tenderness, and grating under the skin are good indications that a mobile bone fragment is present in that area.

Abnormal appearance

Complete fractures are indicated by facial asymmetry and *luxation* (dislocation) in which the patient's normal appearance is changed. *Diplopia* (double vision) may occur if the bones forming the floor of the orbit are involved. Sunken areas or abnormal projections increase the suspicion of fractures.

Abnormal movements

Abnormal mandibular movements occur when muscles displace fragments of the bone fracture, or the continuity of the jaw is broken so that it does not swing from the temporomandibular joint but from the fracture site. The most noticeable indication of a fracture is deviation of the jaw to one side or another when opening and closing the mouth.

Malocclusion

Malocclusion may be quite noticeable to the patient with a *condylar* fracture. The bite corresponds to the deviation of the mandible. Since the mandible swings toward the side of the fracture, the teeth usually strike on that side first when closing. Sometimes all these signs and symptoms are present. No matter how many conditions are noticed, they should be noted and brought to the attention of the dentist, who will confirm the fracture with further examination and radiographs.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

410. Lesions of systemic disorders limited to the oral cavity

- Match the listed condition in column B with the appropriate characteristics in column A. Each description listed in column B will be used only once.

| Column A | Column B |
|--|---------------------------------|
| ____ (1) A "white patch" which may occur in any area of the mouth. | a. Leukoplakia. |
| ____ (2) Sores most often seen in children which occur over a widespread area. | b. Nicotinic stomatitis. |
| ____ (3) Due to the tar products of tobacco and intense heat. | c. Amalgam tattoo. |
| ____ (4) It appears as long elongations of filiform papilla. | d. Mucocele. |
| ____ (5) A white plaque found unilaterally or bilaterally on the sides of the tongue, important early manifestation of AIDS. | e. Geographic tongue. |
| ____ (6) Deep-seated, malpositioned, sebaceous skin glands that appear as numerous white or yellowish, cheesy granules. | f. Hairy leukoplakia. |
| ____ (7) The lesions are irregular red patches of desquamation that move from location to location. | g. Primary herpetic stomatitis. |
| ____ (8) Dark pigmentation of the tissue caused by prolonged contact with a filling material. | h. Fordyce granules. |
| | i. Hairy tongue. |
| | j. Recurrent herpes labialis. |
| | k. Aphthous stomatitis. |

- ____ (9) Retention cysts that occur most commonly on the lower lip.
- ____ (10) The patient may feel an itching or burning sensation prior to the sore's actual appearance.
- ____ (11) The ulcers vary in size from that of .5 to 3 cm in diameter at the greatest dimension.

2. What causes leukoplakia and with what is it associated?
3. What does a mucocele look like? What is the treatment for it?
4. How long is the healing of primary herpetic stomatitis lesions?
5. Where does recurrent herpes labialis usually appear?
6. What causes aphthous stomatitis? What are its contributing factors?
7. What is the appearance and location of Fordyce granules?
8. What is the treatment and prognosis for nicotinic stomatitis?
9. What prevents secondary infection of hairy tongue?
10. What is the color of the papilla elongations? Why?
11. What is the cause and treatment for geographic tongue?
12. What is the treatment for amalgam tattoo?

411. Lesions of systemic disorders not limited to oral cavity

1. Match the listed condition in column B with the appropriate characteristics in column A. Each description listed in column B will be used only once.

Column A

- ____ (1) Has small bluish-white, glossy areas that have a definite lacelike pattern.
- ____ (2) The primary causative agent is *Mycobacterium tuberculosis*.
- ____ (3) Appears as multiple white spots or patches.
- ____ (4) The first stage of this disease is characterized by the appearance of a lesion called the chancre.
- ____ (5) This disease is due to insufficient secretion of insulin by the pancreas.
- ____ (6) This disease is marked by watery blisters on the skin and mucous membranes on the border of the lips.
- ____ (7) The disorder manifests itself in multiple oral lesions and consists of numerous pinpoint, purplish-red spots (petechiae).
- ____ (8) Disease usually acquired by ingestion of contaminated foods or water.
- ____ (9) Prevention against this type of hepatitis involves a series of three injections.
- ____ (10) This disease is caused by the human immunodeficiency virus.

Column B

- a. Herpes zoster.
- b. HBV.
- c. Infectious mononucleosis.
- d. Syphilis.
- e. AIDS.
- f. Tuberculosis.
- g. Diabetes mellitus.
- h. Lichen planus.
- i. Candidiasis.
- j. HAV.

2. Where are organisms of the HBV found and how is it transmitted?
3. What are the greatest risks of HBV transmission to dental personnel?
4. What is the best prevention against HBV for all dental personnel?
5. How long is the immunity of the HBV vaccine expected to last?
6. What are three infective agents capable of producing antibodies and causing the HBV disease?
7. What causes AIDS and what is it called?
8. How is HIV infection spread?
9. What are the signs and symptoms of HIV infection?

10. What oral diseases are commonly observed in the AIDS patient?
11. What are the distinguishing features of herpes zoster?
12. What causes syphilis?
13. Where may a chancre appear? What are its characteristics?
14. Name and describe the secondary lesion of syphilis.
15. How long can a patient remain infectious in the secondary stage?
16. Name and describe the lesion produced in the third stage of syphilis.
17. What signs may be present in a patient who had congenital syphilis? Why?
18. How is tuberculosis spread to the oral cavity?
19. What is the most common site for a secondary tuberculous lesion?
20. How do the oral lesions of tuberculosis form?
21. What are the most common places *lichen planus* occurs?
22. What is candidiasis? Where can it be found?
23. How does candidiasis relate to AIDS?

24. Describe what the impaired healing ability of the body in a patient with diabetes may cause.

412. Oral cancer

1. Match the type of tumor listed in column B with the most appropriate descriptive definition in column A. Use items in column B only once.

Column A

- _____ (1) Nonlife-threatening tumors.
- _____ (2) A benign lesion of the gingiva developing from connective tissue or the periodontal ligament.
- _____ (3) Nodular or dome shaped soft tissue on the lip the same color as the surrounding tissue.
- _____ (4) A mass of tissue arising from the gingiva adjacent to or between the teeth.
- _____ (5) An overgrowth of granulation tissue appearing as an elevated mass, redder than normal mucosa and bleeding easily.
- _____ (6) Growth of tissue exceeding the normal form without a useful purpose.
- _____ (7) Made up of small blood vessels and usually congenital.
- _____ (8) A cauliflower like attachment to the surface epithelium.
- _____ (9) A large benign nodule formed within the bones of the jaws.

Column B

- a. Tumor.
- b. Benign.
- c. Malignant.
- d. Fibroma.
- e. Papillomas.
- f. Irritation fibroma.
- g. Hemangioma.
- h. Peripheral fibroma.
- i. Pyogenic granuloma.
- j. Central giant cell granuloma.

2. Match the type of tumor listed in column B with the most appropriate descriptive definition in column A. Use items in column B only once.

Column A

- ____ (1) Tumors referred to as cancer.
- ____ (2) Malignant epithelial tumor that invades surrounding tissue and spreads to other regions of the body.
- ____ (3) Most common malignant tumor of the oral cavity.
- ____ (4) A malignant lesion of the salivary gland.
- ____ (5) Malignant tumor of the soft tissues arising from supportive and connective tissue.
- ____ (6) Bluish, blackish or reddish blotches on the skin or in the mouth occurring in AIDS patients.

Column B

- a. Sarcoma.
- b. Adenocarcinoma.
- c. Carcinoma.
- d. Kaposi's sarcoma.
- e. Squamous cell carcinoma.
- f. Malignant.
- g. Benign.

3. What is the appearance of a peripheral giant cell granuloma and what other lesions may require microscopic examination to distinguish between them?
4. What is the treatment and prognosis for a hemangioma?
5. What areas of the mouth are especially prone to develop squamous carcinoma?

413. Nonsystemic oral lesions of local origin

- 1. What is a traumatic ulcer and what are the common causes?
- 2. Name the two types of burns.
- 3. Which types of burns are caused by careless handling of heated dental instruments and materials?
- 4. How does the oral mucosa react to heat?
- 5. How do patients often receive self-inflicted chemical burns?
- 6. How does the oral mucosa appear from a self-inflicted chemical burn?
- 7. What are the instructions that should be adhered to by each dental assistant who handles caustics?

8. What is papillary hyperplasia and what causes it?
9. What is an epulis fissuratum and what causes it?
10. What causes angular cheilitis?

414. Oral bone fractures

1. What possibilities must you be alert to regarding patients with oral bone fractures?
2. Describe the general signs and symptoms of trauma that suggest the possibility that bones may be broken.
3. What specific signs and symptoms of trauma indicate that a blow may have been severe enough to break bones?
4. What signs and symptoms indicate a mobile bone fragment is present in an area?
5. Describe how an abnormal appearance may indicate fractures.
6. How do abnormal mandibular movements occur in an oral fracture?
7. What is the most noticeable abnormal movement that would indicate a fracture?
8. What type of fracture may be indicated if the patient notices malocclusion?
9. How can malocclusion indicate a fracture?

Answers to Self-Test Questions

401

1. The sum of the reactions of the body to injury, either physical or caused by the invasion of a pathogenic organism.
2. (a) Redness caused by increased amount of blood supply to the area of irritation.
(b) Heat created by the amount of blood in the area.
(c) Swelling due to accumulated fluids and engorged blood vessels.
(d) Pain that warns us when something is wrong.
(e) The loss of function or altered function caused by damaged or injured tissue plus swelling.
3. Fighting or destructive and repair.

402

1. Over 300 types of bacteria in the oral flora. It also contains mucin.
2. Develops on tooth surfaces, restorations and other dental appliances such as dentures. It accumulates primarily on the gingival third of the teeth and in surface cracks, defects, or rough areas.
3. Acquired pellicle.
4. Molars. Mandibular molars tend to have more plaque on the lingual surfaces. Maxillary molars have more plaque on the facial surface.
5. The type that can live with little or no oxygen.

403

1. 75 to 85 percent.
2. 24 to 48 hours.
3. Formed above the margin of the gingiva, and found either on a single tooth or in a generalized area. It can completely fill an interproximal space between two teeth and appears most frequently in salivary duct areas.
4. Cream or yellow.
5. Claylike or bricklike and becomes extremely hard as it gets older.
6. Below the crest of the gingival margin.
7. Dark brown, black, or dark green in color; caused from staining by blood pigments.
8. Flint like hardness and is more firmly attached.
9. By location as either extrinsic or intrinsic and by source as either exogenous or endogenous.
10. Extrinsic stains.
11. Stains which develop and originate within the tooth.

404

1. The local decalcification and disintegration of the enamel, dentin, and cementum of the teeth.
2. Bacteria.
3. All dental caries begin when plaque deposits on the tooth surfaces become laden with bacteria.
4. Most often occur in the pits, fissures, grooves, interproximal and gingival areas where bacterial plaques are most readily found since they are not easily cleaned.
5. Thorough examination, including radiographs of the teeth.
6. A discoloration of the tooth structure, an increase in translucency of tooth structure, and the formation of a cavity.
7. Sensitivity to cold foods or liquids first, then to foods and liquids containing high concentrations of sugar.
8. Restorative dentistry.
9. Decreases the bacterial count, thereby reducing caries incidence.

405

1. Inflammation of the pulpal tissue.
2. Reversible and irreversible.
3. When the pulp will recover.
4. Irreversible pulpal damage and then eventually pulp death (necrosis of the pulp).
5. By removing the irritant and inserting a sedative filling.
6. A pulpotomy involves the removal of the coronal portion of the tooth where as a pulpectomy involves complete removal of the necrotic pulp and replacement with a suitable root canal filling.
7. The necrotic pulp is removed and replaced with a suitable root canal filling material or the tooth must be extracted.

406

1. A mass of granulation tissue usually surrounded by a fibrous sac.
2. A chronic inflammation of the periapical tissues.
3. At the apex of the root.
4. The tooth may be sensitive to percussion and feel slightly elongated; also, there may be a dull but persistent pain.
5. Either an acute or a chronic periapical abscess is formed when there is a localized collection of pus at the apex of a tooth.
6. A localized collection of pus in a cavity, formed by the disintegration of tissue.
7. The acute periapical abscess area becomes extremely painful. Generally, the chronic periapical abscess is less painful, occurring when pressure (in a certain direction) is applied.
8. By draining.

407

1. An irritant that usually can be identified.
2. It gradually turns to a clear liquid.
3. Around retained roots or any foreign chronic irritant that becomes buried in the tissue.
4. Cells that were left behind after performing a particular function.
5. Develops rapidly with high fever. Skin becomes very red and the area is characterized by severe throbbing pain as the inflammation localizes.
6. After an extraction if a normal blood clot fails to form or is dislodged.
7. Severe to persistent pain because of the exposed bone in the open socket.
8. Irrigating the socket with warm solution and packing the socket with squeezed-dried eugenol-iodoform gauze. Analgesics are usually prescribed to relieve pain and possible insomnia.

408

1. Inflammation of the gingiva.
2. (1) d.
(2) a.
(3) c.
(4) b.
(5) e.
(6) f.
(7) i.
(8) h.
(9) g.
(10) j.
3. Plaque and calculus accumulations, mechanical irritants (improper brushing and flossing techniques, mouth breathing, occlusal trauma), and rough or sharp tooth edges caused by caries or defective restorations.

4. Swelling of gingiva, redness, pain, increased heat, and a change in color of gingival margin from a normal color to a darker, redder or blue-red color.
5. Elimination of etiological factors, removal of supragingival and subgingival irritants, oral prophylaxis, and oral hygiene instructions.
6. A dentist and/or physician.
7. Gingiva that appears fibrous in nature and is neither red nor painful, but grossly enlarged.
8. Dilantin; for epilepsy.
9. Usually by removal of any irritants and good oral hygiene.
10. Vincent's infection, trenchmouth, and NUG.
11. The interdental tissue is either dead or dying. The gingiva is swollen, red, and bleeding. The dead or dying interdental papilla is covered with a gray-white pseudo-membrane. A fetid odor always is present. With the acute stage, the patient has fever, painful gums, and the cervical lymph glands are swollen. The patient suffers from malaise.

409

1. An inflammation of the periodontium, including both the gingiva and tooth attachment apparatus.
2. In gingivitis the marginal and papillary tissues are inflamed. When the inflammation extends and destroys the transseptal fibers, and the supporting structures of the tooth break down, the condition is no longer gingivitis but periodontitis.
3. It is not responsible for initiating the disease; however, it contributes significantly to the maintenance and progression of the disease.
4. Low resistance, fatigue, stress, diabetes, blood problems, and hormone imbalance.
5. It usually stems from a foreign body irritant that becomes embedded in the space between the tooth and the soft tissue or completely within the soft tissue next to the tooth.
6. Bacteria in plaque that is attached to calculus formations, overhanging fillings, and popcorn husks.
7. An inflammation of the soft tissue around the crown of the tooth.
8. As the bacteria multiply, an infectious process is initiated.
9. A condition where the patient has difficulty opening the mouth because the muscles are so aggravated by mechanical trauma or a secondary bacterial infection.
10. Fever and generalized cellulitis.

410

1. (1) a.
(2) g.
(3) b.
(4) i.
(5) f.
(6) h.
(7) e.
(8) c.
(9) d.
(10) j.
(11) k.
2. Unknown. Chronic irritation or trauma, such as cheek biting or smoking.
3. A bluish or greenish round or oval translucent swelling from pea to bean size. Excision.
4. 7 to 14 days.
5. The outside of the lip, at the vermillion border where the red portion of the lip meets the adjoining skin.
6. Exact cause is unknown. Trauma, hormonal disturbances, allergies, psychological problems, and gastrointestinal disorders.

7. Clusters or granules located just beneath the epithelium on the occlusal plane level of the cheek and on the lip mucosa.
8. Remove the cause; excellent if the patient stops smoking.
9. Daily brushing or scraping of the tongue.
10. White but discoloration of black or blue is possible. Caused by something the patient ingested such as food, medication, tobacco, or liquids.
11. No known cause or treatment.
12. None, however excision may be used for cosmetic reasons.

411

1. (1) h.
(2) f.
(3) i.
(4) d.
(5) g.
(6) a.
(7) c.
(8) j.
(9) b.
(10) e.
2. Saliva and blood. Minute quantities of HBV contaminated fluids cause infection and can be transmitted by any object that is transferred from one mouth to another or by any instrument that breaks the skin of an infected person and then used on another patient.
3. Accidental needle or contaminated instrument puncture, hand-piece spray from the mouth of an infected person, and impressions contaminated with blood, saliva, or both.
4. Hepatitis vaccination.
5. At least 5 years in most individuals who receive all three doses.
6. Hepatitis B surface antigen (HBsAG), hepatitis B core antigen (HBcAG), and hepatitis B envelope antigen (HBeAG).
7. A virus that infects certain cells of the immune system. Human immunodeficiency virus (HIV).
8. Sexual contact, needle sharing, and blood transfusions.
9. Tiredness, fever, loss of appetite and weight, night sweats, diarrhea, and swollen glands (usually in the neck, under the arms, or in the groin).
10. Hairy leukoplakia, herpetic lesions, candidiasis, Kaposi's sarcoma, and cervical lymphadenopathy. AIDS patients may also exhibit rapid, progressive gingivitis and periodontitis.
11. Lesions which run in lines following the pathway of a sensory nerve, indicating they are a virus infection of a nerve.
12. The spirochete called *Treponema pallidum*.
13. Anywhere on the body, but the most common sites are on the genitals, lips, or in the mouth. Appears approximately 3 weeks after exposure as a painless, highly infectious ulcer formation with a hard border, having an appearance similar to an aphthous ulcer.
14. Mucous patch when it appears on mucous membranes. Appears 6 to 8 weeks after exposure; the most contagious of all the syphilitic lesions; seldom absent from the oral mucosa during the secondary stage of syphilis; painless; usually oval in shape with a moist, glistening, grayish-white, slightly raised surface.
15. The first 4 years.
16. Gumma. Appears several years after initial infection; usually a single, lesion; appears as nodules and slowly increase in size, becoming softer and less dense; center of the nodule erodes and a definite ulcer results; destroys soft tissue and underlying bone; results in perforations of the palate; noninfectious.
17. Malformed teeth that appear notched, peg shaped, or barrel shaped, Hutchinson's incisors. The spirochetes affect the tooth formation.

18. Secondary lesions spread either through the bloodstream or by direct contamination of an abrasion or wound in the mucosa. Primary lesions can be caused by direct contact of the tissue with an infected instrument.
19. Tongue.
20. Begin as a small tubercle or pimple that breaks down to form painful ulcers. As the process repeats over and over the lesion grows in size.
21. Top and the sides of the tongue and on the buccal mucosa (cheek) opposite the upper and lower molars.
22. A fungal infection, also known as candida albicans or moniliasis. It can be located anywhere on the oral mucosa.
23. It may be one of the most frequent opportunistic infections seen in patients with AIDS.
24. An increased tendency to develop periodontitis, glossitis, gingivitis, and infections. The patients usually exhibit healing difficulties.

412

1. (1) b.
(2) d.
(3) f.
(4) h.
(5) i.
(6) a.
(7) g.
(8) e.
(9) j.
2. (1) f.
(2) c.
(3) e.
(4) b.
(5) a.
(6) d.
3. Dark red, vascular, or hemorrhagic with surface ulceration common; the peripheral fibroma and the pyogenic granuloma.
4. It may regress spontaneously or require surgery or electrocautery; prognosis is excellent.
5. Soft palate, lateral and ventral tongue mucosa, and floor of the mouth.

413

1. A localized area on the mucosa in which the surface epithelium has been destroyed. Denture irritation, biting injuries, hard foods, toothbrush, and dry cotton rolls.
2. Thermal and chemical.
3. Thermal.
4. Tissue protein of the mucosa coagulates, turns white and sloughs off, leaving an ugly raw wound that heals with difficulty and pain.
5. By placing an aspirin tablet in the mucobuccal fold next to the tooth that aches.
6. Mucosa turns white in the area covered by the tablet and usually sloughs off, leaving an ulcer that is difficult to treat.
7. (1) Know the content of all medicament bottles in the dental treatment room.
(2) Be able to describe the properties and precautions necessary for handling, neutralizing, and storing these substances.
(3) Label all containers.
(4) Make a positive identification of all drugs and chemicals.

- (5) Be very careful in handling all chemicals.
- 8. A condition that appears as numerous, closely arranged, red, pebbly projections of the mucosa susceptible to any mucosal surface covered by a dental appliance. Wearing dentures 24 hours a day, and poorly fitting dentures.
- 9. A lesion of two or more flaps of soft hyperplastic tissue separated by a central groove into which the denture border fits. An overextended denture border.
- 10. Overclosure of the bite due to loss of vertical dimension in an edentulous or denture wearing patient.

414

- 1. The possibility of third-party liability and child abuse.
- 2. Wounds, swellings, and discoloration of the face, with a history of trauma to the site.
- 3. Bruising and the escape of blood from under the skin or mucosa. The break may also be seen or felt.
- 4. Pain, severe tenderness, and grating under the skin.
- 5. Normal appearance of the patient is changed in facial asymmetry and luxation (dislocation) may indicate complete fractures. Diplopia (double vision) may indicate the bones forming the floor of the orbit are involved. Sunken areas or abnormal projections increase the suspicion of fractures.
- 6. Muscles displace fragments of the bone fracture, or the mandible swings from the fracture site rather than the temporomandibular joint.
- 7. Deviation of the jaw to one side or another when opening and closing the mouth.
- 8. A condylar fracture.
- 9. The mandible swings toward the side of the fracture and the teeth usually strike on that side first when closing.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

1. (401) *Calor* is the example for which characteristic of inflammation?
 - a. Pain, heat, redness, and swelling.
 - b. Heat, redness, and swelling only.
 - c. Redness and swelling only.
 - d. Heat only.
2. (401) *Dolor* is the example for which characteristic of inflammation?
 - a. Swelling.
 - b. Redness.
 - c. Heat.
 - d. Pain.
3. (402) Which is *not* a location supragingival plaque *primarily* accumulates on teeth?
 - a. Surface cracks.
 - b. Sulcular tissue.
 - c. Defects and rough areas.
 - d. Gingival third of the teeth.
4. (402) How and when do disclosable amounts of plaque *usually* form?
 - a. 2 to 4 hours; Bacteria sticking to acquired pellicle.
 - b. 4 to 6 hours; Bacteria sticking to acquired pellicle or tooth surface.
 - c. 6 to 8 hours; Bacteria formed between sulcular tissues.
 - d. 8 to 10 hours; Bacteria formed between sulcular tissue and tooth surfaces.
5. (403) All describe supragingival calculus *except*
 - a. cream or yellow in color.
 - b. claylike or bricklike in consistency.
 - c. appears only in areas of salivary ducts.
 - d. formed above the margin of the gingiva.
6. (403) What is the *average* number of days required for the soft deposit to mature and change?
 - a. 12.
 - b. 14.
 - c. 16.
 - d. 18.
7. (403) Which dental stains are you *unable* to remove from a patient's teeth?
 - a. Extrinsic and exogenous.
 - b. Intrinsic and endogenous.
 - c. Exogenous and endogenous only.
 - d. Extrinsic, exogenous and endogenous only.

-
-
8. (404) Which of these aids in the control of caries?
 - a. Self-repair.
 - b. Repair by restorative dentistry only.
 - c. Restoration, proper diet, and reduced bacterial count.
 - d. Higher bacteria count and decreased carbohydrate intake.
 9. (405) What type of pain is associated with chronic pulpitis?
 - a. Throbbing, intermittent.
 - b. Sharp, prominent.
 - c. Severe, constant.
 - d. Mild, dull.
 10. (405) What dental clinic section usually treats the early stages of pulpitis?
 - a. Prophylactic.
 - b. Endodontic.
 - c. Restorative.
 - d. Oral Surgery.
 11. (405) Endodontic treatment of a *nonvital* tooth entails
 - a. a pulpotomy.
 - b. a pulpectomy.
 - c. placing a root canal filling only.
 - d. complete removal of the necrotic pulp chamber only.
 12. (406) An *acute* periapical abscess can *best* be described as
 - a. a slow, progressive inflammatory process with pus forming within 24 hours.
 - b. a rapid, painful inflammatory process with pus forming within 24 hours.
 - c. slightly painful, slow, progressively red inflammatory process.
 - d. slightly painful with rapid increase in size of abscess.
 13. (407) What condition may develop in the oral cavity because of cells being left behind after doing a particular function?
 - a. Cellulitis.
 - b. Granuloma.
 - c. Inflammatory cyst.
 - d. Developmental cyst.
 14. (408) Inflammation of all gingival tissues including interdental papillae, marginal gingiva, and attached gingiva *best* describes
 - a. diffuse gingivitis.
 - b. marginal gingivitis.
 - c. papillary gingivitis.
 - d. generalized gingivitis.
 15. (408) Which distribution of gingivitis is *best* described as involving the gingival margins of all teeth along with the interdental papillae?
 - a. Localized diffuse.
 - b. Localized marginal.
 - c. Generalized diffuse.
 - d. Generalized marginal.

16. (408) Tissue that is dead or dying, red, swollen, and bleeding, and has dead interdental papilla covered with a gray-white pseudo membrane, describes which form of gingivitis?
 - a. Desquamative.
 - b. Necrotizing.
 - c. Hormonal.
 - d. Infective.
17. (409) The *most common* cause of periodontal abscesses is
 - a. calculus and walled off periodontal inflammations.
 - b. plaque on calculus formations and popcorn husks only.
 - c. deep gingival or periodontal inflammations that become walled off.
 - d. plaque on calculus formations, overhanging fillings, and popcorn husks.
18. (410) What condition appears as a white plaque found unilaterally or bilaterally on the sides of the tongue?
 - a. Geographic tongue.
 - b. Hairy leukoplakia.
 - c. Fordyce granules.
 - d. Hairy tongue.
19. (410) Which example best describes primary herpetic stomatitis?
 - a. Consist of painful ulcers that occur only on fixed mucosa.
 - b. Causes recurrent sores on the lips and are particular concern to the dental profession.
 - c. Sores occur over a widespread area within the mouth and is most often seen in children.
 - d. Sometimes called canker sores and are found in the mouth as depressions on freely movable mucosa membrane.
20. (410) Ulcers which appear as depressions on the mucous membrane of freely movable mucosa, covered by a grayish-white or a light-yellowish membrane are characteristics of
 - a. intraoral recurrent herpes.
 - b. aphthous stomatitis.
 - c. nicotinic stomatitis.
 - d. candidiasis.
21. (410) A dark pigmented lesion of the oral mucosa caused by the accidental implantation into the tissue or prolonged contact of the tissue with a filling material describes
 - a. a mucocele.
 - b. lichen planus.
 - c. Fordyce granules.
 - d. an amalgam tattoo.
22. (411) Which type of hepatitis is known as infectious hepatitis and is usually acquired by ingestion of contaminated food or water?
 - a. Hepatitis A (HAV).
 - b. Hepatitis B (HBV).
 - c. Hepatitis C (HCV).
 - d. Hepatitis Delta (Delta).
23. (411) Which type of hepatitis, known as serum hepatitis, is transmitted by contact with body fluids?
 - a. Hepatitis A (HAV).
 - b. Hepatitis B (HBV).
 - c. Hepatitis C (HCV).
 - d. Hepatitis Delta (Delta).

24. (411) What condition is marked by watery blisters on the skin and mucous membranes and often called shingles?
- Mumps.
 - Candidiasis.
 - Herpes zoster.
 - Aphthous stomatitis.
25. (411) What disease is caused by the *treponema pallidum* bacteria?
- Syphilis.
 - Candidiasis.
 - Tuberculosis.
 - Infectious mononucleosis.
26. (411) What lesion is found in the oral cavity during the *second* stage of syphilis?
- Mucous patch.
 - Chancre.
 - Gumma.
 - Canker.
27. (411) What *noninfectious* lesion is produced during the *third* stage of syphilis?
- Canker.
 - Gumma.
 - Chancre.
 - Mucous patch.
28. (411) Malformed teeth in a patient who had congenital syphilis are referred to as
- microdontia.
 - macrodontia.
 - supernumerary.
 - Hutchinson's incisors.
29. (411) What disease exhibits multiple oral lesions and consists of many pinpoint, purplish-red spots (*petechiae*) and is attended by fever, malaise, sore mouth, lymph gland enlargement, and loss of appetite?
- Infectious mononucleosis.
 - Tuberculosis.
 - Measles.
 - Mumps.
30. (412) A *benign* lesion of the gingiva that develops from the connective tissue or the periodontal ligament *best* describes a
- fibroma.
 - granuloma.
 - hemangioma.
 - papilloma.
31. (412) What type of tumor is made up of small blood vessels and usually appears on the cheek, tongue, or lip as an elevated lesion with a smooth surface and is somewhat red or blue in color?
- Pyogenic granuloma.
 - Irritation fibroma.
 - Hemangioma.
 - Papilloma.

32. (412) What is the *most common* malignant tumor of the oral cavity and what areas of the oral cavity are more vulnerable?
- a. Adenocarcinoma arising from the salivary glands.
 - b. Squamous cell carcinoma arising from the salivary glands.
 - c. Adenocarcinoma arising from the soft palate, lateral and ventral tongue mucosa and floor of the mouth.
 - d. Squamous cell carcinoma arising from the soft palate, lateral and ventral tongue mucosa and floor of the mouth.
33. (413) Careless manipulation of dental materials, such as impression waxes, cavitron devices and endodontic instruments could result in
- a. a traumatic ulcer.
 - b. a chemical burn.
 - c. a thermal burn.
 - d. hyperplasia.
34. (413) A lesion consisting of two or more flaps of soft tissue separated by a central groove into which an overextended denture border fits describes
- a. angular cheilitis.
 - b. angular cheilosis.
 - c. epulis fissuratum.
 - d. papillary hyperplasia.
35. (414) The *most notable* sign or symptom in a patient with a condylar fracture is
- a. pain.
 - b. malocclusion.
 - c. abnormal movements.
 - d. abnormal appearance.

Unit 2. Dental Therapeutics

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IN THE FIELD OF dentistry, there are several drugs used to treat dental patients. While you will not prescribe drugs, you may be asked to prepare them and assist the dentist in administering them. In either case, your knowledge of drugs permits you to do your duties with expertise and confidence, aid during emergencies, and reduce drug abuse. Properly used drugs can aid in rendering a diagnosis, treating or preventing a disease or other abnormal conditions, relieving pain or suffering, and controlling or improving any physiological or pathological condition. Improper use of drugs can cause physical and mental impairment and even death. Drugs are dangerous and the dental environment is no place for experimenting with them. That is best left to the research scientists in laboratories where experiments are carried out under highly controlled conditions. With that caution, this unit covers the methods of drug administration, drug actions, and specific categories of therapeutic agents. Before we turn our attention to drugs, we need to refresh your understanding of basic chemistry.

2–1. Elementary Chemistry

Knowledge and understanding of the fundamentals of chemistry is very important to every dental assistant. Chemistry is one of those subjects that most people try to avoid. There is a certain amount of intimidation associated with the subject and it stems from a lack of understanding. This is very important to your job as a dental assistant because you not only deal with many types of materials but are also responsible for preparing those materials properly to achieve the required results—successful treatment of patients. So, what exactly is chemistry? Almost every chemistry book presents a slightly different definition. However, if you combine and condense them, chemistry can basically be defined as “the science that deals with the composition of matter, and the changes in composition which the matter may undergo.” Keeping that definition in mind, let’s begin by reviewing the topics of matter and measurement.

415. Matter and measurement

In this lesson we begin by covering the basic properties of matter, the physical states in which matter occurs, and the identity of matter. Next, we’ll look at the universal system of measurement.

Remember, we are only covering the basics to refresh your understanding of how different elements of chemistry work and interrelate.

Basic properties of matter

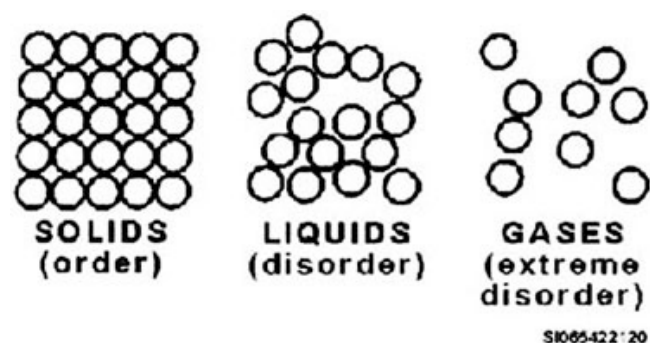
Reread the definition of chemistry. It refers to the composition of matter and the changes matter undergoes. But what is matter? Can you see matter, or is it, like so many things in chemistry, something you read about but never see? Look around you. The books on your desk, the desk itself, the walls, and you are all matter.

Simply defined, *matter* is anything that occupies space and has weight or mass. All of the items mentioned in the preceding paragraph are, of course, examples of matter. Since matter must occupy space, apparently two bodies of matter cannot occupy the same space. The possession of mass endows each body of matter with gravitational attraction and thereby gives it weight. The books, desk, and walls we mentioned previously are obviously matter, but what about air and other gases? It is true that a colorless and odorless gas, such as air, is not readily apparent to our senses.

Nevertheless, such gases occupy space and have weight, and are, by definition, matter. However, do not jump to conclusions and think everything is matter, because many things are not. For example, electricity, rays of light, and sound are not matter, but they do exist. These are examples of *energy*, which is the capacity for doing work. We know now that matter can be converted into energy and energy converted into matter under certain controlled conditions.

Matter can be transformed from one form to another. An iron post, if left exposed to moist air, soon exhibits signs of rust; fruit juices exposed to air ferment and alcohol forms in them; when wood or paper is burned, the original material seems to disappear. Under normal circumstances, matter can neither be created nor destroyed; it merely passes from one form to another. For example, the iron from the post did not disappear; it actually combined with the water vapor and oxygen in the air to form a new substance called rust (iron oxide). The alcohol in the fruit juice did not develop by itself; it resulted from the transformation of sugar which, in turn, disappeared as the alcohol was created. Likewise, the burned wood produced ashes and gave off gases whose combined weights equal the weight of the original substance.

Physical states of matter



All matter exists in one of the three physical states: solid, liquid, or gas. To understand why matter exists in a particular physical state, you must first understand that all matter is composed of very tiny particles (atoms or molecules). The degree to which these particles are packed together or free to move about (within limits) determines which form the matter takes—a gas, a liquid, or a solid (fig. 2-1).

Figure 2-1. Physical states of matter.

Gases

Oxygen and hydrogen are common examples of gases; air is a combination of several gases. The particles that make up gases are farther apart than those in liquids or solids. The vacant spaces between the particles, allows them to move about in almost complete independence of one another. Since the particles are free to move about, gases do not have shapes or boundaries. The volume of a gas can be changed greatly when temperature or pressure changes since the particles can be easily pushed farther apart or closer together.

Liquids

Two forms of most commonly known liquids are alcohol and water. In contrast to gases, liquids have a definite volume at a given temperature, but they do not have a fixed shape. While their particles are packed closer together than those of gases, they are still free to move about. This freedom of movement and lack of a fixed shape defines another characteristic of liquids: they take the shape of any container in which they are placed. You've observed this anytime you have poured a liquid such as milk from a carton into a glass.

Solids

Wood, plastic, salt, sand, and iron are all common examples of solids. In the solid state of matter, the particles are closely packed together and remain in fixed positions. Solids have specific shapes and boundaries. While they may expand or contract slightly in response to normal heating or cooling, they remain hard and retain a fixed shape.

Physical changes

When temperature and pressure are altered sufficiently, many substances can pass from one physical state to another without changing their chemical composition. A substance is classified as a gas, liquid, or solid according to the form we normally experience in ordinary conditions. For example, water's normal classification is as a liquid—although, at a lowered temperature, it freezes and changes to a solid (ice). When ice melts it changes from a solid to liquid state. When heat is added and the temperature elevated, a liquid may change (evaporate) into a gaseous form (steam). In contrast, cooling (removing temperature) allows a gas to change to a liquid state through the process of condensation. Some solids, such as mothballs, change from a solid state directly to a gas through the process of sublimation. As you can see, matter not only occupies space and has mass or weight, but also occurs in various physical states such as solids, liquids, and gases.

Identity of matter

Any specific form of matter, such as salt, water, and wood, where all specimens have the same properties will have a specific identity. These properties are the physical and chemical characteristics that distinguish one substance from another. Characteristics such as odor, color, shape, freezing point, boiling point, or solubility, are called *physical characteristics* of the substance. For example, since water freezes at 0 degrees Celsius (°C) and boils at 100°C, we say that these are its physical characteristics. Sulfated potash has a distinct odor, color, shape, and solubility; therefore, they are listed as its physical characteristics.

A substance's chemical characteristics, however, are more difficult to see than its physical ones. *Chemical characteristics* include energy content, reaction with other substances, and reactions with light, heat, and electricity. For example, salt remains unchanged when heated, whereas sugar will char and burn. Iron rusts if exposed to moist air, while gold does not. If hydrogen peroxide is not stored in a tight, light-resistant container, in a cool place, it decomposes chemically. All of these types of changes are examples of chemical characteristics.

Now that we have refreshed our knowledge of matter and chemistry, let's review the measurement system that is used to describe some of these properties.

The metric system

The metric system of weights and measures is used as the scientific system of measurement throughout the world. It became the legal standard for Federal hospitals in the United States by law on 28 July 1966. All other systems are referred to the metric system for official comparison. It is used as the scientific system of measurement the world over. Although you do not write prescriptions, you will document drugs used in patient treatment using metric volume and weight measures. Gold restorations are constructed using metric weight measures as well. You use metric length measures to determine the depth of periodontal pockets, size of teeth or lesions, etc. To summarize:

- The metric system is used universally.
- Every metric weight and measure has a simple relation to the meter.
- Every metric unit is multiplied or divided by 10 to reach the next higher or lower unit.
- It is the only system of weights and measures with a common standard where a unit of weight equals a unit of volume. Its common standard is water. For example, under standard conditions of temperature and pressure, 1 milliliter of water (H₂O) weighs 1 gram.

You should be familiar with the metric system's three primary units of measure. The *meter* is the primary unit of length. The *liter* is the primary unit of volume, and the *gram* is the primary unit of weight or mass.

The subdivisions and multiples of these principal units are indicated by the addition of Latin or Greek prefixes, as illustrated below.

| Subdivision (Latin prefix) | | Multiples (Greek Prefix) | |
|----------------------------|------|--------------------------|------------|
| Deci | 10 | Deka | 10 times |
| Centi | 100 | Hecto | 100 times |
| Milli | 1000 | Kilo | 1000 times |

Once you master these subdivisions and multiples, the metric system will not be difficult for you to understand and work with. Remember that it works like our money system using a factor of 10.

To abbreviate each subdivision and multiple of a unit, you use the first letter of the prefix and the first letter of the unit. Examples of this are millimeter (mm) (length), milliliter (ml) (volume) and milligram (mg) (weight/mass).

The basic metric unit of temperature is the degree Celsius. In the Celsius scale, water boils at 100°C and freezes at 0°C. In contrast, in the Fahrenheit (°F) scale, water boils at 212°F and freezes at 32°F. The Celsius scale is marked off in increments of 1°. Each degree Fahrenheit is $\frac{5}{9}$ the size of each °C.

The following tables contain the lengths, weights, and fluid measures of the metric system that you may encounter in the dental service.

| Metric Lengths | |
|---|----------------|
| Lengths | Abbreviations |
| 10 millimeters = 1 centimeter | 10 mm. = 1 cm |
| 10 centimeters = 1 decimeter | 10 cm. = 1 dm |
| 10 decimeters = 1 meter | 10 dm. = 1 M |
| 10 meters = 1 dekameter | 10 M. = 1 dkm |
| 10 dekameters = 1 hectometer | 10 dkm. = 1 hm |
| 10 hectometers = 1 kilometer | 10 hm. = 1 km |
| The metric table of lengths may also be written: 1 meter = 1000 millimeters = 100 centimeters = 10 decimeters = 0.1 dekameter = 0.01 hectometer = 0.001 kilometer | |

| Metric Weight | | | |
|--|---------------|---------------|---------|
| Weights | | Abbreviations | |
| 10 milligrams | = 1 centigram | 10 mg. | = 1 cg |
| 10 centigrams | = 1 decigram | 10 cg. | = 1 dg |
| 10 decigrams | = 1 gram | 10 dg. | = 1 Gm |
| 10 grams | = 1 dekagram | 10 Gm. | = 1 dkg |
| 10 dekagrams | = 1 hectogram | 10 dkg. | = 1 hg |
| 10 hectograms | = 1 kilogram | 10 hg. | = 1 kg |
| The metric table of weights may also be written: | | | |
| 1 gram = 1000 milligrams | | | |
| = 100 centigrams | | | |
| = 10 decigrams | | | |
| = 0.1 dekagrams | | | |
| = 0.01 hectogram | | | |
| = 0.001 kilogram | | | |

| Metric Fluid Measures | | | |
|--|----------------|---------------|---------|
| Measures | | Abbreviations | |
| 10 milliliters | = 1 centiliter | 10 ml. | = 1 cl |
| 10 centiliters | = 1 deciliter | 10 cl. | = 1 dl |
| 10 deciliters | = 1 liter | 10 dl. | = 1 L |
| 10 liters | = 1 dekaliter | 10 L. | = 1 dkl |
| 10 dekaliters | = 1 hectoliter | 10 dkl. | = 1 hl |
| 10 hectoliters | = 1 kiloliter | 10 hl. | = 1 kl |
| The metric table of lengths may also be written: | | | |
| 1 liter = 1000 milliliters | | | |
| = 100 centiliters | | | |
| = 10 deciliters | | | |
| = 0.1 dekaliters | | | |
| = 0.01 hectoliters | | | |
| = 0.001 kiloliters | | | |

416. Acids, bases, salts, and pH

At some time in your life, you have probably had an upset stomach. Did you ever stop to think what its true cause was? Have you ever had “heart burn?” Well, if you have, then you have first-hand experience of the power of acids, and if you took any medication to relieve the heartburn, you have also experienced antacids or bases. We are going to find out just how acids and bases are formed and how they influence each other. Let’s begin by defining the terms we’ll be using: acids, bases, and salts.

Acids, bases, and salts

The classic definition of *acids* is “substances containing hydrogen (H⁺) that donate hydrogen ions in solutions.” In a solution acids form positive ions. Therefore, they are classified as *protonic*; that is, they release or donate protons. Acids are usually classified according to the number of protons furnished by each molecule. Acids have the following common properties:

- Usually have a sour taste.
- Neutralize bases to form salts.
- React with some metals to form salts.
- Usually (but not always) soluble in water.

A *base* differs from an acid in that it is a proton acceptor and, when it is dissolved in water, it forms negative hydroxyl ions (OH^-). Generally, the proton, a base acceptor comes from the disassociation of water. Bases are usually classified according to the number of protons they accept. Bases have the following common properties:

- They have a bitter taste in solution.
- They feel slick and slippery like soap.
- They react with acids to produce salts.

Ammonia is considered a base because it furnishes hydroxyl ions. Actually, once the ammonia reacts with water, it is no longer ammonia.

Salts are ionic compounds formed by the replacement of part or all of the hydrogens of an acid by a metal or a radical acting like a metal. A salt is an ionic compound that contains a positive ion other than hydrogen and a negative ion other than hydroxyl (e.g., Na^+Cl^-). Since the body maintains a specific pH in its tissues and fluids, the type of salt is very important when used medicinally.

pH and buffers

The term “pH” is taken from an expression that literally means “presence of hydrogen.” This phrase, in effect, is a definition of pH—it is an indication of the hydrogen ion concentration of a solution. For relating changes in hydrogen concentrations in small, meaningful numbers, the Danish scientist Sorensen, devised the pH scale that we use today. This scale runs from 0 to 14. While you may not need to calculate a pH value, you will need to interpret the meaning of a pH value. To get a better understanding of pH, look at the scale in figure 2-2.

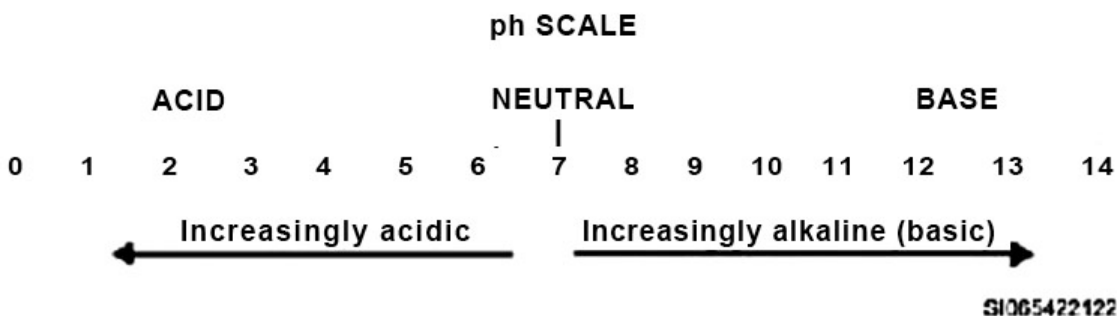


Figure 2-2. Presence of hydrogen.

pH scale

As you can see on the scale, *acids* are solutions measured between 0 and 6.9. An acid solution has more hydrogen (H^+) ions than hydroxide (OH^-) ions, the lower the pH value, the more acidic the solution. For example, a reading of 5.5 indicates that the solution is a weak acid. Tooth enamel can start to demineralize at an acidic level of 5.5.

Readings from 7.1 to 14 are increasingly *alkaline* (basic). Alkaline solutions have more hydroxide (OH^-) ions than hydrogen (H^+) ions, the higher the pH value, the more basic or alkaline the solution. A reading of 8.5 indicates an alkaline solution.

Solutions with the pH value of 7 are considered *neutral*. In a neutral solution, the hydrogen (H^+) ions equal the hydroxide (OH^-) ions. The reaction of acids and bases neutralizing each other produce salts.

The usual method for determining pH is by using organic indicators. These are compounds or agents capable of changing color when they are exposed to different pH values. One example is when you use Litmus paper to test the acidic content of saliva.

Buffers

Compounds, called buffers, are used to achieve and maintain the proper pH. A *buffer* is a solution that *does not* change pH when significant quantities of hydrogen or hydroxyl ions are added. Buffers resist a change in pH. A buffer is a solution of weak acid and the salt of that weak acid. A buffer is most efficient when the concentration of the acid is equal to the concentration of the salt.

An example of a buffer is carbonic acid/sodium bicarbonate. This is the buffer system most common in the fluids and tissues of the body. It is used to keep the pH of the blood and body fluids constant. Buffers in saliva are important in neutralizing the acids formed by bacteria. When the buffering capacity of the saliva is overwhelmed, acids accumulate and lower the pH. This can be harmful to the teeth since demineralization can start at a pH of 5.5.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

415. Matter and measurement

1. What is the definition of matter?
2. What endows each body of matter with gravitational attraction?
3. Under certain conditions, matter can be converted into what?
4. If matter can neither be created nor destroyed, what happens to it?
5. What are the three physical states of matter?
6. How can the volume of gas be changed?
7. How are the volume and shape of liquids determined?
8. How are solids affected by temperature changes?

9. How do many substances pass from one physical state to another without changing their chemical composition?
10. How is a substance classified as gas, liquid, or solid?
11. List the five physical changes that can occur to substances.
12. Match the items in column B with the items in column A. Column B items may be used more than once.

Column A

- ____ (1) Odor.
- ____ (2) Energy content.
- ____ (3) Reaction with light.
- ____ (4) Freezing point.
- ____ (5) Solubility.
- ____ (6) Reaction with electricity.
- ____ (7) Reaction with heat.
- ____ (8) Boiling heat.
- ____ (9) Shape.

Column B

- a. Chemical characteristic.
- b. Physical characteristic.

13. What metric measures would you use to document drugs used in patient treatment?
14. What metric measure is used to determine the depth of periodontal pockets and the size of teeth or lesions?
15. What must you multiply or divide by to reach the next higher or lower metric unit?
16. What is the common standard of the metric system?
17. The meter is the primary metric unit of what?
18. The liter is the primary metric unit of what?
19. What is the primary metric unit of weight or mass?

20. Match the items in column B with the items in column A. Column B items may be used more than once.

| <i>Column A</i> | <i>Column B</i> |
|-----------------|-----------------|
| ____ (1) Kilo. | a. 10. |
| ____ (2) Hecto. | b. 100. |
| ____ (3) Deci. | c. 1000. |
| ____ (4) Milli. | |
| ____ (5) Centi. | |
| ____ (6) Dekka. | |

21. How are subdivisions and multiples of metric units abbreviated? List three examples.

22. How is the Celsius scale marked?

23. Each °F is what size of °C?

416. Acids, bases, salts and pH

1. Define the terms “acids,” “bases,” and “salts.”

2. How are acids and bases classified?

3. What are four properties of acids?

4. What are three properties of bases?

5. Define the following terms:

(a) pH.

(b) pH scale.

(c) Buffers.

6. Define the range on the pH scale for each of the following:
 - a. Neutral.
 - b. Alkaline.
 - c. Acid.
7. At what pH reading can tooth enamel start to demineralize?
8. Explain why buffers in saliva are important?

2-2. Drug Administration and Actions

As a dental assistant, you aid the dentist in all phases of patient treatment. An important phase of patient treatment involves administering drugs. Although the dentist prescribes the specific drug and dosage, you may be asked to prepare the drug for administration. Understanding how drugs actually work to aid humans is one of the challenges of modern medicine. The action of some drugs still remains a mystery to us. Nevertheless, we can profit from a look at the actions of drugs that we do understand and how they are used in the dental environment. However, before we look at the drugs themselves, we need to focus on the ways in which drugs are administered.

417. Common methods of drug administration

There are several common methods of administering drugs. Those commonly used in the dental clinic include topical, oral, inhalation, injection, and rectal.

Topical

In the topical method the drug is applied to the surface of the skin or mucous membrane to produce a local effect. Such drugs come as ointments, lotions, or creams. A good example is the topical anesthetic ointment.

Oral

Oral administration of a drug is probably the simplest and easiest method. It is painless, requires no special apparatus, and produces a systemic effect in a short time. Drugs administered orally are in either solid or liquid form. The solid forms are tablets, lozenges, and capsules. The liquid forms used for oral drug administration are solutions, elixirs, and syrups. Although these terms are sometimes used interchangeably, there are differences in their composition. A *solution* uses water as a vehicle (carrying agent) for the drug. An *elixir* is a clear, sweetened liquid, usually containing water and alcohol in addition to the drug. *Syrup* is an aqueous solution of sugar used as a vehicle for a drug.

Inhalation

Inhalation is not as common as some of the other methods. In fact, very few drugs are administered by inhalation. However, you may encounter some of them in your career. Some inhalants are supplied

in cylinders equipped with regulators that adjust the flow of the drug and use a face mask for administration. This highly volatile (easily vaporized) group includes ether, nitrous oxide, or oxygen. These inhalants are, of course, in gas form. Other inhalants, such as aromatic ammonia, are supplied in liquid form in a cloth-covered vial that can easily be crushed to release the vapors. One example is the aromatic ammonia inhalant often used in the dental clinic to revive patients who experience *syncope*.

Injection

Drugs that are to be delivered by injection are usually prepared with normal saline as the vehicle. However, some drugs, such as penicillin, that are rapidly absorbed and excreted by the body may be suspended in medicinal oils instead of saline. Though there are many methods of injecting drugs, the dental clinic mainly uses intramuscular, intravenous, and subcutaneous methods.

- *Intramuscularly* means to inject the drug into muscle tissue.
- *Intravenously* means to inject the drug directly into a vein.
- *Subcutaneously* means to inject the drug just under the skin.

With intramuscular injection, the onset of the drug's action is slow, and the duration of its affect is prolonged. This prolonged activity occurs because a pool of medication is deposited in the muscle, and is slowly absorbed into the blood stream. The use of oils as a vehicle or the addition of a vasoconstrictor may delay absorption and prolong the drug's action. Although you probably will never give an injection, you need to know the correct procedures in event of an emergency.

First, the needle is inserted into the area to be anesthetized. Next, the dentist aspirates the syringe by pulling its plunger slightly back. This is to check to see if the needle is inserted into a blood vessel. If the needle is in a blood vessel, pulling the plunger back draws blood into the barrel of the syringe. If this occurs, the needle is removed and reinserted into another location. Injecting the medication into the blood vessel results in a more rapid absorption of the drug than is appropriate. This could be dangerous since the rapid absorption would place too much of the drug in the patient's system at once.

Subcutaneous injection is similar to intramuscular injection. The onset of the drug's action is slow and its duration of its affect is prolonged. The difference between the two methods is the area where the medicament is deposited. In the subcutaneous method, the medicament is deposited under the skin where it is slowly absorbed into the blood stream.

Intravenous injections produce a very rapid response because the drug is instantly carried through the entire body. This method is used when a quick response to the drug is needed such as an emergency or during conscious sedation. Intravenous injections are generally made slowly so that the patient's reaction can be watched.

Normally, the dentist administers any injections (both intramuscular and intravenous) given in the dental clinic. Your job is to prepare the drug for administration.

Rectal

The rectal method of administering medications is not used very often in dentistry. However, there may be a time when it is the most appropriate method. An example is a patient who continues to vomit. Rectal administration of medications uses the drug in the form of a suppository. A suppository is a medicated solid body that is designed to be introduced into different orifices of the body. It is designed to melt or soften at body temperature, releasing the drug which is then absorbed through the mucosal lining.

Choice of the administration method

The dentist chooses the method of administration. The method selected depends on several factors.

- Effect desired.
- Rapidity of action needed.
- Nature and amount of the drug to be given.
- Physical condition of the patient.

418. Local and systemic drugs

The body has varying responses to a drug. Most of these responses can be divided into two categories: local action or systemic action. We'll explore both of these responses in the following paragraphs.

Local action

Local action is the effect that a drug or medication produces on tissue at the point or area of application or introduction. These effects are confined to the site or area of application only if the medication is dispensed in reasonable doses. Included in medications with local action are emollients and demulcents. *Emollients*, made from fats or oils, protect or soften the skin. *Demulcents*, composed of glycerin or lanolin, are used to soften and reduce pain on mucous membranes.

Systemic action

A systemic action is defined as the effect of a drug on some tissue or organ remote from the site of introduction. This action occurs only after the drug has been absorbed or has entered the vascular system. Before the medical profession accepts a drug for use as a systemic medication, it must first meet the following criteria:

- Be administered so that it is introduced effectively into the body.
- Be absorbed. (This assumes its solubility in one or more of the body fluids and its ability to permeate cell membranes.)
- Reach specific cells of the body to increase or decrease an already existing function.
- Be excreted by the body or destroyed within the body. It may be eliminated unchanged or in combination with other waste products of the body, chiefly through the intestines, kidneys, lungs, or skin.

Types of systemic drug reactions

The action of drugs cannot cause any cell to produce a new response that does not already exist. Drugs can, however, alter the productivity of a normal or diseased cell, tissue, or organ through stimulation, depression, or replacement. Drugs also may function to attenuate (weaken) or destroy microorganisms. Let's look a little closer at the stimulation, depression, and replacement actions of drugs.

| Systemic Drug Reactions | |
|-------------------------|---|
| Stimulation | The activity of a tissue or an organ is increased by stimulation. Caffeine is an example of a stimulant that acts upon the central nervous tissue. There are many other drugs that stimulate selected tissue within the body. |
| Depression | This drug action decreases cell function. A drug that decreases the ability of the respiratory center is called a respiratory depressant. Barbiturates (Phenobarbital and Seconal) are central nervous system (CNS) depressants. |
| Replacement | Replacement therapy is used to replace body organ secretions the body is no longer making in sufficient quantities. In general, it is a therapy of substitution. This type of therapy represents one of the greatest triumphs of modern medicine. For example, estrogens and androgens are a form of replacement therapy for nonavailable normal hormones. Insulin and thyroid hormone therapy are other examples of replacement therapy. |

419. Drug toxicity

Any drug, medicinal preparation, or compound may have a *toxic* (damaging) effect on the human body. While the undesirable, or toxic, effects of some drugs have minimal impact in the average person, in others these effects can have serious consequences and produce effects ranging from nausea to death. In some cases these undesirable effects appear early; in others they appear only after prolonged administration of a drug. Sometimes adjusting the dosage of the medication can alleviate the toxic reaction. In other cases, the patient must refrain from taking the drug. Occasionally, another drug must be administered to counteract the drug producing the toxic effect. Let's take a look at some of these toxic effects.

Side effect

A side effect is an effect or action of a drug other than the one for which it is given or intended. The primary action of a drug may be therapeutic for a medical or dental condition. Yet it may have a side effect which is not the effect expected in treating that condition. Antihistamines are a good example of this process. They are administered for their decongestant action. However, they can also cause drowsiness, an often unwanted side effect of the drug.

Antagonistic effect

An antagonistic effect occurs, when two or more drugs administered to a patient act against each other. That is, one counteracts or neutralizes the other in its effect on an organ or tissue. When this occurs they are said to be *antagonistic* toward one another. Sometimes antagonistic effects are desirable and some drugs are highly valued for their antagonistic effects. For example, a doctor may use Narcan (a narcotic antagonist) to counteract the respiratory depression of narcotics.

Synergistic effect

Synergistic means "working together." In terms of drugs, the synergistic effect refers to the enhancing effect one drug has on another. In the treatment of certain types of dental pain, the combined effects of acetaminophen and codeine are far greater than either when taken separately. Naturally, the synergistic effect of any combination of drugs is effective only when an organism is susceptible to their combined action.

Cumulative effects

Some drugs are processed and excreted so slowly that the body has not eliminated one dose before the next dose is given. In this way, the drug accumulates in certain body tissues and its effects are continual. Sometimes this effect is desired to maintain long-term medication. Drugs such as iodides and digitalis can have this cumulative effect. However, with some medications, a possible toxic effect can occur if administration continues. Ideally, the therapeutic level is maintained without reaching the toxic level.

Idiosyncrasy

Idiosyncrasy refers to an unexpected response to a drug, an effect that differs from that which the drug normally causes. For example, occasionally a patient becomes excited after an injection of morphine, whereas sedation is the more common response. Idiosyncratic effects usually differ among individuals. You should be alert to the possibility that a patient is not responding to a drug in the usual or "normal" manner.

Drug tolerance

Tolerance is an acquired resistance to a drug. In this situation the effective dosage level has to be progressively increased to attain the same result produced by the original dose. Addictive drugs are typical examples of the effects of drug tolerance. Someone addicted to a drug, a narcotic for instance, must keep increasing the amount of the narcotic he or she takes to obtain the same result.

Psychological dependence

Psychological dependence describes the state of mind in which a person believes he or she is unable to maintain optimum performance without taking a drug or substance. Psychological dependence can vary in severity from mild desire, such as a morning cup of coffee, to compulsive obsession such as the next heroin dose. A person can develop tolerance to and physical dependence on a drug with prolonged self-administration. The desire for the drug or substance may produce anxiety, depression, and nervousness. Some people can develop psychological dependence to almost anything. Tobacco, coffee, alcohol, amphetamines, and tranquilizers are common examples of substances associated with psychological dependence.

Physical dependence

Physical dependence refers to the altered physiologic state resulting from constantly increasing drug concentrations. Physical dependence is often discovered by the occurrence of withdrawal symptoms that occur when the drug is discontinued because the body cannot function without the drug. Narcotic analgesics such as morphine and heroin, and sedative-hypnotic drugs, such as barbiturates, cause a physical dependence on the drug with continued use.

Hypersensitivity

Hypersensitivity usually refers to the body's allergic reaction to a drug. Hypersensitivity in its severe form is known as *anaphylactic* (ane-e-fe-'lak-tik) reaction. There are four different types of hypersensitivity: redness of the skin, rash, large welts, and swelling. Signs of hypersensitivity can range from a mild skin rash to a life-threatening reaction (anaphylaxis).

Overdose

An overdose is an undesirable effect caused by an excessive amount of a drug in the body. When a drug overdose causes poisoning it is called a *toxic* dose. One that causes death is called a *lethal* dose.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

417. Common methods of drug administration

1. Name the five methods of administering drugs commonly used by the dental service.
2. Define the topical method of drug administration.
3. Why is oral administration of a drug the simplest and easiest method?
4. What types of highly volatile drugs are used in the dental setting? What method of administration is used for them?
5. What is the usual vehicle for injected drugs?

6. When using the intramuscular injection method, why is the drug action slow and prolonged?
7. What is accomplished by the addition of a vasoconstrictor or the use of oil as the vehicle in medications to be injected intramuscularly?
8. Why is it important not to inject into a blood vessel when giving an intramuscular injection?
9. What injection method is used when a quick response to a drug is desired?
10. What are suppositories?
11. What factors does the dentist consider to determine the appropriate method of drug?

418. Local and systemic drugs

1. What is local drug action?
2. What is systemic drug action?
3. Match the drug action in column B with the statements describing the action in column A.

| <i>Column A</i> | <i>Column B</i> |
|--|-----------------|
| ____ (1) This action decreases the cell function. | a. Depression. |
| ____ (2) The activity of a tissue or organ is increased. | b. Replacement. |
| ____ (3) It is a therapy of substitution. | c. Stimulation. |

419. Drug toxicity

1. Match the toxic drug effect in column B with its description in column A.

| <i>Column A</i> | <i>Column B</i> |
|---|------------------------------|
| ____ (1) A drug is excreted so slowly that one dose has not been completely eliminated by the body before the next dose is given. | a. Side effects. |
| ____ (2) Two drugs having an opposite effect on an organ, tissue, or to each other. | b. Overdose. |
| ____ (3) An allergic action of the body to a drug. | c. Antagonistic effects. |
| ____ (4) A state of mind in which a person believes he or she is unable to maintain optimum performance without a drug or substance. | d. Synergistic effects. |
| ____ (5) An effect or action of a drug other than that for which it is given or intended. | e. Cumulative effects. |
| ____ (6) An undesirable effect due to an excessive amount of a drug in the body. | f. Idiosyncrasy. |
| ____ (7) Enhancing effects of one drug on another. | g. Tolerance. |
| ____ (8) Acquired resistance to a drug in which the effective dosage has to be progressively increased to obtain the same result as that produced by the original dose. | h. Psychological dependence. |
| ____ (9) Unexpected response to a drug. | i. Physical dependence. |
| ____ (10) Ability of a drug to alter the physiological process within the body. | j. Hypersensitivity. |

2. How is a physical dependence of a drug often discovered?

3. What types of drugs will cause physical dependence? How?

4. What is the most severe form of hypersensitivity?

5. What can a drug overdose cause?

2-3. Therapeutic Agents and Aids

Therapeutics is the science and art of healing. Therapeutic agents are those drugs used to treat diseases. These agents may be known by more than one name—they may be identified by a brand name (proprietary or trade name), a generic name (nonproprietary name), or by both. In addition to brand and generic names, drugs are also classified according to their use, source, or chemical similarities. For our purpose, *we will classify them by their use*. It is not our intent to cover all the drugs. Instead, we will cover only a few representative drugs of each class. Before discussing the drugs themselves, let's review the information on drug names.

420. Drug names

Drugs often have several names. When first discovered a drug is given a chemical name, next, a shorthand version of the chemical name or a code name. When approved by the Federal Food and

Drug Administration (FDA) it is given a trade (brand or proprietary) name and a generic (official) name. The selection and use of brand or generic names must conform to the requirements of the FDA.

Brand names

The manufacturer gives a brand or proprietary name to its drugs. These names help distinguish drugs produced by one manufacturer from similar drugs produced by another manufacturer. For example, various drug manufacturers produce tetracycline (an antibiotic) and market them under the names of Achromycin, Panmycin, Polycycline, Stedin, and Tetracyn. Each of these drugs is the same—only their brand names are different.

Generic names

The official name of a drug is its *generic* name. For example, *tetracycline* is the official (generic) name for Achromycin, Panmycin, Polycycline, Stedin, and Tetracyn. The *United States Pharmacopoeia (U.S.P.)* and the *National Formulary (N.F.)*, the pharmaceutical standards made official by the Food, Drug, and Cosmetic Act, refer to all drugs by their generic name. Further, the Air Force encourages its dentists and physicians to prescribe drugs by their generic names. It is more cost effective for the pharmacy to purchase generic drugs over brand name drugs.

Drug classification

The Council on Dental Therapeutics of the American Dental Association (ADA) annually publishes *Accepted Dental Therapeutics (ADT)*, a compilation of drugs useful in dentistry. For a drug to be listed in the ADT it must have first met the criteria of the council. The ADT contains the description, dosage, pharmacological action, and therapeutic use of each drug. The *Physician's Desk Reference (PDR)* is another source of information. It provides available prescription information on all major pharmaceutical products.

421. Antibiotics

Antibiotics suppress the growth of other organisms (*bacteriostatic*) and sometimes destroy them (*bactericidal*). Some antibiotics are synthetic; however, most antibiotics are substances produced from or by various bacteria, fungi, and actinomyces. There are literally hundreds of antibiotics. Some effects are not beneficial to humans. As with any drug, each antibiotic has its own possible side effect and can, in certain circumstances, cause a disturbance in the normal flora that could result in an opportunistic infection. To be an ideal antibiotic, a substance should meet the following criteria:

- Exhibit selective and effective antimicrobial activity, preferably against several pathogenic microorganisms.
- Have little or no side effect.
- Not disturb any vital organ or its function.
- Not have its effect reduced by the body's fluid, plasma, protein, or enzymes.
- Be soluble in a variety of solvents and be stable.
- Be manufactured at a reasonable cost to the patient.

Penicillin

Penicillin and its semisynthetic derivatives are still the most important of the available antibiotics. It is by far the most common drug used for dental infections. Dramatic results have been obtained from its use, even within its narrow spectrum of use with gram-positive bacteria such as streptococci. Penicillin is not effective in the treatment of infections caused by many gram-negative microorganisms or by viruses and fungi. One essential requirement for the *bactericidal* action of penicillin is that the bacteria actively multiply. Penicillin causes a *lysis* (decomposition) of the bacterium's cell wall and interferes with its assimilation of necessary elements to build a new cell wall. Like any drug, penicillin can have side effects. When a person is allergic to penicillin, erythromycin or clindamycin are the drugs normally used as a substitute.

Tetracyclines

The various types of tetracyclines are very closely related chemically and possess essentially the same antibacterial spectra. These drugs are effective in the treatment of many infections caused by gram-positive and gram-negative bacteria, such as spirochetes and certain rickettsia. However, they are *not* generally considered to be the drug of choice for the majority of oral infections.

Tetracyclines can have adverse reactions. Photosensitivity, hypersensitivity, nausea, vomiting, diarrhea, and blood dyscrasia are a few of the possible complications that have resulted from the use of tetracyclines. Tetracycline use is contraindicated during periods of tooth development because it may produce disfiguring stains on teeth. Tetracyclines also are contraindicated for use with oral contraceptives because they may render the contraceptive ineffective.

Erythromycin

Erythromycin closely resembles penicillin in its spectrum of antibacterial activity. Erythromycin is usually administered orally. If given without a suitable buffer or acid-resistant coating, the drug should be taken a half-hour before or 2 hours after meals. Erythromycin can be used for patients allergic to penicillin.

422. Analgesics and sedative-hypnotic agents

Analgesics are drugs that dull the perception of pain without causing unconsciousness. Usually, analgesics are divided into two groups—narcotic and nonnarcotic analgesics. Sedative-hypnotic agents reduce excitement or produce sleep.

Narcotic analgesics

The narcotic analgesics are used to relieve severe pain. Their primary action is on the central nervous system. They do, however, produce side effects that preclude their long-term use. Morphine sulfate falls into this category. There is probably no drug superior to morphine for the relief of pain. However, morphine is habit forming, depresses breathing, and constricts the pupils of the eyes. These adverse side effects limit its use. Codeine is another narcotic analgesic that has similar side effects. It does, however, have some distinct advantages over morphine. Codeine is less habit forming; it depresses respiration less than morphine; and, when administered with other drugs (Tylenol or aspirin), it increases their effectiveness. Still another narcotic analgesic, meperidine (Demerol), is ideally suited for the relief of pain.

Nonnarcotic analgesics

Nonnarcotic analgesics reduce less severe pain. They primarily act on the peripheral nervous system. Besides their pain-reducing (analgesic) action, most of the drugs in this group also function as antipyretics (fever-reducing agents).

Salicylates (aspirin) are the most representative members of the nonnarcotic analgesic group. They relieve pain and reduce abnormally high body temperature in *febrile* (feverish) patients. As an analgesic, aspirin is an effective drug against mild pain—it has antipyretic and anti-inflammatory effects. However, there is a down side: frequent, large doses of aspirin are likely to produce a condition known as *salicylism*, which is characterized by ringing in the ears, mental confusion, and profuse sweating. Allergies to aspirin are quite common and usually occur in *urticaria* (raised patches and itching of the skin); *edema* (swelling); *anaphylaxis*-like (hypersensitive) reactions. As with other drugs, take care when dispensing aspirin. Ulcer patients, in particular, should not be administered aspirin. Aspirin affects the platelets in the blood, preventing clotting which means it takes longer for a blood clot to form. This may be a problem if surgery or a tooth extraction is planned. Acetaminophen (Tylenol) is a synthetic agent similar to aspirin in both action and dosage. It is antipyretic but is not anti-inflammatory and is useful when patients are allergic to aspirin.

Ibuprofen (Motrin) is another commonly prescribed nonnarcotic. It possesses both antipyretic and anti-inflammatory action. It is also available in nonprescription tablets.

Sedative-hypnotic agents

Often it is necessary to relax the patient or to induce sleep in the treatment of various disorders and diseases. Agents used for these purposes are termed “sedative-hypnotics.” *Sedatives* reduce excitement and activity but *do not* produce sleep. *Hypnotics* produce sleep. The same drug can be either a sedative or a hypnotic, depending on the dose administered. With few exceptions, drugs produce sedation in small therapeutic doses and act as hypnotics when used in larger therapeutic doses. The dose of a particular agent required to produce sleep varies with the physiologic and psychological state of the individual and the environmental situation in which the drug is given. Because of their common quality of counteracting anxiety, sedatives and hypnotics are often called antianxiety drugs. In dentistry, sedatives are used mainly before dental procedures to relieve nervousness and apprehension and in preanesthetic medication, whereas hypnotics are used the night before a surgical operation to promote sleep.

The following drugs are used in most Air Force dental clinics. There may be others that are the personal preference of dentists for use in various dental and surgical procedures.

- Diazepam (Valium) is a fast-acting antianxiety drug. It is usually administered intravenously, alone or in combination with other drugs, for conscious sedation during oral surgery. Valium is chiefly indicated in dental practice as a psychosedative agent or as general anesthesia premedication.
- Pentobarbital sodium (Nembutal) is a short-acting barbiturate. It is effective in treating conditions where mild sedation is desired such as preoperative apprehension and anxiety states. It is administered orally, intravenously, or intramuscularly.
- Medazolam (Versed) is similar to Valium but is more potent. It produces significant post-operative amnesia in most patients.

423. Hemostatics and vasoconstrictors

A patient is scheduled to have their third molars extracted. What type of pain control might the dentist select to prolong the anesthesia and decrease the bleeding around the site? For a patient scheduled to have a crown preparation, what medication will the dentist use to control the bleeding around the preparation prior to the impression? These are examples of situations where you need to understand the effects of a drug or other agents and how they are used to control bleeding, so that you can better assist the dentist. In dentistry two types of agents are used the most for these purposes: hemostatics and vasoconstrictors.

Hemostatics

What comes to mind when you think of hemostatics? If you take the word apart and look at it, you have *hemo-* (blood) and *-static* (not moving). So, the word means that blood is not moving. When a hemostatic agent is used, it acts to stop blood movement. The most common dental hemorrhage problems occur following a tooth extraction. When hemorrhaging occurs, the commonly used local hemostatics are gauze with pressure, vasoconstrictor agents (epinephrine in dental anesthesia), and astringents (Hemodent). In cases where excessive bleeding is secondary to a systemic disorder, the physician prescribes medication (i.e., vitamin K therapy) or withholds medication before treatment (i.e., anticoagulants) to control bleeding from dental procedures.

Among the more common absorbable hemostatics are gelatin sponge, oxidized cellulose, and oxidized regenerated cellulose. The gelatin sponge (Gelfoam) is a pliable surgical sponge material that absorbs and retains blood until it coagulates and forms a firm clot. Oxidized regenerated cellulose (Surgicel) reacts chemically with the blood and leads to rapid coagulation. These products are used to pack sockets following tooth extractions and as a sutured implant in soft oral tissues. Absorbable gelatin sponge is normally absorbed within 4 to 6 weeks. Small amounts of the oxidized cellulose types are absorbed in 2 to 7 days, but large amounts may take up to 6 weeks before total absorption occurs.

Vasoconstrictors

As their name implies, *vasoconstrictors* are drugs that constrict blood vessels. They are particularly effective for constricting the capillaries. *Epinephrine* is the most widely used vasoconstrictor in dentistry. When it's applied to a local area, it may act as a hemostatic agent. Its action is similar to that of a tight rubber band around a blood vessel. As a local vasoconstrictor, its main purpose is to prolong the effect of local anesthetics and minimize bleeding of the tissue. The vasoconstricting action decreases the blood flow in the injection area that, in turn, decreases the absorption rate of the anesthetic. Thus, the slower the anesthetic is absorbed or the longer it stays close to the nerve, the longer its effect. The amount of vasoconstrictor used is determined by the procedure to be accomplished and by the patient's requirement and health history. Some lengthy operations require more prolonged vasoconstriction effect. Sometimes the patient may feel their heart rate increase for a few minutes after a dental injection due to the epinephrine. *Levonordefrin* is another vasoconstrictor that is commonly used in dental anesthetic solutions.

424. Local anesthetics

Anesthetics are drugs that diminish or eliminate the sensation of pain. While analgesics are administered to relieve pain from an existing condition, anesthetics are administered to eliminate the sensation of pain that might be produced by the operative or surgical treatment of a condition. Local anesthetics eliminate sensation by blocking the peripheral pathways of pain impulses (the nerves). In the dental environment both topical and local injection anesthetics are used.

Topical anesthetics

Topical anesthetics are usually applied with a cotton-tipped applicator or aerosol spray. When applied to the area, they produce only superficial anesthesia and are often used before injecting a local anesthetic. They are also used before making impressions, exposing radiographs, and scaling teeth in patients who have an excessive gag reflex. Topical anesthetics may also be used to provide temporary relief of the pain from ulcers, wounds, and other injured areas of the mouth.

Local injection anesthetics

The dental profession uses local injection anesthetics more than any other profession. The intended result of using a local anesthetic is to produce anesthesia in a specific area. This makes them "ideal" for dental procedures. As a general rule, the dentist injects these anesthetics as close as possible to the area nerve fibers. There are many brands of local anesthetics available and most of them work in the same way.

There are two injection procedures used in dentistry: the block and the infiltration. In *block anesthesia* the dentist injects the anesthetic solution in the proximity of a nerve trunk. An example of this technique is the mandibular block where the dentist deposits the anesthetic agent around the inferior alveolar nerve as it enters the mandibular canal. This injection blocks the transmission of impulses along the mandibular nerve forward of the injection site. This injection anesthetizes all mandibular teeth on the side of the injection, but does not cross the midline of the mouth.

The dentist gives *infiltration anesthesia* when it is necessary to anesthetize only a small area of tissue and a minimal number of teeth, or when a nerve block is not desirable. Maxillary teeth and tissues are usually anesthetized by infiltration anesthesia because of the extreme porosity of the maxilla. The dentist injects anesthesia just above the periosteum as close to the position of the apex of the tooth as possible.

Ordinarily, Air Force Dental Service uses two basic injectable anesthetics—lidocaine hydrochloride (HCl) and mepivacaine HCl. Lidocaine HCl (Xylocaine) is available in two forms—ointment for topical use and liquid for injection purposes. The injectable form is available in 1.8 cubic centimeter (cc) carpules (glass-type cartridge) containing a 2-percent solution of lidocaine HCl and varying amounts of vasoconstrictor (typically, 1:100,000 epinephrine).

Mepivacaine hydrochloride (Carbocaine) is available in carpules of 2-percent mepivacaine with a vasoconstrictor, or in 3-percent carpules with no vasoconstrictors. Bupivacaine (Marcaine) is available in carpules of .5-percent with a vasoconstrictor. Marcaine provides long-lasting anesthesia (up to 10 hours), which is suggested for some procedures.

425. Fluoride

Water fluoridation has been shown to reduce the incidence of caries in children and young adults. Fifty years of experience has clearly defined water fluoridation as the most effective and economical public health means of controlling caries. About 65 percent of the United States population drinks water that contains controlled amounts of fluoride. Research has shown that a concentration of 1.0 part per million (ppm) provides optimum caries protection without resulting in fluorosis. *Fluorosis* is a permanent, discoloring of the enamel. Drinking water with an excessive amount of fluoride can be defluoridated, but it's an expensive procedure.

Each Air Force base that has a water treatment facility monitors the fluoride concentration in its drinking water supply daily. The optimum concentration in warm climates may be lower than the 1.0 ppm because of the greater average intake of water; the reverse is true in colder climates. The range of optimum concentrations, based on the average mean daily temperature of an area, can range from 0.7 to 1.2 ppm of fluoride.

Water fluoridation's beneficial effects can be systemic or topical. During tooth formation, dietary (systemic) fluoride is deposited in the developing enamel and incorporated in its crystalline structure. This results in enamel which is less soluble in the acids produced by bacteria that cause caries. There is also a topical benefit afforded to teeth that are formed and erupted. Newly erupted teeth can incorporate fluoride into the surface layer of enamel; and fluoride stimulates the remineralization of incipient carious lesions.

Fluoride supplements are an alternative to water fluoridation when the fluoride concentration is well below optimal for an area. Chewable tablets or drops can be administered to children by prescription based on age and fluoride concentration of the drinking water. Note that milk inhibits the absorption of fluoride from the stomach. For this reason milk should not be given immediately before, during, or after fluoride supplementation. Parents and children should be advised of this precaution when fluoride supplements are prescribed.

Professionally (office) applied topical fluorides also are used to prevent caries. Topical fluorides benefit the teeth only after eruption. They are supplied in solutions, gels, or foam and usually applied by a styrofoam tray. Only 1.23 percent acidulated phosphate fluoride (APF) and 1.23 percent neutral fluoride (NaF) are generally used, with fluoride varnishes gaining popularity. Polishing pastes also can contain fluoride, but this form is *not* approved for therapeutic purposes. Remember that teeth are only polished to remove stains. Every time the tooth is polished the surface fluoride is removed from the enamel. A topical fluoride treatment should be completed each time the teeth are polished.

Other vehicles for fluoride application are dentifrice or toothpaste, fluoride rinses, and home-use fluoride gel. Multiple, low-doses of fluoride offered by daily applications of an approved dentifrice are more beneficial than single, high-doses (topical fluorides). Although water fluoridation has been employed for more than 50 years, most researches attribute the large reduction of smooth surface caries seen in the last 25 to 30 years to the almost universal use of fluoridated dentifrices. We discuss dentifrices and fluoride rinses in more detail later in this unit.

426. Dentifrices, mouthwashes, and mouth rinses

Throughout the field of medicine and dentistry, various substances are used as aids in the art and science of treating patients. These substances have little or no medicinal value but are simply aids in rendering treatment. This lesson discusses a few of these dental therapeutic aids: dentifrices, mouthwashes, and mouth rinses.

Dentifrices

Dentifrices or toothpastes are therapeutic aids used together with a toothbrush to provide low doses of fluoride and remove plaque. Dentifrices are available in powder, paste, and gel forms. Most dentifrices consist of abrasives, flavoring agents, detergents, and a base vehicle (such as glycerin). All dentifrices have fluoride compounds added with clinically proven benefits. Tests show that some (not all) fluoride toothpastes used regularly actually aid in reducing the incidence of tooth decay.

Some dentifrices produce some undesirable results. These undesirable results are directly related to the coarseness and amount of the abrasives in the toothpaste. For example, some dentifrices are so abrasive that they can scratch tooth enamel and severely erode the tooth structure over time. Although most people desire clean, white teeth, maintaining them by using highly abrasive toothpastes is unwise and can have long term detrimental effects including thermal sensitivity and a “yellowing” of the tooth due to the gradual thinning of the enamel.

There is no single dentifrice that is suitable for all patients; recommendations should be based on individual cases. Desensitizing dentifrices are recommended for patients with hypersensitive teeth. Dentifrices should be selected carefully to meet the particular needs of each patient. You should avoid recommending specific brands and limit recommendations to fluoridated dentifrices with the ADA seal of acceptance.

Antimicrobial mouthwashes

Cepacol, Scope, and Listerine are just a few brand-name, over-the-counter antimicrobial mouthwashes. Chlorohexidine (Peridex) is available by prescription only. Recent studies have proven that Chlorohexidine and Listerine inhibit plaque and reduce gingivitis when used as prescribed.

Anticariogenic mouth rinses

Anticariogenic mouth rinses differ from the antimicrobial mouthwashes in that they contain fluoride. In essence, every time you use them you are getting a “mini” fluoride treatment. Their benefits are realized with extended and regular use. They are not designed to replace the professional topical fluoride treatment, but rather to serve as adjuncts to fluoride therapy administered in the dental office and for high risk caries patients.

427. Other therapeutic agents

Numerous other therapeutic agents are used in dentistry. Some used are antisialogogues, antihistamines, solvents, and phenolic compounds.

Antisialogogues

Antisialogogues are drugs that reduce the flow of saliva. These drugs are sometimes used on patients who secrete an excessive amount of saliva. Using an antisialogogue allows the dentist to complete dental procedures without the problem of moisture contamination from saliva. Antisialogogues are used only on patients having severe salivary problems. Besides dry mouth, they also cause drying of the throat and make speaking difficult. *Atrophine sulfate* and *scopolamine* are representatives of the antisialogogues used in dentistry.

Antihistamines

Antihistamines are used to combat the body’s allergic reactions to certain agents such as pollen, bee stings, and drugs. Medically, antihistamines are prescribed to counteract conditions such as hives, seasonal hay fever, and drug reactions. In dentistry, antihistamines are generally used to counteract the body’s allergic reaction to a drug used during dental treatment. For example, a patient having a mild reaction to a local anesthetic would probably be administered an antihistamine drug. Antihistamines may produce such side effects as drowsiness, dizziness, and disturbance of body coordination. Benadryl is the most frequently used antihistamine for such allergic reactions. Benadryl can also be used as a local anesthetic for those patients who are allergic to all other anesthetics.

Besides Benadryl, the antihistamines with the brand names Chlor-Trimeton and Pyribenzamine are representatives of the group.

Solvents

Solvents are substances that are used to dissolve other substances. In dentistry, solvents are used for cleaning purposes and helping with treatments. Common solvents used for cleaning purposes in dental clinics are orange oil, alcohol (ethyl alcohol), and isopropyl alcohol. The orange oil dissolves zinc oxide and eugenol materials from the hands and face. Alcohols dissolve a variety of substances found on instruments, cabinet tops, etc. Alcohols in combination with other compounds are also used as disinfectants; however, *alcohol by itself is an unacceptable disinfectant*. Eucalyptol is a solvent sometimes used to aid in treating root canals. It is effective in partially dissolving and softening gutta-percha points before they are inserted as root canal filling materials.

Phenolic compound

Phenolic compounds are used in dentistry for their antiseptic and disinfecting qualities. Camphorated parachlorophenol is the most commonly used phenolic compound. It is used during endodontic procedures to sterilize root canals. Also representative of this group are creosote and thymol. Creosote disinfects root canals during endodontic procedures.

NOTE: Phenol (carbolic acid), itself, is a caustic material. When it is used in any strength, you should have a 50 percent solution of alcohol available to neutralize it in case an accident occurs. Misplaced or spilled phenol could cause severe acid burns to soft tissues.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

420. Drug names

1. Who establishes brand names for drugs?
2. What is the official name of a drug?
3. Which two books refer to all drugs by their generic names?
4. Where can you find a compilation of drugs used in dentistry?

421. Antibiotics

1. Name the six qualities desired for an ideal antibiotic.
2. What is an essential requirement for bactericidal action of penicillin?

3. When is the use of tetracycline contraindicated? Why?
4. Erythromycin can be used for what type of patient?

422. Analgesics and sedative-hypnotic agents

1. What is the function of analgesics?
2. Which group of analgesics is used to relieve severe pain?
3. What drug is usually thought to be best for the relief of pain?
4. What adverse side effects limit the use of morphine?
5. How does codeine compare to morphine?
6. Which narcotic analgesic is almost ideally suited for pain relief?
7. Which group of analgesics is used to reduce less severe pain?
8. What group of drugs is most representative of the nonnarcotic analgesic group?
9. In addition to relieving pain, what other beneficial effect is provided by salicylates?
10. What condition is likely to be produced by frequent large doses of aspirin? Describe the characteristics of this condition.
11. For what type of patients is the use of aspirin contraindicated?

12. When would acetaminophen be the drug of choice over aspirin?
13. What drug, other than aspirin, is a nonnarcotic analgesic that possesses both antipyretic and anti-inflammatory action?
14. What is the purpose of sedatives and hypnotics?
15. Explain how the same drug can be either a sedative or a hypnotic.
16. How are sedatives and hypnotics mainly used in dentistry?
17. What drug is chiefly indicated in dental practice as a psychosedative agent or as general anesthesia premedication?
18. What drug is effective in treating conditions where mild sedation is desired, such as preoperative apprehension and anxiety states?
19. What drug is similar to Valium but is more potent?

423. Hemostatics and vasoconstrictors

1. For what purpose is a hemostatic agent commonly used in dentistry following a tooth extraction?
2. Name the more common absorbable hemostatics used in dentistry.
3. In what two ways are absorbable hemostatics used in dentistry?
4. How long does it take for absorbable hemostatics to be absorbed?
5. What is the purpose of vasoconstrictors?

6. What is the most widely used vasoconstrictor in dentistry? Name an alternate.
7. What effect does epinephrine have on local anesthetic?
8. Explain the vasoconstricting action.

424. Local anesthetics

1. Explain the difference between analgesics and anesthetics?
2. How are topical anesthetics usually applied? What are their uses?
3. What is the intended result of using local anesthetics?
4. Where does the dentist inject the anesthetic solution in block anesthesia?
5. When does the dentist use infiltration anesthesia?
6. What are the two basic kinds of injectable anesthetics used in the Air Force Dental Service?
7. When is the use of Bupivacaine (Marcaine) indicated?

425. Fluoride

1. What concentration of fluoride in drinking water provides optimum caries protection without resulting in fluorosis, a discoloring of the enamel?
2. Why is the prescribed concentration of fluoride in the water supply of warmer bases lower than that of colder climates?

3. In terms of parts per million, what is the desired range of fluoride concentrations in the water supply systems?
4. Explain how the beneficial effects of water fluoridation can be systemic or topical.
5. What is the alternative method of administering fluoride when fluoride concentration is well below optimal for that area?
6. What precautions should parents and children be advised of regarding fluoride supplements?
7. What are other vehicles for fluoride application?

426. Dentifrices, mouthwashes, and mouth rinses

1. Define dentifrices.
2. What is contained in most dentifrices?
3. To what are the undesirable results of some dentifrices related? Give an example of the results.
4. Explain how to recommend dentifrices.
5. What affects do antimicrobial mouthwashes have?
6. For what are anticariogenic mouth rinses designed?

427. Other therapeutic agents

1. What drugs are useful in dentistry to reduce excessive secretions of saliva?

2. Give two reasons that antisialogogues are used only on dental patients with severe salivary problems.
3. Name two representative antisialogogues used in dentistry.
4. Why are antihistamines used? How are they generally used in dentistry?
5. Why would you use Benadryl?
6. What side effects may antihistamines produce?
7. For what two general purposes are solvents used in dentistry?
8. Name three common solvents used for cleaning purposes in dental clinics.
9. What solvent is suitable for partially dissolving and softening gutta-percha points before they are inserted as root canal filling materials?
10. What are the uses of the phenolic compounds, camphorated parachlorophenol, and creosote?
11. What should you have available as a neutralizer when you are using phenol?

Answers to Self-Test Questions

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1. Anything that occupies space and has weight or mass is matter.
2. Mass.
3. Energy.
4. It is changed from one form to another.
5. Solids, liquids, or gases.
6. A change in temperature or pressure easily pushes the particles farther apart or closer together.

7. Liquids have a definite volume at a given temperature and take the shape of the container in which they are placed.
8. They may expand or contract slightly upon normal heating or cooling.
9. If temperature and pressure are altered sufficiently.
10. The form that it is normally found in under ordinary conditions.
11. Freeze, melt, evaporate, condensation, and sublimation.
12. (1) b.
(2) a.
(3) a.
(4) b.
(5) b.
(6) a.
(7) a.
(8) b.
(9) b.
13. Volume and weight.
14. Length.
15. 10.
16. Water.
17. Length.
18. Volume.
19. Gram.
20. (1) c.
(2) b.
(3) a.
(4) c.
(5) b.
(6) a.
21. Use the first letter of the prefix and the first letter of the unit. Millimeter (mm), milliliter (ml) and milligram (mg), and dekameter (dm), hectometer (hm) and kilometer (km).
22. In increments of 1 degree.
23. $\frac{5}{9}$ the size.

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1. (1) Acids—substances containing hydrogen that donate hydrogen ions in solution.
(2) Bases—proton acceptors; when dissolved in water, they form negative OH ions.
(3) Salts—ionic compounds formed by the replacement of part or all of the acid hydrogen of an acid by a metal or a radical acting like a metal.
2. Acids are usually classified protonic according to the number of protons they release or donate. Bases are usually classified according to the number of protons they accept.
3. Acids have a sour taste, neutralize bases to form salts, react with some metals to form salts, and are usually soluble in water.
4. Bases have a bitter taste in solution, feel slick and slippery like soap, and react with acids to form salts.
5. (a) Presence of hydrogen.
(b) A scale from 0 to 14 used to related changes in hydrogen concentration.
(c) Solution that does not change pH when a large amount of hydrogen or hydroxyl ions is added.
6. (a) 7.

- (b) From 7.1 to 14.
- (c) Between 0 and 6.9.
- 7. 5.5.
- 8. Buffers neutralize the acids formed by bacteria. When the buffering capacity of the saliva is overwhelmed, acids accumulate lowering the pH which can start demineralization.

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- 1. (1) Topical.
 - (2) Oral.
 - (3) Inhalation.
 - (4) Injection.
 - (5) Rectal.
- 2. Applying the drug to the surface of the skin or mucous membrane to produce a local effect.
- 3. Because it is painless, requires no special apparatus, and produces a systemic effect in a short period of time.
- 4. Ether, nitrous oxide, or oxygen. Inhalation.
- 5. Normal saline.
- 6. With this method a pool of medication is deposited in the muscle and slowly absorbed into the blood stream.
- 7. This delays absorption and further prolongs the drug's action.
- 8. Injecting into a blood vessel results in a more rapid absorption of the medication than desired or intended. This could be dangerous since the rapid absorption would place too much of the drug in the patient's system at one time.
- 9. Intravenous.
- 10. A medicated solid body intended for introduction into different orifices of the body.
- 11. The effect desired, the rapidity of the action needed, the nature and amount of the drug to be given, and the physical condition of the patient.

418

- 1. The effect that a drug or medication produces at the point or area of application or introduction.
- 2. The action of a drug on some tissue or organ remote from the site of introduction. Such action occurs only after the drug has been absorbed or it has entered the vascular system.
- 3. (1) a.
 - (2) c.
 - (3) b.

419

- 1. (1) e.
 - (2) c.
 - (3) j.
 - (4) h.
 - (5) a.
 - (6) b.
 - (7) d.
 - (8) g.
 - (9) f.
 - (10) i.
- 2. When withdrawal symptoms occur when the drug is discontinued because the body cannot function without the drug.

3. Narcotic analgesics, such as morphine, heroin, and sedative-hypnotic drugs, such as barbiturates. With continued use.
4. Anaphylactic reaction.
5. A toxic dose causes poisoning. A lethal dose causes death.

420

1. The manufacturer of the drugs.
2. Its generic name.
3. The *United States Pharmacopoeia (U.S.P.)* and the *National Formulary (N.F.)*.
4. *Accepted Dental Therapeutics* and *Physician's Desk Reference*.

421

1. (1) Exhibit selective and effective antimicrobial activity.
(2) Have little or no side effect.
(3) Not disturb any vital organ or its function.
(4) Not have its effect reduced by the body's fluid, plasma, protein, or enzymes.
(5) Be soluble in a variety of solvents and be stable.
(6) Be manufactured at a reasonable cost to the patient.
2. That the bacteria actively multiply.
3. Their use is contraindicated during periods of tooth development because they may produce disfiguring stains on teeth. They are also contraindicated for use with oral contraceptives because they may render the contraceptive ineffective.
4. It is used with a penicillin-allergic patient.

422

1. They dull the perception of pain without causing unconsciousness.
2. Narcotic analgesics.
3. Morphine.
4. It is habit forming, depresses breathing, and constricts the pupils of the eyes.
5. It is less habit forming, depresses respiration less than morphine, and when administered with other drugs (Tylenol or aspirin), it increases their effectiveness.
6. Meperidine (Demerol).
7. Nonnarcotic analgesics.
8. Salicylates (Aspirin).
9. Antipyretic (fever reducing) and anti-inflammatory.
10. Salicylism. Ringing in the ears, mental confusion, and profuse sweating.
11. Those with ulcers.
12. When the patient is allergic to aspirin.
13. Ibuprofen (Motrin).
14. To relax the patient or induce sleep.
15. Drugs produce sedation in small therapeutic doses and act as a hypnotic in larger therapeutic doses.
16. Sedatives are used before dental procedures to relieve nervousness and apprehension and in preanesthetic medication, where as hypnotics are used the night before a surgical operation to promote sleep.
17. Diazepam (Valium).
18. Pentobarbital sodium (Nembutal).
19. Medazolam (Versed).

423

1. To stop the hemorrhage of blood.
2. Gelatin sponge, oxidized cellulose, and oxidized regenerated cellulose.

3. To pack sockets and as a sutured implant in soft tissues.
4. Absorbable gelatin sponge—within 4 to 6 weeks; small amounts of oxidized cellulose types—in 2 to 7 days; large amounts up to 6 weeks before total absorption occurs.
5. To constrict blood vessels.
6. Epinephrine. Levonordefrin.
7. Prolongs its effects.
8. It decreases the blood flow in the injection area which decreases the absorption rate of the anesthetic. The slower the anesthetic is absorbed or the longer it stays close to the nerve, the longer its effect.

424

1. Analgesics are administered to relieve pain from an existing condition. Anesthetics are administered to eliminate the sensation of pain that might be produced by the operative or surgical treatment of a condition.
2. Cotton-tipped applicator or aerosol spray. Before injecting a local anesthetic and prior to making impressions, exposing radiographs, and scaling teeth in patients who have an excessive gag reflex.
3. Produce anesthesia in a specific area.
4. Around a nerve trunk.
5. When it is necessary to anesthetize only a small area of tissue and a minimal number of teeth, or when a nerve block is not desirable.
6. Lidocaine hydrochloride (Xylocaine) and mepivacaine hydrochloride (Carbocaine).
7. For some procedures needing long-lasting anesthesia (up to 10 hours).

425

1. 1.0 ppm.
2. The average daily water intake in warm climates is greater.
3. 0.7 to 1.2 ppm.
4. During tooth formation, systemic fluoride is deposited in the developing enamel and incorporated in its crystalline structure resulting in a combination, which is less soluble in acids produced by bacteria that cause caries. The topical benefit is afforded to teeth that are completely formed and erupted. Newly erupted teeth incorporate fluoride into the surface layer of enamel, and fluoride stimulates the remineralization of incipient carious lesions.
5. Fluoride supplements.
6. Milk inhibits the absorption of fluoride from the stomach and should not be given immediately before, during, or after supplementation.
7. Dentifrice or toothpaste, fluoride rinses, and home-use fluoride gel.

426

1. Therapeutic aids used in conjunction with a toothbrush to provide low doses of fluoride and remove plaque.
2. Abrasives, flavoring agents, detergents, and a base vehicle (such as glycerin). All dentifrices have fluoride compounds.
3. The abrasive quality of the dentifrice. The abrasiveness of some available dentifrices is so high that they can scratch tooth enamel and severely erode the tooth structure over time.
4. Recommendations should be based on individual cases. For example desensitizing dentifrices are recommended for patients with hypersensitive teeth. Recommend fluoridated dentifrices that have the ADA seal of acceptance and avoid recommending specific brands.
5. Recent studies have shown that some of these mouthwashes have proven to inhibit plaque and reduce gingivitis when used as prescribed.
6. To serve as adjuncts to fluoride therapy administered in the dental office and for high risk caries patients.

427

1. Antisialagogues.
2. They make the mouth dry, and cause dryness of the throat, which makes speaking difficult.
3. Atropine sulfate and scopolamine.

4. To combat the body's allergic reaction to certain agents. Used to counteract conditions such as hives, seasonal hay fever, and drug reactions.
5. Allergic reactions.
6. Drowsiness, dizziness, and disturbance of body coordination.
7. Cleaning and helping treatment.
8. Orange oil, alcohol (ethyl alcohol), and isopropyl alcohol.
9. Eucalyptol.
10. Use for their antiseptic and disinfecting qualities.
11. 50 percent solution of alcohol available to neutralize it in case an accident occurs.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

36. (415) Anything that occupies space and has weight or mass is an example of
- energy.
 - gravity.
 - matter.
 - volume.
37. (415) The degree to which the particles are packed together and, therefore, are almost free to move about determines the
- physical changes.
 - identity of matter.
 - properties of matter.
 - physical state of matter.
38. (415) Which form of matter has a definite volume at a given temperature, but *not* a fixed shape?
- Gas.
 - Solid.
 - Liquid.
 - Energy.
39. (416) What substance is classically defined as containing hydrogen and donating hydrogen ions in a solution?
- Salts.
 - Acids.
 - Bases.
 - Hydroxyls.
40. (416) Substances with properties such as a bitter taste in a solution and feeling slick and slippery like soap are called
- salts.
 - acids.
 - bases.
 - buffers.
41. (416) Readings from 7.1 to 4 on the pH scale are
- increasingly acidic.
 - decreasingly acidic.
 - increasingly alkaline.
 - decreasingly alkaline.
42. (416) Solutions with the pH value of 7 are considered
- acids.
 - bases.
 - buffers.
 - neutral.

43. (417) Which method of drug administration refers to application of a drug to the surface of the skin or mucous membrane to produce a local effect?
- a. Inhalation.
 - b. Injection.
 - c. Topical.
 - d. Oral.
44. (417) What type of inhalant is often used in the dental clinic to revive patients who experience syncope?
- a. Ether.
 - b. Oxygen.
 - c. Ammonia.
 - d. Nitrous oxide.
45. (418) A drug that *decreases* the ability of the respiratory center is called a
- a. replacement.
 - b. depressant.
 - c. stimulate.
 - d. irritant.
46. (418) The use of an estrogen for a nonavailable normal hormone is what type of systemic drug action?
- a. Replacement.
 - b. Stimulation.
 - c. Depression.
 - d. Irritation.
47. (419) What type of effect occurs when drugs work together to enhance the effect of one drug on another?
- a. Side.
 - b. Synergistic.
 - c. Antagonistic.
 - d. Idiosyncrasy.
48. (419) What type of drug effect is described as an unexpected response that differs from what is normally seen?
- a. Idiosyncrasy.
 - b. Antagonistic.
 - c. Synergistic.
 - d. Side.
49. (419) An *acquired resistance* to a drug in which the effective dosage level has to be progressively increased to attain the same result as produced by the original dose is called
- a. habituation.
 - b. drug addiction.
 - c. drug tolerance.
 - d. hypersensitivity.
50. (419) A drug that alters the *physiological* state within the body has what effect?
- a. Side.
 - b. Antagonistic.
 - c. Physical dependence.
 - d. Psychological dependence.

51. (420) A source of information that provides prescription information on major pharmaceutical products *best* describes
- Accepted Dental Therapeutics (ADT).
 - Accepted Dental Remedies (ADR).
 - Physician's Desk Reference (PDR).
 - ADT and ADR.
52. (421) To avoid stains on teeth, what drug is *contraindicated* during periods of a patient's tooth development?
- Penicillin.
 - Tetracycline.
 - Streptomycin.
 - Chloromycetin.
53. (422) Which agents are *most* effective when used for less severe type of pain?
- Sedatives.
 - Hypnotics.
 - Narcotic analgesics.
 - Nonnarcotic analgesics.
54. (422) How can the same drug be used either as a sedative or a hypnotic?
- It only produces sedation in larger therapeutic doses.
 - It acts as a hypnotic only in smaller therapeutic doses.
 - It produces sedation in larger therapeutic doses and acts as a hypnotic in smaller therapeutic doses.
 - It produces sedation in small therapeutic doses and acts as a hypnotic in larger therapeutic doses.
55. (423) What effect does *epinephrine* have on local anesthetic?
- Decreases blood supply in injection area, decreases the absorption rate of the anesthetic, and increases its effect.
 - Increases blood supply to injection area, increases the absorption rate of the anesthetic, and decreases its effect.
 - Decreases blood supply in the injection area and decreases the anesthetic's effect.
 - Increases blood supply to injection area and increases the anesthetic's effect.
56. (424) Drugs used before making impressions, exposing radiographs, and scaling teeth in patients who have an excessive gag reflex are examples of
- analgesics.
 - antisialagogues.
 - local anesthetics.
 - topical anesthetics.
57. (424) Which local anesthetic is available with *no* vasoconstrictors?
- Marcaine.
 - Xylocaine.
 - Carbocaine.
 - Bupivacaine.
58. (424) What local anesthetic provides long-lasting anesthesia?
- Lidocaine.
 - Carbocaine.
 - Bupivacaine.
 - Mepivacaine.

59. (425) The fluoride content of drinking water in southern states as compared to that in northern states should be
- a. the same.
 - b. slightly higher.
 - c. somewhat lower.
 - d. significantly higher.
60. (425) What *inhibits* the absorption of fluoride from the stomach?
- a. Starches.
 - b. Sugars.
 - c. Food.
 - d. Milk.
61. (426) What dentifrices should you recommend to patients?
- a. Specific brands only.
 - b. One dentifrice for all patients.
 - c. Desensitizing dentifrices to all patients.
 - d. Fluoridated dentifrices with the ADA seal.
62. (426) Therapeutic aids that have proven to inhibit plaque and reduce gingivitis when used as prescribed, are examples of
- a. mouthwashes.
 - b. mouthrinses.
 - c. antimicrobial mouthwashes.
 - d. anticariogenic mouthrinses.
63. (426) *Anticariogenic* mouthrinses are
- a. necessary for all patients.
 - b. the same as antimicrobial mouthwashes.
 - c. designed to replace professional applied fluoride.
 - d. adjuncts to fluoride therapy administered in the dental office.
64. (427) What neutralizer should be available when using Phenolic compounds?
- a. 0 percent solution of alcohol.
 - b. 30 percent solution of alcohol.
 - c. 50 percent solution of alcohol.
 - d. 70 percent solution of alcohol.

Student Notes

Unit 3. Dental Materials

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THE SUCCESS OF ANY dental procedure depends on the quality and handling of dental materials. These materials enter the supply system from the manufacturer and eventually get to your dental clinic. There, the responsibility for properly using them rests with you and your dentist. While the dentist oversees every procedure, he or she relies on you to prepare the materials properly. The dentist looks on you as a professional assistant. In addition, the dentist expects you to have the knowledge and ability to proportion, mix, and assist with the placement of materials. A mistake in any one of these steps can mean the failure of a procedure.

3–1. Factors Affecting Dental Materials

Air Force dental clinic materials are supplied by many manufacturers. These materials have been through many quality-control inspections to assure they are of high quality and meet established standards. Both the American Dental Association (ADA) and federal government set the specification standards for dental materials. Although you can expect dental materials to perform to certain standards, they are *not* fail-safe. Human error and the oral environment may so drastically affect the quality of dental materials used in treatment that the restoration fails in service. When mistakes or oral accidents occur, the patient suffers. Thus, you need to be familiar with the factors that affect dental materials.

428. Handling materials and oral environment demands

You can be sure dental materials arrive as high-quality products. However, there is no guarantee and improper handling during shipment can alter a material's quality. Dental materials are of little or no value unless they are properly handled. While you can't control the conditions the materials are exposed to during shipment, you can ensure they are properly handled once they reach your hands.

Handling of materials

You should not mix together materials from different lot numbers. Why? It's a lot like mixing paint: two cans of paint may have the same brand name, the same ingredients, and the same color listed on

the label but each has a different lot or batch number. In this situation, the professional painter knows that it is next to impossible to obtain an exact color match with paints of different lot numbers. There may be slight differences in the ingredient percentages that affect the drying (setting) time and the resultant texture. The same concept applies to dental materials with different lot/batch numbers. While the outward appearance is the same, with only a difference in batch/lot number, there could be small differences in the proportion of ingredients or other factors that affect the properties of the resulting material.

Not following the manufacturer's instructions for measuring and mixing could also be detrimental. We generally concede the manufacturers know their materials best. Along with each unit (package, box, etc.), the manufacturer sends instructions that briefly explain the use, mixing procedure, mixing time, setting time, and handling characteristics of the material involved. Therefore, it is important to read and follow the manufacturer's instructions before using an unfamiliar product. Let's first consider some demands placed on dental materials (demand factors), the physical structures of the materials, and their properties.

Demands of the oral environment

The mouth is a harsh environment, subjecting dental materials to great forces, abrasion, temperature extremes, and corrosive conditions. Besides resisting these conditions, the materials must:

- Be biologically compatible.
- Be esthetically pleasing.
- Help protect the tooth and oral tissues.
- Restore the natural contours and functions of missing tooth structures.
- Be easily formed and placed in the patient's mouth, despite limited access and poor visibility.

Biting forces

A person with natural dentition applies approximately 170 pounds of biting force in the posterior area of the mouth. This works out to approximately 28,000 pounds of pressure per square inch on a single cusp of a molar tooth. Materials used in restoring chewing surfaces must have sufficient strength to withstand these forces.

Temperature changes

The temperature fluctuations within the mouth can be as great as 100 to 150°F within a matter of seconds: for example, when the individual is drinking hot coffee or eating ice cream. Restorative materials must be able to withstand such radical changes and, as nearly as possible, have the same rate of thermal conduction, expansion, and contraction as does the natural tooth structure.

Acidity

Acidity in the mouth varies greatly. Some foods, such as citrus fruits, are very acidic while others are quite alkaline. In addition, acid is liberated when bacteria act on food debris present in the mouth. Thus, the surfaces of teeth and dental restorations constantly contact the corrosive effects of acid or alkaline substances. In such an environment, nonmetallic materials tend to deteriorate, and even metallic restorations will discolor and corrode.

Esthetic factors

Restorations must resemble the natural dentition as closely as possible. This demands color matching and color stability in addition to materials that can be shaped to resemble dentition or designed to be unnoticeable. Color stability is important because restorations are subjected to many substances that can stain. Chemical action within the oral environment may cause changes within the material itself that will result in discoloration.

Retention

The retention needs of restorations must be met within all of the physical and biological limitations imposed by the oral environment. Retention is complicated because the materials used must be nontoxic, both organic and inorganic matter are involved, the mouth normally has a wet atmosphere, and the preparation surfaces have imperfections, irregularities, and debris. These factors create a complex problem in trying to keep restorations firmly in place. In trying to achieve mechanical retention, it also is necessary to consider the following:

- The differing rates of expansion and contraction of tooth structure and restorative materials.
- The limited amount of tooth structure that may safely be removed.
- The limited amount of stress that abutment teeth and oral tissues can withstand in trying to stabilize a fixed or removable denture. The biological limitations involved also are important.

Biological limitations

The biological characteristics of dental materials are closely related to their physical properties. Materials that possess ideal physical and chemical properties may be unsuitable if they also do not meet the biological limitations imposed by the oral cavity. To meet the biological limitations, a material must be harmless to people and preserve or restore the health of their teeth and oral tissues. A substance that is potentially poisonous would not be suitable as a dental material despite the desirability of its other characteristics. Materials used in the mouth must not irritate the soft and hard tissues. Further, they should be neither mechanically nor chemically damaging, and they should cause no allergic or sensitizing effect. Few dental materials are totally inert or completely harmless to people and dental tissues. For these reasons, all dental materials must be properly used, following the appropriate precautions.

Microleakage

One of the greatest deficiencies found in all the materials used in the restoration of carious lesions is that they do not actually seal the cavity preparation. There is always a microscopic space between the restoration and the tooth. This space permits microleakage which allows fluids, microorganisms, and debris from the mouth to penetrate the outer margins of the restoration. This debris progresses down the walls of the cavity preparation through the dentin and into the pulp. With severe leakage, the pulp is irritated and could cause the tooth to become sensitive or redecay.

Temperature effects

Tooth structure and restorative materials expand and contract at differing rates in response to temperature changes. This means that restorative materials used should expand or contract at or close to the same rate as tooth structure. Consideration must also be given to temperature changes produced by chemical reactions that occur during hardening of restorative materials after insertion.

Metal restorations rapidly conduct heat and cold. Within a matter of seconds, the temperature at the base of a large metal restoration can be the same as that at the surface. The layer of dentin that remains beneath the restoration may be so thin that it is inadequate to insulate the pulp against these sudden temperature changes. This inadequacy can cause injury to the pulp. In such instances, the dentist may provide additional thermal protection by placing a layer of suitable insulation under the restoration.

Galvanism

Another cause of tooth sensitivity is the small electrical currents created when two different metals are located close together in the oral cavity. Because both metals are wet with saliva, an action similar to that in a battery is created. When the two metals touch, an electrical current is created and causes a small shock. A similar effect may occur when the edge of a silver fork touches a metal restoration.

429. Physical properties of dental materials defined

To understand fully the proper manipulation of dental materials and predict how these materials will react under actual use, you must understand some of their basic physical and chemical properties. You also should know how these properties are measured and compared, and how they affect the potential value of the material in relation to the many factors that make demands on dental materials.

Force

Force is any push or pull upon matter. It can be a “tensile force” that pulls and stretches a material, a “compressive force” that pushes it together, or a “shearing force” that tries to slice it apart.

Stress

Stress is the internal reaction or resistance within a body to any externally applied force. It is the reaction or resistance that occurs within a material when a force is applied from the outside. For stress to occur within a material there must be an applied outside force. The greater the applied force, the greater the stress within the material.

When an applied force stretches a material, *tensile stress* occurs. A heavy weight suspended from a metal wire creates tensile stress in the wire and it will increase in length. If the weight is placed on top of a material, a compressive force is established that, in turn, creates a *compressive stress*. The length of the specimen decreases. When an applied force slides one layer of a material past an adjacent layer, *shearing stress* is produced in the material. Scissors also are called shears because they create a shearing stress in the material as one layer of the material is forced to shear past the adjacent layer.

Strain

Strain is the distortion or change produced in a body as the result of stress. The type of strain (distortion) depends on the type of stress involved. Stress is the internal reaction to an external force and strain is the change caused by that stress. The greater the stress the greater the resulting strain. Each type of stress creates an accompanying type of strain. Tensile stress is always accompanied by tensile strain, compressive stress is always accompanied by compressive strain, and shearing stress is always accompanied by shearing strain.

Elasticity

Elasticity is the ability of a body that has been changed, or deformed, under stress to resume its original shape. An object that regains its original shape when stress is removed is elastic. A rubber band is also called an elastic band because it can be stretched (tensile stress), yet it returns to its original shape when you remove the stress. On the other hand, an object that remains permanently changed is *inelastic*. After compressive stress has been placed on a piece of soft butter, it will not return to its original form; therefore, it is inelastic.

The three terms, *elastic limit*, *proportional limit*, and *yield strength* are used interchangeably. They refer to the maximum stress that a structure or material can withstand without being permanently deformed. An elastic material that has been subjected to a stress above its elastic limit will not return to its original shape. A spring strained within its elastic limit returns to its original shape when the stress is removed; however, once you strain the spring beyond its elastic limit, it will not return to its original shape. Knowledge of the elastic limits of dental materials is useful because this allows the dentist to estimate when a given stress will permanently change the shape of a dental restoration or appliance.

Ultimate strength

The greatest stress that a structure or material can withstand without fracture or rupture is known as its ultimate strength or, for the sake of brevity, its strength. If the stress and strains are tensile in type, the stress at fracture is called the *ultimate tensile strength*. If the stresses are compressive in character, then maximum stress is called *ultimate compressive strength*, or crushing strength.

Ductility and malleability

Both ductility and malleability indicate the ability of a metal to be bent, contoured, or otherwise permanently deformed (reshaped). *Ductility* is the ability of a material to withstand permanent deformation under tensile stress without fracture. If a metal or alloy can be formed into a wire (i.e., shaped under tensile strain) it is ductile. *Malleability* is the ability of a material to withstand permanent deformation under compressive stress without rupture. If a metal can be hammered or rolled into a sheet (i.e., shaped under compressive strain) it is malleable.

Flow

Some materials continue to deform permanently under a load, even when the load (stress) is constant. The slow bending of a glass rod under its own weight, when only supported at each end, is an example of this. This change is called *flow*. It also may be called “creep” or “slump.” In dental materials, flow is generally measured under *compressive stress* and used to evaluate the tendency of dental waxes or amalgam alloys to deform under a constant load.

Hardness

For dental purposes, surface hardness is generally measured in terms of its resistance to indentation. One scale used to measure hardness is the Brinell hardness number (BHN) system. In the Brinell test, a small steel ball is pressed against the material to be tested and a predetermined compressive force is applied. After the load is released, the size of the indentation in the material is measured and the results are expressed in terms of the BHN. The harder the material, the smaller the indentation; the smaller the indentation, the higher the BHN number. *The opposite is true of softer materials.* There is also a relationship between hardness and strength in dental alloys—harder alloys are generally stronger as well.

Distortion

Stresses and strains are present whenever a substance is permanently deformed. These stresses cause internal rearrangement of the material’s atomic structure and leave it in a state of tension. With the passage of time, particularly in the presence of heat, the materials tend to relax and the tension is eased. The resulting change in shape or dimension is known as *distortion*.

The phenomenon of *relaxation* and the resulting distortion is very important in dentistry since such dimensional changes could result in the misfit of a precise dental restoration or appliance. For example, dental waxes tend to resume their original shape at room temperature after being bent or molded. The resulting distortion can be very important to the dentist if that wax was used to create a very precise inlay pattern.

Thermal properties

The ability of a material to conduct heat is known as its *thermal conductivity*. It is measured by figuring the rate at which heat can be transmitted through a given cross-sectional area of a specimen of the material (The higher the rate value; the greater the thermal conductivity).

Tooth structure itself is an excellent heat insulator and has a low thermal conductivity. Tooth restorative materials should have as low a thermal conductivity as possible; however, thermal conductivity is only one of many factors that must be considered. In some prosthetic appliances, a high rate of *thermal conductivity* is desirable, so the patient can have a normal sense of hot and cold while eating. A complete denture with a cast metal base is one such example.

Thermal expansion is the rate at which a material expands or contracts with temperature changes. It is usually measured in terms of the linear coefficient of thermal expansion. This is the increase in length of a material per unit length when the temperature is increased by 1°C. If the tooth and restorative material would expand the same amount every time their temperatures changed, there would be little reason to consider thermal expansion. However, for any given temperature change, the linear

coefficients of thermal expansion between materials differ widely, and none of them expand or contract at the same rate as the tooth structure.

Adhesion

Adhesion is the force that causes unlike molecules to attach to each other. It is the “stickiness” that allows tape or glue to stick. In order for adhesion to take place, the materials being joined must be in close contact. This is most often accomplished by applying an adhesive in the liquid state. The adhesive property of liquids involves the interplay of viscosity, wetting, film thickness, and surface tension.

Viscosity refers to the property of a liquid that causes it *not* to flow easily. An example of a viscous liquid is thick or heavy syrup. A highly viscous adhesive does not flow easily and is not as effective in wetting a surface as an adhesive of lower viscosity.

Wetting is the characteristic of a liquid to flow easily over the surface and to come into contact with all of the small irregularities that may be present. The wetting characteristics of an adhesive are generally found by measuring the angle formed by the adhesive when a drop of it is placed on the surface. This measurement is called the *contact angle*. Water placed on a clean surface will flow freely and have a low contact angle with good wetting qualities. Water placed on a waxed surface will form drops, which have a high contact angle and poor wetting qualities. When a liquid has a low contact angle on a solid, the liquid is said to “wet” the solid well. The ideal adhesive would spread into such a thin film that the contact angle would be zero.

Film thickness refers to the thickness of the adhesive films, and this affects the strength of the adhesive junction also. Generally, the thinner the film the stronger the adhesive junction.

Surface tension is related to the composition of the surface of the material, its atomic structure, and other factors. The higher the surface tension, or surface energy, the more readily the adhesive reacts with it. Metals usually have a high surface tension and, therefore, are easy to wet by a suitable adhesive. In contrast, Teflon has a very low surface energy and is used in situations in which sticking is not desirable.

Adhesion and tooth structure

Few conditions essential for adhesion are present in the oral cavity. Enamel and dentin are mixed in their composition which is partly organic and partly inorganic. An adhesive that will adhere to the organic component of the tooth will not be as likely to adhere to the inorganic portion. Thus, adhesion will only occur on isolated sites and will not be uniform over the entire surface. Also, it is difficult to design an adhesive that can flow into the minute imperfections and irregularities that mar the surface of the prepared cavity.

An important factor in adhesion is the presence of moisture. Even when a tooth appears dry, there is always a microscopic, single-molecule layer of water on the tooth surface. This layer prevents the adhesive from coming into intimate contact with the tooth. Other major factors include the differing rates of thermal expansion and contraction between tooth and restorative material and the mechanical stresses created during the pressure of mastication. Together these forces create a severe strain on any adhesive bond that may have formed.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

428. Handling materials and oral environment demands

1. List two ways that dental materials may be improperly handled.

2. What is the first thing that you should do before using an unfamiliar product?
3. List the demands dental materials must meet in the oral environment.
4. What is the average pressure per square inch created from the biting force of a person with normal dentition?
5. What factor causes differing rates of expansion and contraction between tooth structure and restorative materials?
6. What causes acidity in the mouth to vary greatly? What does the effect of acidity have in the mouth?
7. Why is color stability important to materials used for restoration?
8. Why is retention of a dental restoration complicated?
9. What additional factors must be considered when trying to achieve mechanical retention?
10. What biological limitations must a material meet?
11. What is one of the greatest deficiencies found in all of the materials used in the restoration of carious lesions?
12. Explain microleakage. How does it affect the pulp?
13. Explain the temperature effects of a large metal restoration on the pulp.
14. What can be done to protect the pulp from the effects of temperature?

15. In addition to expansion and contraction, what other considerations must be given regarding temperature effects?

16. Describe galvanism.

429. Physical properties of dental materials defined

1. Briefly explain the three types of force that have an influence on dental material.
2. What must occur within a material to produce stress?
3. What is strain?
4. When a body is said to have elasticity, what properties does it exhibit?
5. What three terms refer to the maximum stress that a structure or material can withstand without being permanently deformed?
6. What is ultimate strength?
7. Define ductility.
8. What property does malleability give a material?
9. What change does flow cause in a material?
10. How is flow generally measured in dental materials?
11. What is flow used to evaluate?

12. How is a material's hardness generally measured?
13. How is hardness expressed?
14. What is distortion?
15. Why is the phenomenon of relaxation and the resulting distortion important in dentistry?
16. What is thermal conductivity?
17. When is a high rate of thermal conductivity desirable? Why?
18. Define thermal expansion.
19. What is adhesion?
20. The adhesive property of liquids involves what four factors?
21. Explain viscosity.
22. Define wetting.
23. Explain film thickness.
24. Explain how surface tension and adhesives react.
25. Why does adhesion occur only on isolated sites and will not be uniform over the entire tooth surface?

26. How does the presence of moisture on the tooth structure affect adhesion?

3-2. Restorative Materials

Restorative dentistry is the practice of rebuilding, repairing, or replacing lost dentition. Restorative dentistry accounts for much of the patient treatment performed in a dental clinic. Restorative dental practices can be found in almost all of the general and specialty areas of dentistry. Our discussion of restorative uses of dental materials in this section is limited to insulating materials, cements, composite resins, and amalgam.

Although the dental profession developed many dental materials that are highly desirable, it has not yet developed the perfect restorative (filling) material. Such a material would provide all the qualities of natural tooth structures. To date, one of the problems with these dental materials has been that many possess very poor insulating qualities. Those that insulate against some and possibly all irritants are usually deficient in other restorative properties. The result is the requirement for separate insulating materials.

430. Insulating materials

Insulating materials are used to protect the vital dental pulp from thermal, chemical, electrical, and other possible sources of irritation. Though researchers have been unable to find the perfect insulating material for the dental pulp, several products are considered valuable. While some provide adequate strength, they are inadequate as thermal insulators. Others may be adequate as thermal, electrical, and chemical insulators but inadequate in crushing strength. As a result, the dentist has a variety of insulating materials to choose from and selects the insulator best suited for the particular treatment rendered. The most common insulators, besides zinc phosphate cement, are variations of calcium hydroxide and zinc oxide mixed with eugenol (oil of cloves).

Calcium hydroxide

Pure calcium hydroxide is a fine white powder. It is almost nontoxic and is used by both the medical and dental professions as a protective material. It is widely used in dentistry as a pulp-capping material because it stimulates the production of secondary dentin. It also is used as a base under permanent restorations. This insulating material is available in powder and paste forms; the paste form is either self-curing or light-cured. The powder is sometimes mixed with either sterile water or a local anesthetic to form a paste. The paste forms may or may not require mixing depending on the type. Since the light-cured materials do not require mixing, we will not discuss their purpose and handling here. The self-curing paste forms are either hard- or soft-setting.

Hard-setting type

Hard-setting type (e.g., Dycal) arrives in two tubes—one tube of base paste, one tube of catalyst (to accelerate chemical setting action), and a mixing pad. To mix them, place small, equal portions of base and catalyst on the pad and mix. When mixed, the hard-setting type is used as a rigid base to buttress restorations.

Soft-setting type

The soft-setting type (e.g., Pulpdent) arrives in a paste form and is used for pulp capping in pulpectomy procedures and as a cavity liner under cement bases. This material comes in a single tube so no mixing is necessary.

Zinc oxide and eugenol

A combination of these two ingredients is used in surgical dressings, impression materials, root canal sealing materials, base material under restorations, cementing agents, and temporary or sedative-

filling materials. It is used in surgical dressings because of its soothing effect on tissues and because it possesses mild antiseptic qualities. The major disadvantages of this combination are its low-crushing strength and its solubility in oral fluids. Zinc oxide and eugenol are frequently classified as dental cements and are very good insulating materials.

Manufacturers make zinc oxide and eugenol in paste form for use as pulp protectors or insulating materials. Like the hard-setting type of calcium hydroxide, zinc oxide and eugenol pulp protective paste arrive in two tubes—one of base material and one of catalyst. To prepare a zinc oxide and eugenol paste mix, use equal lengths of material from both tubes. You may mix the two on the small parchment pad supplied. This cement will set to a very hard consistency in 3 to 4 minutes, making it suitable as a base material under restorations.

Cavity liners and varnishes

Cavity liners and varnishes are the least effective of the dental insulating materials. In fact, they are usually *not* classified as insulators at all. In spite of their inefficiency as thermal insulators, cavity liners and varnishes do serve to partially insulate tooth structures from certain chemicals. For example, they are used to support zinc phosphate cement bases and silicate cements. Therefore, cavity liners and varnishes are better known as sealers than as insulators. They seal dentinal tubules exposed during tooth preparation.

Cavity liners are primarily solutions of resins in a solvent, whereas cavity varnishes are solution of varnishes in a solvent. The solvents used in these solutions are volatile and evaporate readily. Because of this property, the solutions become thick after prolonged use and you must add a thinner to return them to a usable consistency. The manufacturer supplies the liners and varnishes in sets, each containing a bottle of the sealer and a bottle of thinner. No mixing is required with this material. The dentist simply moistens a cotton pellet in cavity varnish and applies it to the cavity preparation.

431. Dental cements

A variety of cements have been used in dentistry over the years. Dental cements are a category of dental materials routinely used when working with indirect restorations. Dental cements have distinct characteristics, which vary according to the type of restoration the cement will be used to restore.

Use of dental cements

Dental cements are widely used for specialized dental procedures where strength is *not* a prime consideration. In spite of certain inferior properties, cements possess so many desirable characteristics that they are used in 40 to 60 percent of all restorations. The following are ways dental cements are used:

- Cementing agents for fixed restorations, such as crowns, bridges, and inlays—both temporary and permanent.
- Cementing agents for orthodontic bands.
- Insulating bases to protect against thermal shock under metallic restorations.
- Temporary restorations (i.e., those with a limited life span).
- Sedative treatment materials.
- Capping materials for an exposed pulp or to protect the pulp.
- Root canal fillings.

Cements, although widely used, are far from ideal. They are soft and weak in comparison to metals. Although resin cements are not soft and weak, they do dissolve and erode in the mouth. The same applies to polycarboxylate cements, except they are not adhesive to enamel and dentin under oral conditions. Cements, except for zinc oxide-eugenol and polycarboxylate, may be irritating to the dental pulp. The physical properties of these materials vary considerably from one type to the next, in all cases these properties are controlled almost entirely by the mixing technique.

Zinc phosphate cement

In recent years, many new dental materials have been introduced. Many are widely accepted and have replaced older materials. Although zinc phosphate cement is among the older dental materials, it is still widely used. One reason for its continued use is its wide applicability. Zinc phosphate cement is used as a permanent cementing agent for crowns, inlays, fixed partial dentures, and other dental appliances. It's also used as a temporary restoration and occasionally as an insulating base under amalgam fillings.

Components

Zinc phosphate cement is composed of a powder and liquid. Each component is packaged in a small bottle.

Powder

The exact ingredients of zinc phosphate powder vary from manufacturer to manufacturer, but the chief ingredient in all brands of the powder is zinc oxide. Sometimes, the powder also contains magnesium oxide, silica, bismuth, trioxide, and certain pigments. The different pigments, of course, produce different shades of powder. Air Force dental clinics primarily use light gray and light yellow shades. If you have any doubt about the shade you should mix, ask the dentist.

Liquid

The liquid used with zinc phosphate cement powder is composed of phosphoric acid and water. Zinc phosphate cement liquid also may contain aluminum hydroxide and zinc hydroxide. When the liquid and powder are mixed, the phosphoric acid combines with the zinc oxide to form zinc phosphate. The manufacturer adjusts the water content to provide a suitable setting time. Excessive water in the liquid causes the mix to set rapidly, while too little water causes it to set slowly. To maintain the proper water balance and keep humidity out of the liquid, dispense it immediately before use and recap the bottle promptly. Mixing the powder and liquid yields certain properties that we call combined properties.

Combined properties

Zinc phosphate cement in its combined state possesses some desirable and undesirable properties. In this respect, it is like amalgam. However, the properties of zinc phosphate cement make it more suitable as a cementing agent than as a restorative material.

Desirable properties

The shades of zinc phosphate cement allow it to be used inconspicuously. The cement is easily mixed and manipulated and can be mixed and used in a thin consistency, which gives the cement sufficient flow to form a very thin layer for cementing crowns, inlays, and fixed partial dentures. Zinc phosphate cement also is desirable because it has low thermal conductivity. Consequently, it is used under metallic restorations as an insulator to protect the pulp from the rapid temperature changes that are characteristic of metal restorations.

Undesirable properties

Probably the most significant clinical property of zinc phosphate cement is its solubility and disintegration in the oral environment. Cement solubility can lead to recurrent decay (caries) around crowns and inlays. Cement also is used as an intermediary base for deep cavity preparations and as a cementing agent for crowns, inlays, etc. The acidity of the cement irritates the tooth pulp. As a precaution, then, first apply a cavity varnish to the preparation to seal dentinal tubules and minimize pulpal irritation before using zinc phosphate cement on vital pulp. The comparably low crushing strength of the cement is also undesirable. The crushing strength of a zinc phosphate cement mix of medium consistency is about 12,000 pounds per square inch. The strength of the mix is directly proportional to the amount of powder it contains. Therefore, mix the maximum amount of powder that still yields the desired mix consistency. Zinc phosphate cement shrinks during setting, which also

is undesirable. All these undesirable properties influence its use. It is still, however, widely accepted and used as one of the basic dental materials. As with amalgam, the method of mixing zinc phosphate cement is very important.

Mixing zinc phosphate cement

The best source of information on the proper mixing procedures is the manufacturer's instructions. Generally, the steps include equipment preparation, materials preparation, and the approved mixing technique.

Equipment preparation

You need a clean, cool, dry glass slab and spatula to mix zinc phosphate cement. The #313 and #324 stainless steel spatulas are designed for mixing zinc phosphate cement. You may need to cool them under cold running water before use. Thoroughly dry them before the actual mixing. The temperature of the mixing slab and spatula affects the setting time of the mix. Cooler slab and spatula temperatures lengthen the setting time.

Material preparation

When the dentist indicates zinc phosphate cement will be used, select a matching set of powder and liquid and measure out the powder. To do this, remove the cap and roll the neck of the powder bottle on the glass slab until you have dispensed from $\frac{1}{6}$ to $\frac{1}{4}$ of a teaspoon of powder. The amount of powder depends on the type of mix needed. (We cover this topic later.) The powder is then divided into portions—generally fourths. Then one of the fourth portions is divided in half, and sometimes one of the eighth portions is divided into halves again. This division yields a total of six portions—three $\frac{1}{4}$ -portions, one $\frac{1}{8}$ -portion, and two $\frac{1}{16}$ -portions. Wait until the dentist is ready for you to mix the material before you measure out the liquid. Exposing the liquid to air prematurely can affect the water content and, in turn, affect the setting time of the cement. With the signal to mix, dispense from 3 to 5 drops of liquid and then begin the mixing procedure. (The amount of powder dispensed governs the amount of liquid needed.)

There are two types of zinc phosphate cement mixes. The first mix has a thin to medium consistency. It is used as a cementing agent for inlays, crowns, and other dental appliances. The second type is a thick mix, which is used as a base material under fillings and sometimes as a temporary filling.

Mixing technique

The thickness of the zinc phosphate cement mix depends largely on the amount of powder incorporated. For a cementing-type mix, incorporate one of the $\frac{1}{16}$ -portions and spatulate them over a large portion of the slab; then follow the same pattern with the next $\frac{1}{16}$ -portion, the $\frac{1}{8}$ -portion, and so on, until the desired consistency is reached. A thin-to-medium mix should be completed in approximately 1½ minutes. The consistency of the mix should appear creamy and flow from the spatula. To thicken the mix, add more powder and finish mixing within the 2-minute working time limit. Be sure the mix is homogeneous (of uniform consistency). Always mix zinc phosphate cement over a large area of the slab to dissipate the heat which is generated by the chemical action of the ingredients. If mixing is done improperly and heat is not allowed to dissipate, it will harm the tooth pulp and shorten the setting time.

Several factors influence the setting time (working time) of zinc phosphate cement. The following table summarizes them:

| Factors Influencing Zinc Phosphate Cement Working Time | |
|---|---|
| Shorten | Prolong |
| A warm mixing slab and spatula | A cool, dry slab |
| A moist mixing slab | Evaporation of water from the liquid |
| Rapid mixing | Mixing over a large area of the slab and slow spatulation |
| Dilution of the liquid with moisture from the air | |

432. Other dental cements

Certain other cements are used for specialized purposes in the restorative, endodontic, and orthodontic sections of dentistry. We'll cover five of them: zinc oxide-eugenol, EBA (ethoxy benzoic acid) cements, resin cements, polycarbonate cements, and glass ionomer cements.

Zinc oxide-eugenol cements

Zinc oxide-eugenol (ZOE) cements are probably the most effective materials used as temporary fillings before a permanent restoration is placed in the mouth. The eugenol exerts a palliative (soothing) effect on the pulp of the tooth. Zinc oxide-eugenol cement is *not* used as a permanent restorative material because it has a very low crushing strength (2,500 psi). ZOE cements are also good thermal insulators and may be one of the least irritating of any dental cement. Besides being used as temporary fillings and thermal insulating bases, they are also used sometimes as cementing agents.

The zinc oxide-eugenol cements are usually dispensed in either liquid or powder form. Their composition is essentially the same as that of the impression pastes, except that no plasticizers (used to keep a material soft or pliable) are introduced. Satisfactory ZOE cement can be made with just zinc oxide and eugenol. However, additives can improve the working properties of the cements. Resin acts to improve the cement's consistency and provide smoother mixing. The addition of plastics, such as polymethyl methacrylate and polystyrene, increases the strength of ZOE cement.

Fixed bridges are frequently temporarily cemented with zinc oxide-eugenol cements to reduce postoperative sensitivity while the pulp heals. Because of the relative weakness of this type of cement, the bridge is later cemented permanently with zinc phosphate cement.

EBA cements

Experimentation with additives and ZOE cement led to the formulation of improved or reinforced zinc oxide-eugenol cements. The addition of ortho-ethoxybenzoic acid to the eugenol and quartz or alumina as a filler to the powder results in a composition often called EBA cements. The strength and solubility of EBA cements, though improved, are *not* superior to those of the zinc phosphate cements. However, they are *not* irritating to the pulp and help to eliminate or greatly reduce the postoperative sensitivity associated with zinc phosphate cementation of a restoration.

Resin cements

Resin cements based primarily on polymethyl methacrylate with mineral fillers have been available since 1952. They were not widely accepted mainly because of their short working time and the difficulty of removing excess hardened cement from interproximal spaces and from beneath the free gingival margin. Their principal advantage is that they are virtually insoluble in water. Typically resin cement is used to attach resin-bonded bridges or orthodontic bands to acid-etched enamel. Recent improvements have increased working times and strength, and lowered viscosity. Newer resin cements are even light cured.

Polycarboxylate cements

Polycarboxylate cements are powder-liquid systems in which the liquid is a viscous (thick) aqueous solution of polyacrylic acid and water. The powder is composed of zinc oxide with some magnesium oxide. It also may contain small quantities of calcium hydroxide, fluorides, and other salts that modify the setting time and enhance the manipulative characteristics. The compressive strength of the polycarboxylate cement falls into the range of the reinforced zinc oxide-eugenol cements but is inferior to that of zinc phosphate cements. The solubility of the carboxylate cements is comparable to that of zinc phosphate and the reinforced zinc oxide-eugenol cements. The principal advantage of polycarboxylate cement is that it bonds to both enamel and dentin, improving its overall bond strength in these instances. Also, it is kinder to the pulp than zinc phosphate cement.

Glass ionomer cements

Glass ionomers (e.g., Ketac-cem and Fuji) are the newest dental cements. They are quickly gaining popularity and replacing other cements except ZOE for cementing provisional restorations. Glass ionomers are similar to polycarboxylate cements in that the liquid is an aqueous solution of polymers of acrylic acid. The powder of a glass ionomer is a calcium fluoroaluminosilicate glass. The set cement is structurally like composite resins used for restorative fillings. Glass ionomers are stronger than zinc phosphate cements, and have the added advantage of being anticariogenic due to slow fluoride release. These cements are more difficult to mix and proper measuring of the powder and liquid is essential. Because glass ionomer cements are sensitive to contact with water during the initial setting time, their strength can be improved if they are used in an isolated, moisture-free surrounding. Therefore, you may need to assist the dentist in maintaining a dry-field throughout the cementing process.

433. Composite resins and glass ionomer filling materials

Composite restorative materials are the materials of choice for some restorations. Like the other restorative materials, they have both desirable and undesirable properties. The composite restorative materials are available from many different manufacturers. Some brand name examples are Concise, Herculite TPH®, and Prisma APH®. Each of these materials is different from the other and, therefore, requires special handling. Therefore, we will not cover the mixing procedures for composite filling materials. You should be thoroughly familiar with the manufacturer's instructions for the composite restorative material used in your clinic.

Uses

Composite restorative materials are used primarily for anterior restorative procedures. Because of their high crushing strength they are very suitable for incisal restorations. The ADA has recently approved a limited number of composite resin products for use in the posterior areas, but the products are limited to restorations that are small and conservative.

Components

All composite restorative materials consist of a composite material and a catalyst. The exact ingredients of the various composite materials and their catalysts remain closely guarded secrets of their manufacturer. Composite materials consist of organic binders and inorganic fillers. These binders are modified acrylates that become highly cross linked and binds the mix during setting. The inorganic fillers comprise the bulk (probably 70 percent) of the composite material. Various inorganic materials are associated with the fillers of the different manufacturers. Fiberglass, natural quartz, glass beads, and powdered minerals are some of the fillers used. Most fillers are translucent and can transmit light; a factor that makes color matching more precise since the color of the surrounding tooth structure is reflected in the composite material.

The more common composite materials are supplied as two-paste or one-paste systems. Depending on the manufacturer, these materials are packaged in jars, tubes, or individual units. In the two-paste system, one paste contains a catalyst and the other contains the base. Two-paste systems are always chemically activated resins. In a one-paste system, the catalyst is included with the base and curing is accomplished with the use of an ultraviolet or visible blue light source.

Types of composite resins

There are three types of composite resins available—macrofilled, microfilled, and hybrid. The classification of each product depends on the particle size of its inorganic filler. *Macrofilled* resins have particles ranging from 1 to 5 microns in size. *Microfilled* resins have much smaller particles ranging from .01 to .1 microns. *Hybrid composite* resins have a combination of both macro and micro inorganic fillers. The hybrid type is the most commonly used composite resin as it has many of the desirable physical properties of the other two resin types.

Physical properties

The ideal composite resin would have high strength and be fracture resistant, making it useful for restorations that include the incisal edge. Second, it would have low shrinkage at the margins since shrinkage increases the chance of microleakage and recurrent caries. Third, it would have the same amount of thermal expansion as tooth structure since increased expansion results in increased staining and recurrent caries. Finally, it should be polishable for optimal esthetics. Because the ideal material is seldom available, let's discuss the physical properties of composite resins related to their compositions and how it affects their performance.

Bear in mind that the opposite amount and type of component produces an opposite result:

- Higher amounts of inorganic filler produce resins with increased strength and fracture resistance.
- Lower amounts of organic resin result in lower shrinkage.
- Lower amounts of organic resin decrease thermal expansion.
- Smaller inorganic filler particles produce resins that are more polishable.

The *macrofilled* and *hybrid* resins have higher amounts of inorganic fillers and lower amounts of organic resin than the *microfilled* resins, making them superior to microfilled resins in strength, fracture resistance, thermal expansion, and shrinkage. On the other hand, because *microfilled* resins have a smaller particle size, they are easier to polish than macrofilled resins. Many more recently developed hybrids achieve good polishability and esthetics, one reason for their increased popularity.

Acid etch retention

One of the most effective methods of improving the seal and retention of resin to the cavity walls is treatment of the enamel with an acid before inserting the resin. This procedure, called the acid etch technique, uses a solution of 35 to 50 percent phosphoric acid in either liquid or gel form. The gel allows for easier handling and placement. Handle the etchant with care since it is caustic. After etching the tooth, an unfilled resin, called a bonding agent, is applied. The bonding agent penetrates into the surface irregularities created by the acid and forms resin "tags" that mechanically interlock the resin with the enamel surface. The composite resin is then placed and it bonds to the intermediate layer of the resin bonding agent.

Placement procedures

The placement procedures used with composite filling materials are uncomplicated. The dentist uses a clear plastic matrix strip to partially form and hold the composite in place. The composite material is condensed into the cavity preparation with a stellite, plastic restorative condenser or special syringe. In using light-cured composites, it is important that large buildups be done in increments and exposed to the light beam, ensuring maximum depth of cure. After the material sets, the dentist trims and smooths it until it assumes the contour of the natural tooth. The dentist then places a protective coating over the restoration to protect it from premature exposure to oral fluids.

Glass ionomer filling materials

Glass ionomers (e.g., Ketac-fil) are also being used for restorations involving cervical abrasions and root caries. Their ability to release fluoride results in less recurrent caries than with conventional restorative materials. Strong bonding between dentin and the glass ionomer cement is possible when the dentin is first conditioned with a 10 percent polyacrylic acid. This gives it the added advantage of achieving excellent retention with only minimal cavity preparation required. The handling properties of this material are similar to those discussed for glass ionomer cements. Light-cured glass ionomer products have been developed that greatly accelerate the setting time over the self-cured products. Moisture contamination must be avoided throughout the setting period specified by the manufacturer. Unless the assistant and the dentist can maintain a dry field, the restoration is likely to fail.

434. Dental amalgam

Dental amalgam is one of the oldest restorative materials still in use today. It is an effective, long-lasting, and inexpensive restorative material that has been used for over 150 years to restore teeth.

Dental metallurgy

Metals are opaque, lustrous, crystalline solids that conduct heat and electricity, and when polished, are good reflectors of light. Most metals are malleable and ductile. These unique characteristics allow them to be shaped into a variety of forms that cannot be easily constructed from nonmetallic materials. For example, gold foil is sometimes used to plug holes in cast restorations.

Most dental metals are alloys. An *alloy* is a material that has the characteristics of metal and is composed of two or more elements, at least one of which is metal. Alloys are produced to improve properties, such as corrosion resistance, handling ability, and strength of pure metals. The most commonly used dental alloys are amalgam alloy, wrought alloys, and casting alloys. Amalgam alloy is a combination of silver alloy and mercury used in restorative dentistry. Wrought alloys and casting alloys have complex compositions and are supplied in a variety of forms. We'll discuss these alloys in a later section on prosthodontic use of materials.

Dental amalgam

Amalgam is the most widely used restorative material in dentistry and is the material of choice for many restorative procedures. To achieve the best possible results, you must know how to mix and handle amalgam properly. Every step in handling amalgam, from mixing the alloy to final polishing of the restoration, has some effect on its properties. Try, then, to standardize your handling of amalgam to eliminate any variable in its manipulation.

Uses

Dental amalgam is a restorative material usually limited to use in restoring posterior teeth because its color makes it esthetically undesirable in anterior teeth.

The composition of amalgam alloy

An alloy is the fusion of two or more metals. Amalgam restorations are made by combining a silver-tin-copper alloy (*amalgam alloy*) with mercury. A typical amalgam alloy composition is 60 percent silver, 27 percent tin, and 13 percent copper. Some alloys also contain zinc.

Silver, the main component, imparts a high luster and a silver-colored appearance to the alloy. It also increases the strength, durability, and expansion of the alloy, but it decreases flow and setting time. A high percentage of silver causes an amalgam to expand excessively, tarnish easily, and amalgamate slowly.

Tin, the second major constituent, reduces the expansion, strength, and hardness to increase the flow, setting time, and workability. Although it weakens the amalgam, it is used to counterbalance the rapid hardening and high expansion properties of the silver.

Copper, within a limited range, increases the hardness and expansion while decreasing the flow and setting time. Amalgam alloys are usually called "low-copper alloys" or "high-copper alloys." All of the amalgam alloys you will use in Air Force clinics are high-copper alloys.

Zinc is used principally as a deoxidizer. It acts as a scavenger in uniting with oxygen and certain other impurities present. Amalgams containing an appreciable amount of zinc expand excessively and corrode badly if moisture is incorporated during mixing or packing. Not all alloys contain zinc. Those without it are called zinc-free or nonzinc alloys. When zinc is added, there is a proportionate reduction in the tin or copper content.

Mercury

Mercury (Hg) is a metal in liquid form at room temperature. When mercury is placed in contact with certain other metals, it bonds the metals together. An example of this action is seen when mercury is placed on a silver coin. Similarly, the mercury reacts chemically with the particles of silver in the alloy to bond the silver particles to the other particles. To accelerate this chemical action, the alloy and mercury are capsulated and mechanically triturated (mixed or thrown together). We'll discuss mixing the amalgam in more detail later. First we need to review the precautions for handling any form of amalgam or mercury.

Mercury left uncovered at room temperature volatilizes (converts into vapor) into the air. Since mercury vapors can be a health hazard, observe these practices:

- Use precapsulated amalgam. Close the capsule after use and before discarding it in order to reduce mercury vapors.
- Clean up any known mercury spill at once. There are several approved techniques for cleaning up. For small spills, use vacuum aspiration through a water trap followed by a wet "HgX" (mercury vapor decontaminant) or calcium polysulfide treatment. HgX is available in a 16 ounce jar through National Stock Number (NSN) 6850-00-495-5506.
- Use water spray and high volume evacuation when grinding or polishing dental amalgam.
- Do *not* heat dental amalgam.
- Store dry scrap amalgam in a covered, screw-cap container.

Naturally, mercury in its pure state is harmful, but the mercury found in medicinal compounds and dental amalgam is not harmful when properly applied.

Properties

As we have said previously, the ideal restorative material is one that duplicates original tooth structures. While science has been unable to manufacture this ideal material, dental amalgam however, does possess many of the more desirable qualities of a restorative material.

Desirable properties are evidenced in a properly proportioned and properly mixed amalgam:

- It easily adapts to a prepared cavity.
- It sets in an appropriate time and resists corrosion.
- It is dimensionally stable.
- It has adequate strength when set.

Undesirable properties of dental amalgam include its high thermal conductivity and poor color. Because of its high thermal conductivity, dental amalgam restorations are often placed over an insulating base material that helps to protect the tooth pulp from temperature-change irritation. The metallic or silver-gray color of dental amalgam also makes it undesirable as a restoration in anterior teeth. You can avoid producing other undesirable results by properly mixing amalgam.

435. Preparing dental amalgam

Normally, dental amalgam is easily prepared. Very little equipment and time are needed to produce a satisfactory mix. However, you should understand what happens when amalgam alloy and mercury are mixed.

Setting reactions

The first thing that occurs during *trituration* (the mixing together of the mercury and alloy) is the combining of the mercury and alloy particles. Since this absorption decreases the total volume, the amalgam mass initially shrinks. This contraction continues during the first hour after mixing.

Immediately afterward, an expansion takes place as crystals of a silver-mercury compound and a tin-mercury compound form. The two compounds are called the *gamma-one* and *gamma-two* phases, respectively. These crystals exert pressure on one another as they interlace and meet while the amalgam hardens.

After approximately 6 or 7 hours, this crystallization is completed. A second, very slight contraction takes place as more of the free mercury, which remains, is taken up by the remaining original particles of the alloy.

Dimensional changes

Dimensional type changes are to be expected and, within a limited range of ± 20 micrometers per centimeter, are acceptable under the ADA specification. The composition and constituents of the amalgam affect its dimensional change during hardening; however, dimensional change can be influenced markedly by improper trituration, manipulation, or condensation. After the restoration is inserted, dimensional change in it should be at a minimum. Any excessive expansion can lead to pressure and postoperative sensitivity in the tooth or to a protrusion of the restoration from the cavity. Also, if contraction is severe, the restoration could conceivably pull away from the cavity walls and allow gross leakage between the tooth and restoration.

Strength is most important in an amalgam restoration. The restoration in a tooth is subject to compressive, shearing, and tensile stresses. A lack of true adequate strength to resist mastication forces has long been recognized as a weakness of the amalgam restoration. A study has shown that about 26 percent of clinical amalgam restorations failure was due to fracture. Fracture, even on a small area, and deterioration of exposed margins will hasten the recurrence of decay and subsequent clinical failure.

Quality control measures

To assure high-quality amalgam restorations, quality control measures must be continually applied. The control measures must begin with the development of the amalgam materials and end only after a prepared part of a tooth has been restored successfully. Quality control measures are divided along three lines of responsibility:

1. The manufacturer.
2. The dental assistant.
3. The dentist.

Manufacturer control measures

The manufacturers are responsible for the purity of the ingredients in their products. Regarding amalgam alloy specifically, the manufacturer must exercise proper controls to produce an alloy with the metals in the correct proportions. We depend on the manufacturer to provide an alloy with the proper particle size since the particle size affects the consistency of the mix for a given alloy-mercury ratio. The heat treatment given to the alloy metals is another process controlled by the manufacturer. This is the controlled heating and cooling of the metals to bring out the best combination of the alloy's strength, condensing ability, and chemical bonding ability. Finally, the manufacturer must properly proportion the alloy and mercury contained in precapsulated amalgam; an important factor affecting manipulative procedures.

Assistant control measures

Although the dentist has the overall responsibility for any restoration, you are responsible for exercising certain control measures in handling dental amalgam. Among the areas under your control are the mixing and manipulating of amalgam.

Mixing

Properly mixing amalgam is vital to producing a quality restoration. Some improper quality control measures are faulty timing, overtrituration, and undertrituration.

Timing is important, especially in determining when the mixing process should begin. If you begin a mix too soon, the amalgam may begin to set prematurely. To rectify this error, prepare a new mix and dispose of the old mix properly. Also, before you begin to mix always ask the dentist when it will be needed.

Overtrituration is undesirable because it decreases the setting time and increases the shrinkage of the amalgam. *Undertrituration* is also undesirable because it increases the setting time, increases the expansion, and weakens the amalgam. Again, consult the manufacturer's instructions to prevent overtrituration or undertrituration of amalgam.

Manipulation errors

Your manipulation of amalgam is important. If you do not exercise proper control, the results can mean discomfort and inconvenience for the patient. The most common error in manipulating amalgam is contaminating the mix with moisture or other impurities. Any foreign materials that enter the amalgam are contaminants. If debris on an instrument is introduced into an amalgam, it can interfere with the chemical bonding action. To prevent contaminating amalgam with foreign matter, make sure that you use only clean instruments.

Dentist control measures

The dentist has the sole responsibility for condensing the amalgam. If he or she does not condense the amalgam sufficiently, it can result in an increase in expansion and, therefore, a weakened amalgam. Additionally, the chemical setting action can be interrupted if the dentist takes too long in condensing the amalgam. This interference also weakens the amalgam. We mention these potential problems in condensing amalgam only because the dentist must use the amalgam you prepare. Therefore, an improper action on your part can cause condensing problems for the dentist. As you may have already concluded, teamwork is essential in handling dental amalgam.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

430. Insulating materials

1. What is the purpose of insulating materials?
2. Why is calcium hydroxide widely used as a pulp-capping material?
3. With what do you mix calcium hydroxide powder to form a paste?
4. Describe the mixing procedures involved with the hard-setting type of calcium hydroxide paste.
5. Why is the soft-setting type of calcium hydroxide paste used?

6. What are the uses of the zinc oxide and eugenol combination?
7. What are the major disadvantages of zinc oxide and eugenol combination?
8. How does the manufacturer make zinc oxide oxide and eugenol? What are its uses?
9. How do you mix the paste forms of zinc oxide and eugenol?
10. State the uses of cavity liners and varnishes.
11. What action should you take if the cavity liner or varnish solution gets too thick to use?

431. Dental cements

1. What are all of the uses of dental cements?
2. Why are cements far from ideal?
3. How are the physical properties of materials controlled?
4. List three distinct uses of zinc phosphate cement.
5. What is the chief ingredient in the zinc phosphate cement powder?
6. How are the proper water balance maintained and humidity kept out of the liquid portion of zinc phosphate cement?
7. Briefly list the desirable properties of zinc phosphate cement.

8. What is the most significant clinical property of zinc phosphate cement? What does it cause?
9. What should be applied to the preparation prior to the zinc phosphate cement? Why?
10. How can you control the strength of the mix?
11. What equipment should you use for mixing zinc phosphate cement?
12. How does the temperature of the mixing equipment affect the mix of zinc phosphate?
13. How should the zinc phosphate powder be prepared for mixing?
14. What are two types of zinc phosphate cement mixes and the uses of each?
15. What is the mixing time for a thin-to-medium mix of zinc phosphate cement?
16. What is the total mixing time for a thick mix of zinc phosphate cement?
17. Why is it important to mix zinc phosphate cement over a large area of the slab?
18. Briefly list the factors that shorten the setting time of zinc phosphate cement.

432. Other dental cements

1. Match the dental cements listed in column B with their correct description in column A. Each cement listed in column B will be used only once.

Column A

- ____ (1) Sensitive to water during the initial setting time, their strength can be improved if they are used in an isolated, moisture-free surrounding.
- ____ (2) Probably the most effective materials known for temporarily filling teeth before a permanent restoration is placed in the mouth. Used as temporary fillings, as thermal insulating bases, and as cementing agents.
- ____ (3) Based primarily on polymethyl methacrylate with mineral fillers. Their principal advantage is that they are virtually insoluble in water.
- ____ (4) Improved or reinforced zinc oxide-eugenol cements as a result of the addition of ortho-ethoxybenzoic acid to the eugenol and quartz or alumina as a filler to the powder.
- ____ (5) Its powder is composed of zinc oxide and magnesium oxide and it will bond to both enamel and dentin.

Column B

- a. Zinc oxide-eugenol cements.
- b. EBA cements.
- c. Resin cements.
- d. Polycarboxylate cements.
- e. Glass ionomers.

2. Why are fixed bridges frequently cemented temporarily with zinc oxide-eugenol cements?
3. How do EBA cements compare to zinc phosphate cements?
4. What are polycarboxylate cements?
5. How do polycarboxylate cements compare to other cements?
6. How do glass ionomers compare with other cements?

433. Composite resins and glass ionomer filling materials

1. How can you become thoroughly familiar with the mixing procedures for the various composite restorative materials used in your clinic? Why is this necessary?
2. In what teeth are composite filling materials primarily used? Why?
3. Name the basic components of a composite filling material set.

4. Name the basic ingredients and specify the function of the composite filling material's organic binders and inorganic fillers.
5. In what form are composite restorative materials usually supplied?
6. How are one-paste systems cured?
7. List the three types of composite materials and their reason for classification.
8. Match the compositions of composite resins listed in column B with their results in column A. Each item listed in column B may be used more than once.

Column A

- ____ (1) Results in lower shrinkage.
- ____ (2) Decreases thermal expansion.
- ____ (3) Increased strength and fracture resistance.
- ____ (4) More polishable resins.

Column B

- a. Higher amounts of inorganic filler.
- b. Smaller inorganic filler particles.
- c. Lower amounts of organic resin.

9. How do the macrofilled and hybrid resins compare to the microfilled resins?
10. Which type of composite resin is easier to polish?
11. What is an effective method of improving the seal and retention of resin to the cavity walls?
12. What type of acid is used in the acid-etch technique?
13. How is the bonding agent used?
14. Briefly describe the placement procedures for composite filling material.
15. Where is glass ionomers used for restorations?

16. What is used to condition the dentin? What does this create and how is it an advantage?

434. Dental amalgam

1. What is an alloy?
2. Where is amalgam used in restoring teeth? Why?
3. State the ingredients and their percentages (except mercury) that typically make up dental amalgam.
4. What does each of the following metals do in amalgam?
 - (a) Silver.
 - (b) Tin.
 - (c) Copper.
5. How do amalgams containing an appreciable amount of zinc perform?
6. Briefly explain mercury's role in dental amalgam.
7. Because of its mercury content, what practices are followed when handling amalgam?
8. What is the approved technique for cleaning up a small mercury spill?
9. What are four desirable properties of amalgam?
10. What are two undesirable properties of amalgam?

435. Preparing dental amalgam

1. What is the first phenomenon that occurs during trituration?
2. How long does the crystallization process take as the amalgam hardens?
3. What improper techniques can markedly influence dimensional change?
4. What can excessive expansion and severe contraction cause?
5. Why is strength important in an amalgam restoration?
6. What are the three divisional lines of responsibility for quality control?
7. Who is responsible for the purity of ingredients, correct proportions of metals, proper particle size, and the heat treatment of the silver alloy?
8. What areas are under the control of the dental assistant?
9. What are some improper quality control measures of mixing?
10. What happens if you begin a mix too soon? How can you rectify this error?
11. Why is overtrituration or undertrituration of an amalgam undesirable? How can both be prevented?
12. What is the most common error in manipulating amalgam?
13. Give an example of contaminants that could enter the amalgam and what it does.

14. What are the results if an improper action on your part, as the assistant, caused condensing problems for the dentist?

3-3. Prosthodontic and Other Materials

The prosthodontic treatment of a patient is a lengthy process involving the use of several dental materials. The improper use of any of these materials could cause a delay in treatment and inconvenience to the patient. Many materials we will discuss also have uses in other areas of the dental clinic, such as orthodontics, oral surgery, and general dentistry. Also, bear in mind that any given material may be known by a variety of names according to its composition, form, or use. In this section we will consider dental alloys, impression materials, gypsum products, dental waxes, acrylic resins, and other prosthodontic materials.

436. Dental alloys

Although you do not make dental prostheses, you must understand the types of materials used in their construction. When a patient's prosthesis is given to the dental lab for repair or change, they need to know its history to do the work properly—or a tragic result may follow.

Precious, *semiprecious*, and *nonprecious* are a few terms used to describe dental alloys, but they imply some intrinsic value and are not really descriptive of these alloy types. Dental alloys are better classified as noble metal or base metal alloys.

Noble metal alloys

Noble metals resist oxidation and corrosion. The four noble metals primarily used in dentistry are: silver, platinum, palladium, and gold. Gold is very useful for dental purposes. Although too soft for use alone, it can be combined with other metals in varying proportions to produce alloys of almost any desired properties. Until recently, gold was the dominant metal in alloys. However, due to cost other noble metals are gaining popularity.

Dental gold

Gold has been used for centuries as a dental restorative material. It was used quite early as an almost pure metal in wire or sheet form. No other metal or combination of metals serves dentistry in such wide ranges of applications as gold and its several alloys. As with all restorative materials, the quality of the restoration depends on a combination of manipulative procedures and physical or mechanical properties.

Gold is a soft, malleable, ductile metal that does not oxidize under atmospheric conditions and is attacked by only a few of the more powerful oxidizing agents. It has a rich, yellow color with a strong metallic luster. It must be alloyed with copper, silver, platinum, or other metals for dental applications and in making of coins and jewelry articles. Alloying develops the hardness, durability, and elasticity necessary for lasting restorations.

Direct filling gold

Pure gold is the most malleable of all metals and can be rolled into very thin sheets. These sheets can be further thinned to the point that light can be transmitted through the metal—a condition called *foil*. When the surface of the foil is absolutely clean, two pieces can be welded together by simply bringing them into contact. Pure gold is also supplied in forms other than foil. When compressed and heated to a temperature just below the melting point of the metal, a fine gold powder forms a compact mass, called *mat foil*. Mat foil is supplied in small, thin strips. More recently, pure gold has been provided in a powder form. Small particles of gold are lightly compressed into *pellets* ranging in size from approximately 1 to 3 millimeters. Each pellet is then wrapped in gold foil. These forms exhibit

the same physical properties, there is no evidence of a superiority of one form of direct-filling gold over another.

Gold casting alloys

Different types of alloys have different physical properties and uses. Gold casting alloys are classified by their values for hardness, and remember, hardness is a good indicator of strength. Consequently, while one type of alloy might be fine for an occlusal inlay, it would be too soft for use as a fixed partial denture. The reverse also is true; a hard alloy is not as malleable as an alloy used for occlusal inlays. The casting alloys are classified into four types based on their properties.

| Casting Alloy Types | |
|----------------------------|--|
| Type | Description |
| I—Soft | This is soft, malleable, and easily burnished. It is used for restorations <i>not</i> subjected to much occlusal stress, such as on the buccal surface of molars. |
| II—Medium | Called “inlay gold,” it is burnishable, but not to the same degree as the softer, type I alloy. This is used for restorations, inlays, or some crowns subject to moderate stress. |
| III—Hard | This is used for single onlays, crowns, and fixed partial denture restorations. It is harder and not as easily burnished as the type I or type II noble alloy. It will withstand more wear and is not as likely to deform under the forces of mastication. |
| IV—Extra Hard | Type IV extra hard alloy is used for removable partial denture (RPD) frameworks and clasp assemblies. It is extremely hard and not easily burnished. |

Elements most commonly found in noble casting alloys are gold, silver, copper, platinum, palladium, and zinc. There is a progressive increase in the hardening elements for types I through IV. The increased use of silver in types II and III is intended to lighten the color of the alloy and not to affect the hardness. As the copper content of gold is increased, the alloy becomes darker, unless offset by silver. Most people consider this darker color less attractive. In these alloys zinc is used to prevent the loss of copper by oxidation of the molten metal. As a result, as the copper content is increased, the zinc content also increases. Zinc also lowers the alloy’s melting point, making it more fluid and easier to cast.

Metal-ceramic alloys

Noble alloys used in the metal-ceramic technique of fixed prosthodontics differ only slightly from those described above. Adding increased amounts of platinum and palladium hardens these alloys. They are light in color and have a higher melting range. Small amounts of base metals, such as indium and tin, are included to produce a thin oxide surface film that provides a means for chemical bonding of the metal to the porcelain. The two more commonly used alloys are gold-platinum-palladium and gold-palladium-silver.

Solders

Solders are used to join units of fixed partial dentures and make repairs of everything from mending holes in castings to adding proximal contacts. Solders come in many forms; the most common are wires and strips. Each type of solder has a different composition and use.

Platinum foil

Platinum foil is supplied in thin sheets approximately 0.001 of an inch. Pure platinum has a strong attraction for molten gold. This property makes it a very useful metal in the dental laboratory. Platinum is used for gold repair procedures (e.g., mending holes in castings), and as a matrix for porcelain jacket crowns and veneers.

Base metal alloys

Since base metal alloys do *not* contain noble metals, they readily oxidize when heated. Generally, these alloys are much stiffer and harder than noble metal alloys, making them useful for constructing removable partial dentures (RPD) and certain types of bridgework.

Casting alloys

Alloys of chromium-cobalt and chromium-nickel that contain approximately 20 to 30 percent chromium have been used for over 40 years in dentistry. They are used for such applications as denture bases, RPD frameworks, resin-bonded bridges, dental implants, and orthopedic surgery implants throughout the body.

When properly finished and polished, these chromium-containing alloys are silver-white and lustrous in color and appearance. These alloys have several advantages for dental castings: they are lighter in weight, have an excellent resistance to corrosion, have good mechanical properties, and are less expensive than the noble alloys. In the resin-bonded bridge technique, the retainers are acid etched for resin bonding of the bridge to etched enamel. One disadvantage is that RPD frameworks require the use of specialized equipment usually only found in an area dental laboratory.

Wrought alloys

The wrought base metal alloys are available as wires and band materials. They are used in the construction of orthodontic and prosthodontic appliances. The wrought alloys differ from the base metal casting alloys in how they are manufactured.

Wrought base metal alloys are made through a process of rolling, annealing, and drawing into the various forms. Cold working alloys, in this manner, impart certain mechanical properties to them of value to dentistry. Of particular importance is the alloy's elastic and flexible nature. This property allows a wrought wire clasp to "spring" into and out of an undercut area. Within limits, these alloys do *not* distort easily in the mouth due to their increased tensile and yield strength.

437. Impression materials

Though there are many types of impression materials used in the dental clinic, no one material fulfills all the requirements for making a perfect negative reproduction of the oral structures. Because clinical situations and dentists' techniques vary, so will the choice of the material. In this lesson we discuss some of the more common materials used for impressions.

Impression compounds

An impression compound has a limited use as an impression material in the Air Force. It is primarily used for border molding of acrylic custom trays, fabricating an improvised custom tray for complete dentures, and securing broken pieces of a denture, cast mountings, etc.

Impression compound is a "plastic" impression material, not an "elastic" material, because it does *not* release from an undercut area without permanent deformation. Impression compounds are thermoplastic materials that soften to working consistency when placed in a hot water bath or heated over a flame. When a large quantity is needed, using a water bath is recommended.

Impression compounds are divided into two types—impression and stick compound (type I) and tray compound (type II). *Impression and stick compound* is a low-fusing material used with copper bands for inlay and crown impressions and recording *functional* or *preliminary* impressions. It is most commonly used for border molding of acrylic custom trays and securing broken pieces of dentures. It is available in stick and cake form with various colors denoting the softening temperature. *Tray compound* is a high-fusing material, relatively tough, and strong enough to act as a tray to support other types of impression materials. Tray compound is *not* used intraorally, but instead, it is adapted to a study model to fabricate an improvised custom tray. It has been largely replaced by acrylic tray material.

Be careful when softening impression compound because overheating makes it so sticky that it is extremely difficult to handle. When it cools, impression compound becomes hard and brittle. Trimming an impression correctly requires a sharp knife to reduce the possibility of breakage. To separate a master cast from a compound impression, soak the impression in warm water for several minutes. This softens the compound and aids in removing the impression without damaging the cast.

Impression wax

Impression wax is a low-fusing material that can be used as a “wash” to correct defects or deficiencies in other impressions. It is specially compounded so that it flows at mouth temperature. After this wax is melted in a water bath, it is painted in the individual impression tray to serve as a corrective liner for final impressions. If you rinse the impression, do so very carefully with cool water. Also avoid touching the wax areas with your fingers because they may cause the wax to flow and distort the impression surface.

Impression paste

Impression paste also is used as a corrective “wash.” It contains zinc oxide (ZnO) and eugenol and is supplied in two tubes. One tube contains the base material, the other the hardener. Equal lengths of material from each tube are used. Because cleaning up after preparing this material is difficult, you will save time by mixing it on a parchment pad, using a tongue depressor for a spatula. You can discard both the parchment sheet and tongue depressor when you finish. If you want to extend the setting time of this material, decrease the amount of hardener. To decrease the setting time, increase the amount of hardener. As with all of the materials we have discussed, you should read and follow the manufacturer’s instructions.

Alginate impression materials

Hydrocolloids that are altered through a chemical change are known as *irreversible* hydrocolloids because, once the chemical change has taken place, it cannot be reversed or turned back to the previous state. Irreversible hydrocolloids, more commonly known as *alginate*s, were developed from seaweed during World War II when agar became scarce. Now they are in standard use in dentistry.

There are several advantages of alginate impression material:

- It is easy to prepare and handle.
- It does not require extensive equipment and advanced preparation.
- It is comfortable for the patient.
- It is inexpensive.

Alginate is used in making preliminary impressions for all study casts and most final impressions for removable partial denture working casts.

According to ADA specifications, alginate materials are divided into two types based on gelling time. Type I, a fast-set material, must gel in 1 to 2 minutes. Type II, a regular-set material, must gel in 2 to 4.5 minutes after beginning of the mix. The ADA specifications also require the manufacturer to include detailed instructions for use. You should read and follow these instructions carefully.

Composition and chemistry

The exact formula for an alginate impression material varies with the manufacturer; however, the chief ingredients necessary for chemical reaction are calcium sulfate and potassium alginate. When these powders are mixed with water, they combine to form an insoluble calcium alginate gel. This reaction must be delayed long enough to allow time to mix the materials adequately, load the tray, and position it in the patient’s mouth. A *retarder*, such as trisodium phosphate, is added to the formula to make this possible.

Alginate impression materials deteriorate rapidly if exposed to heat or moisture. In turn, they may fail to set or set too quickly. Alginate materials should be stored in cool, dry locations. Alginate in premeasured foil packages assures an accurate measure and protection from moisture contamination and atmospheric conditions. Bulk quantities of alginate in cans should be stored properly with the lid tightly replaced immediately after use.

Preparation and use of alginate impression materials

Maximum gel strength is required to prevent tearing (fracture) and ensure elastic recovery of the alginate impression upon its removal from the mouth. All the manipulative factors (gel time, temperature, etc.) affect the gel strength, and each should be carefully controlled to ensure best results.

Gel time, commonly called setting time, is important because rapid gelling does *not* allow adequate working time. Too long a setting time is tedious for both the operator and patient. Once the gelling starts, it must not be disturbed since any distortion of the material is permanent.

Temperature also is important because higher temperatures speed the setting time, whereas colder ones retard it. The most common temperature variable is the water used in mixing the alginate. Water at 122°F can cause a setting time of only 1.8 minutes, whereas water at 43°F increases setting time to 7.8 minutes. The manufacturer's directions list the recommended water temperature.

Exact proportions of water and powder are essential to achieve a good mix of alginate. Along with instructions, the manufacturers usually supply volume measures for both water and powders. Use them to accurately measure the powder and water.

You will normally hand mix alginate for 30 to 45 seconds, carefully timing this period because it is an important factor. Insufficient mixing (spatulation) can cause failure of the ingredients to dissolve sufficiently so that the chemical reactions can proceed uniformly throughout the mass. The strength of the gel can be reduced as much as 50 percent if the mixture is incomplete. Conversely, if the mixing time is unduly prolonged, the gel will break up as it forms, and the strength is decreased.

The strength of the alginate gel increases for several minutes after initial gelation. Therefore, you should *not* remove the alginate impression from the mouth for at least 2 to 3 minutes after gelation occurs. This is approximately the time at which the material loses its tackiness.

Care of the impression

An alginate impression should be poured immediately after the proper disinfection procedures have been taken. If it is left out in the air, *syneresis* (loss of water) will cause the impression to shrink and become distorted. If it is soaked in water, *imbibition* (intake of water) will cause the impression to swell.

Synthetic rubber materials

Rubber impression materials are supplied as pastes in collapsible metal tubes or in a double barreled injector cartridge. The first type requires mixing, the other type does not. One tube contains the "base" while the other contains an "accelerator" or "catalyst." When mixed in appropriate amounts, the mixture hardens to form a synthetic rubber.

Consistency types

Rubber impression materials can be used for almost any impression. They come in three consistencies:

| Rubber Impression Material Consistencies | |
|--|--|
| Consistency | Description |
| Light bodied | Injected with a syringe onto preparations for inlays, crowns, and fixed partial dentures. Sometimes referred to as a wash. |

| Rubber Impression Material Consistencies | |
|--|--|
| Consistency | Description |
| Regular bodied | Used in an impression tray for inlays, crowns, and fixed partial dentures, and as “wash” impressions for full dentures, relinings, and RPDs. Its high degree of flow registers the fine details. |
| Heavy bodied | Used in a tray to force light bodied impression material onto the cavity preparation or with a copper band for impressions of single teeth. |

Material types

Rubber impression materials can be grouped into three types depending on their composition—polysulfides, silicones, and polyethers.

Polysulfides

Polysulfides can be identified by the usually dark color of one of the two pastes and their resulting opaque mix and sulfur type smell. If the materials are improperly mixed, the impression will have streaks in it, thereby affecting dimensional stability. Mixing time is between 45 and 60 seconds with a 5-minute working time. The impression must not begin setting before placement in the mouth. If the 5-minute working time is exceeded, the resulting impression will have inadequate expansion, producing a smaller cast. The impression must set completely before removal from the mouth and poured no later than 1 hour after removal.

Silicones

Silicone materials are generally lighter in color, translucent when set, and have a much more subdued odor. Besides the three consistencies mentioned above, a heavy putty material is also available that can be used with a stock tray to make up the bulk of the impression and thereby minimize distortion. The dimensional stability and accuracy of the “addition” silicones (vinyl polysiloxane) is superior to all other rubber materials. Impressions made from silicone materials do not have to be poured immediately, and they also may be repoured if necessary.

Polyethers

Polyethers have lighter colors than polysulfides, but are darker than the silicones. The working and setting times are much shorter than the other two rubber impression materials. Polyether is comparable to polysulfide for long-term dimensional stability. Unlike polysulfide, however, polyether will absorb water. This type of impression material is very stiff, making it difficult to remove from the mouth and from a cast. Also, the material tears easily, especially in thin areas like the subgingival sulcus.

438. Gypsum products

Gypsum products are supplied as a powder. When mixed with water in the right proportions, a paste forms that will eventually solidify. This setting, or hardening process, takes place over a period of several minutes, during which time the mixture is soft and pliable, and can be formed into the desired shape. As it initially solidifies, gypsum gives off an appreciable amount of heat, which is characteristic of all its products. Each material in the gypsum group is carefully compounded to give it the particular combination of physical properties needed for a particular job. Dental plaster, stone, and die stone are the most frequently used gypsum products.

Dental plaster

Dental plaster, commonly referred to as *plaster of Paris*, is used primarily for pouring preliminary impressions and making diagnostic casts. Because of the porous and irregular crystals, dental plaster requires the most water for mixing and produces a weaker cast. Plasters made for dental use are specially processed to provide high purity and suitable working properties. These properties must be uniform within each batch and from one batch to another. One of the most important requirements is

that the plaster must be set within a definite time limit. The amount of its setting expansion also must be within reasonable limits

Plaster has many uses. You can use it to form casts, construct matrices, and attach casts to the articulator. The initial setting time for most dental plaster ranges 7 to 13 minutes. The final set is complete within approximately 45 minutes.

Dental stone

Chemically, dental stone (hydrocal) is very similar to plaster; however, the dental stone particle is smaller, much denser, and relatively nonporous. Consequently, dental stone requires less water in mixing and initially sets more slowly. When it is set, it is harder, denser, and has a higher crushing strength. These properties make stone preferable to plaster as a master cast in complete and partial denture construction. Stone is more resistant to scratching and damage and can withstand more pressure in acrylic processing. Stone has many dental uses, including pouring and mounting casts and flasking dentures for processing. Final setting time for dental stone is the same as dental plaster.

Die stone

These improved stones have particles that are smaller and more random-shaped than hydrocal. Due to their lower surface area, less water is needed. Also, the smaller particles form crystals closer together than the other dental stones. Using less water results in a product with higher compressive strength. Other chemicals are added to control the setting expansion during the hardening process. Initially die stone was only used for making the first pour of a working cast for fixed prosthodontics; now, it's also being used for working casts for removable prosthodontics.

439. Waxes

Dental waxes play an important role in constructing prosthodontic, orthodontic, and maxillofacial appliances. For instance, the treatment of a complete denture patient, from final impression to delivery, might require as many as five different waxes to complete. The waxes are supplied in many different forms, each with specific properties designed for an intended purpose. It is important to use the proper wax for a required task.

Baseplate wax

Baseplate wax is supplied in two types—hard and medium. The hard type is better suited for warm climates because it resists flow at higher temperatures, but it may be too brittle and have a tendency to crack at lower temperatures. The opposite is true of the medium type, but it should not be used in a warm environment because too much flow would result. Baseplate wax is used for making occlusal rims, recording bite registrations, and waxing denture bases. It also is used as a spacer over casts before custom trays are made. Baseplate wax is pink. It is available in sheet form and ribbon form, and as preformed occlusal rims.

Bite registration wax

Bite wax is a metal-impregnated wax in sheet form. It is used intraorally to record the occlusal relationships between a patient's opposing arches and later used to transfer this relationship to the casts for articulation. Often, without this record, it is impossible for the dentist or laboratory technician to properly occlude the patient's casts.

Boxing wax

Boxing wax is a red, specially prepared wax that is supplied in strips about 1½ inches wide and 12 inches long. It is used to box impressions. Boxing is placing a wall boundary around an impression to confine the flow of stone for pouring a cast.

Disclosing wax

Disclosing wax is an ivory-colored wax that is low fusing and flows at mouth temperature. A dentist uses disclosing wax to detect points of unequal pressure when inserting fixed restorations and removable partial denture frameworks. This wax flows away from the pressure points, disclosing them for corrections. Disclosing wax is easily removed by scrubbing with wax solvent, followed by soapy water in an ultrasonic cleaner.

Indicator wax

Indicator wax, usually green in color, is coated with a water-soluble adhesive on one side. It has a diagnostic use for registering occlusal contacts on natural teeth, individual restorations, fixed partial dentures, RPDs, and complete dentures. It is sometimes used by the dentist to evaluate premature contacts (high spots) on restorations.

Inlay wax

Inlay wax is one of the most carefully compounded of all the dental waxes. It is used to make wax patterns for castings and frameworks in fixed and removable prosthodontics. Inlay wax is supplied in two types, one for intraoral use and the other for laboratory use. The latter type comes in a variety of colors in both medium and hard grades. Manufacturers also make a colorless inlay wax, called ivory wax, for use when a pigmented wax would be undesirable.

Sticky wax

Sticky wax is made of beeswax, paraffin, and resin. It is dark blue, dark red, dark violet, or orange. The resin gives the wax its adhesiveness and hardness. An important requirement of sticky wax is that it must break under pressure rather than bend or distort. This property makes it useful for holding the parts of a broken denture together so that it can be repaired.

Undercut wax

Undercut wax is a high fusing wax used to fill voids or block out undesirable undercuts on working casts. This handling characteristic makes it useful for blocking out defects in dies that later must be waxed over with inlay wax.

Utility wax

Utility wax is a red or colorless wax that is supplied in rope form. It is extremely pliable and tacky at room temperature, making it usable without heating. It is primarily used in beading (curbing) impressions before proceeding to the boxing and pouring steps. It has various other applications, one of which is its use on impression trays to avoid injury to soft tissue.

440. Acrylic resins

The use of acrylic resins or plastics has been steadily increasing since the late 1930s. A considerable amount of refinement and improvement has been made in both the handling and processing of acrylic resins.

Methyl methacrylate

True resins are derived from plant secretions, but those used in dentistry are synthetic resins. The synthetic resin, methyl methacrylate, is the most widely used type. It is normally sold in a fine powder (polymer) and liquid (monomer). They are mixed to form a gel or dough and then processed into a rigid solid. *Polymerization* is the term used to describe the processing or curing of acrylic resins. Polymerization can be accomplished by different means and we normally refer to a class of acrylic resin by its method of curing. A few of the more common acrylic resins include the heat-cured, self-curing, and light-activated types. To limit the scope of this discussion, only the more customary acrylic resin materials and their curing methods are presented.

Clear acrylic

Clear heat-cured acrylic resin is used to construct night guards and surgical appliances. Since it is perfectly clear, it has diverse dental applications. One application is as a surgical template. The template is used after extraction of the remaining teeth to disclose possible interferences between the alveolar bone and the immediate denture.

Crown and bridge resin

Crown and bridge resin are tooth-shaded acrylic resins used in fixed prosthodontics to make provisional and permanent restorations. The self-curing type is used as an interim restoration while the permanent one is being constructed. This resin is normally used with a vacuum or pressure-formed matrix to sculpt the contours of the interim crown or bridge.

There are several different types of resins available for permanently veneering crowns and fixed partial dentures. These resins are either heat-cured or light-activated and are supplied as powder-liquids, pastes, or gels. The newer resins are microfilled composites that have superior advantages over the older varieties. Composite resins offer better esthetics, can be used chairside and in the laboratory, and have better abrasion resistance. These resins can also be used on full coverage crowns and inlays because of their increased strength.

Denture base resin

Denture base materials are available in premixed form or as a set containing a powder (polymer) and a liquid (monomer). The powder and liquid variety is the most widely used. They are supplied in a variety of shades to match the oral mucosa of most people, despite race or nationality. Both heat-cured and self-curing resins are used to construct the bases of full and partial dentures.

Denture base stains

Denture base stains are used in specific areas of the denture base to highlight anatomical details. The purpose of the pigment is to simulate the patient's mucosal coloring in the finished denture.

Orthodontic resin

Self-curing orthodontic resin is used to construct nightguards and orthodontic appliances. While this material can be ordered in kit form, its components are usually requested separately. The clear polymer powder can be used with several tinted liquids to produce different shades. The dental clinic normally stocks only the clear and pink liquid types.

Repair resins

Similar in composition and use to self-curing denture resins, repair resins are used to construct record bases and interim removable partial dentures and to repair any acrylic appliance. They are normally stocked by the dental clinic only in self-curing in pink and light-pink, fibered shades.

Tray acrylic

Tray acrylic is used to make customized impression trays. There are two methods: self-curing dough and light-cured material. The most common is the light-cured material (Triad) method.

Self-curing dough method

This method uses autopolymerizing acrylic in a doughy state that is rolled flat and adapted to the diagnostic cast by hand. Fabrication of custom trays using the self-curing dough method follows:

| Fabricating a Self-curing Dough Impression Tray | |
|---|---|
| Step | Action |
| 1 | Design tray. |
| 2 | Block out undercuts on the diagnostic cast. |
| 3 | Apply baseplate wax within the tray area outlined onto the diagnostic cast. |

| Fabricating a Self-curing Dough Impression Tray | |
|---|---|
| Step | Action |
| 4 | Cut baseplate wax away from areas designated as tissue stops. |
| 5 | Apply a separator to the cast to prevent the acrylic resin from sticking. |
| 6 | Mix the acrylic into a doughy state. NOTE: <i>Always wear gloves when handling acrylic resin.</i> |
| 7 | Shape and flatten the acrylic. A mold is often used to control the shape and thickness. |
| 8 | Store excess acrylic in a jar to use later for fabricating a tray handle. |
| 9 | Center the resin over the cast and rapidly adapt the dough to the cast's surfaces. |
| 10 | Shape the resin to the borders and cut away the excess with a sharp knife. |
| 11 | Use the remaining acrylic to shape a handle. |
| 12 | Use a few drops of monomer to moisten the attachment site between the handle and the tray. |
| 13 | Press the base of the handle onto the moistened area. |
| 14 | Support the handle in the desired position while autopolymerizing. |
| 15 | Remove the tray from the cast and the wax from the tray after the acrylic resin has set. |
| 16 | Trim the tray's flanges back to the dentist's design using an arbor band to remove the bulk and acrylic finishing stones and burs for finer details. NOTE: Make sure there are no sharp edges on the tray's borders. |

Light-cured material method

A light-curing unit is needed to cure the material used in this method. Materials come prepackaged for consistent size and thickness. The Dentsply International® Triad system is a light-cured system that can be used for making custom trays. The fabrication procedures for this method are as follows:

| Forming a Custom Tray Using Light-Cured Material | |
|--|---|
| Step | Action |
| 1 | Adapt a layer of baseplate wax to the blackout design line on the diagnostic cast. |
| 2 | Cut out tissue stops. |
| 3 | Adapt small pieces of tray material into the tissue stops. |
| 4 | Adapt the tray material to the cast. |
| 5 | Position wire support for the handle then cure tray for 30 to 45 seconds to "set" the material. |
| 6 | Separate the tray and remove wax spacer. This will prevent melting the wax in the curing unit. |
| 7 | Add material for the handle and cure tray for 2 minutes. |
| 8 | Apply the manufacturer's air barrier coating and cure tray for an additional 8 minutes. |
| 9 | Finish the tray to the design line using arbor bands, acrylic finishing burs and stones. |

441. Other prosthodontic materials

Along with the prosthodontic materials previously explained, you need to be familiar with other miscellaneous materials such as acetone, alcohols, dental porcelain, modeling clay, mouthguard materials, separating media, tray adhesive, treatment liners, and wax solvent.

Acetone

Acetone is an excellent solvent for such materials as cyanoacrylate glue, waxes, plastic patterns, and paint. So, if you need to remove or dissolve one of these substances, acetone will do the work.

Alcohols

Isopropyl, methanol, and denatured ethanol are examples of fuels used in an alcohol torch for melting wax. Denatured ethanol is preferred since it is safer to use and burns cleaner.

Dental porcelain

Dental porcelain is manufactured as a powder. It is mixed with water and applied to a crown substrate. It is then heated to a very high temperature in a porcelain furnace, causing it to fuse into a

homogeneous mass. When it cools, the mass is hard and dense. Dental porcelain is manufactured in a variety of shades to match most tooth colors. The translucency of baked porcelain is like that of enamel. This allows porcelain crowns, facings, pontics, and inlays of a highly pleasing appearance to be made.

Modeling clay

In the laboratory, modeling clay (e.g., Ticene) is used to block out large tissue undercuts before a master cast is duplicated or to hold casts in position when they are mounted in an articulator.

Mouthguard material

Mouthguards are fabricated from polyvinyl acetate ethylene blanks and preforms. This thermoplastic resin is molded over a cast by means of a vacuum-forming machine. The use of mouth protectors in sports is to reduce injuries to the oral tissues, head, and neck. Custom fluoride trays also are made out of this material for prescribed home treatment with fluoride gels.

Separating media

Separators work by preventing one material from bonding to another. This is accomplished by filling a material's surface porosities with a nonbonding material. Commercially prepared materials are available to prevent bonding. Separators are required between the following materials:

| Separating Media | |
|--------------------------|--|
| Gypsum and gypsum | Several commercial products (e.g., Die Sep) are available that do not leave a space between the gypsum layers—petrolatum and liquid floor wax work—but create space. Liquid soap is also somewhat effective. |
| Gypsum and acrylic resin | Commercial alginate-based separators (e.g., Al-cote) work well when handled correctly. Disadvantages include discoloring clear acrylic, peeling away from the gypsum, and easy deterioration. Tinfoil is an excellent separator for clear resin since it does not discolor the resin. Its main disadvantages are difficulty adapting to the cast and the amount of time required to adapt. |
| Gypsum and wax | Commercial die lubricants (Ney Die Lube) work well since they do not create much space. Alginate-based separators work well between gypsum and baseplate wax. Talc rubbed into the cast's surface is also an effective separator. |

Tray adhesive

Custom impression trays are coated with tray adhesive before they are filled with rubber impression material. This ensures the impression material stays in the tray when it is removed from the mouth. Tray adhesive is available in spray form for use with alginate impression materials and stock impression trays. Since tray adhesive bonds to almost any surface, it is difficult to remove. If you ever need to peel the impression material from a custom tray or remove the adhesive from a stock tray, use monomer. Use it with caution, however, since monomer is very toxic.

Treatment liners

Treatment liners, also known as tissue conditioners (e.g., Coe-Soft and Lynal), allow oral tissues to recover, improving tone and health, before making a new denture or relining an existing one. The dentist changes the tissue conditioners at 3- to 4-day intervals since the liners stiffen rapidly. These materials also are used as functional impression materials. Do not touch the tissue surface of the liner as this action may distort the impression.

Wax solvent

Wax solvent is specially formulated to dissolve wax. It is not toxic, flammable, or harmful to acrylic resin. It is very effective and much safer to use than many chemicals.

442. Miscellaneous dental materials

Besides the materials we have already covered, there are other materials that have an important place in dentistry. For lack of a better classification, we call these miscellaneous dental materials.

Abrasives

Unless the surfaces of the restorations and appliances are smooth and highly polished, they cannot be kept clean. Food, debris, and salivary deposits collect on a rough surface, producing calculus. If all the surfaces of the restorative materials and the natural teeth are smooth and polished, the cleansing action of the tongue, assisted by proper toothbrushing or denture cleansing, should prevent the formation of any permanent deposits. In dentistry, materials called dental abrasives are used for smoothing and polishing restorations and appliances that are placed in the mouth.

The basic technique behind smoothing and polishing any restoration or appliance is to use progressively finer particles until there is a reflective surface. Reduction of abrasive size produces smaller and smaller scratches until they are no longer visible. This polished surface is one that reflects light evenly and contains no obvious scratches. This use of abrasives usually involves three steps—rough finishing, smoothing, and polishing. The difference between these steps is the type of abrasive used and the effect it produces on the surface.

The abrasives we are discussing encompass carbide and diamond burs, powders, pastes, and anything that abrades a material. Particle size, shape, pressure, and rotational speed all affect the way an abrasive is used all affect the rate of abrasion. Large particles or coarse burs produce deep scratches and require less working pressure. Irregularly shaped particles, like those found on diamond burs, also produce deep scratches when compared to double-cut burs. Increased pressure abrades quickly, causing deep scratches. The faster the rotational speed, the faster the abrasion.

Probably the single most considered factor affecting abrasion is the hardness of the abrasive. There should be a large difference between the hardness of the abrasive and the surface to be finished. Now let's focus our attention on the abrasive compounds that you will normally see.

| Types of Abrasives | |
|--------------------|---|
| Type | Description |
| Pumice | Pumice, a finely ground, sand like material, is used as a polishing agent for amalgams and as an abrasive for acrylic resins. It is mainly composed of complex silicates of aluminum, potassium, and sodium. Pumice is supplied in two grades—flour of pumice and coarse pumice. Flour of pumice is used for polishing restorations. Coarse pumice is primarily used in the dental laboratory to smooth dentures. Never use coarse pumice in a patient's mouth. |
| Zirconium silicate | Zirconium silicate material has largely replaced pumice for polishing teeth. Zirconium silicate is mixed with water or a stannous fluoride solution to prevent caries. |
| Tin oxide | Tin oxide is used to polish teeth and restorations. It is a fine, white powder that is made into a paste form by mixing it with water or glycerin. |
| Tripoli | Tripoli is a polishing agent used in the dental laboratory for gold and other metals. It is made of certain porous rocks found near Tripoli, North Africa, and supplied in cake form. Tripoli is slightly more abrasive than rouge and usually used just before the rouge is used. |
| Rouge | Rouge is a polishing agent, which imparts a high luster to gold. It is composed of iron oxide and is usually supplied in cake or stick form. NOTE: Rouge is not used in the mouth! |
| Chalk | Chalk (whiting) is used as a polishing agent for both acrylic resins and metals. Its main component is calcium carbonate. |

Surgical dressings

During oral and periodontal surgery, the dentist exposes oral soft tissues and sometimes bone, leaving raw wounds. Surgical dressing materials are usually applied to the wounds as a protective barrier. They are sometimes called “surgical packs.”

Surgical packs

Surgical packs are placed on soft tissue or bony wounds to act as both a protective barrier and a soothing and healing agent. They are primarily used as a gingival bandage after periodontal surgery (periodontal dressings). These packs not only protect the area by preventing food from touching the excised margins but also soothe and aid in healing the tissues. Your main duty is to mix the ingredients and form the packs that the dentist places in the patient's mouth.

Types of dressings

There are two types of self-cured surgical dressings—those that contain eugenol and those that do not. Dressings that contain eugenol have given way to noneugenol types of surgical dressings because eugenol irritates the healing process of soft tissues. A noneugenol type is Coe-Pack and is usually used on patients whose surgery left some exposed bone or who are allergic to eugenol.

Another recently developed product (e.g., Barricade) is a light-cured resin for packing or dressing surgical areas. The light-cured products are rapidly gaining popularity and they do not require mixing. Patient acceptance of these products is high because they are translucent and more esthetic. This translucent ability allows the dentist to see the tissues throughout the postsurgical phase.

Endodontic materials

The main materials used in root canal therapy are various liquid antiseptics, paper points, gutta percha points, and sealers. The dentist uses these to treat and fill a properly prepared root canal from which the pulp has been removed.

Paper points

Paper points are primarily used during the treatment phase of endodontics to dry out root canals. Saturated with an antiseptic (ethyl alcohol, camphorated parachlorophenol, and sometimes creosote) they are inserted into the prepared canal to act as antiseptics (bacterial growth inhibitors) and bactericidals (bacterial destruction agents). Paper points are never used as permanent root canal filling materials.

Gutta-percha

Gutta-percha is used as a root canal restorative material. Gutta-percha is the refined, coagulated, milky exudate of certain trees in the Malay Peninsula of Southeast Asia. It is pink or gray in color, softens when heated, and is easily molded. When it is cool, it maintains its shape well. Gutta-percha points have been a choice for root canal restorative materials for many years. The material has many advantages: it has a high thermal expansion, does not shrink unless used with a solvent, is radiopaque, can be kept sterile in an antiseptic solution, is resistant to moisture, is bacteriostatic, and a poor conductor of heat. On the other hand, gutta-percha shrinks when used with a solvent and is not always easily inserted into the root canal. Gutta-percha points are prepared for insertion by disinfecting them in sodium hypochlorite or by washing them in alcohol. They are then air-dried and cemented into the root canal with root canal cement or sealer.

Root canal sealers

The root canal sealers most commonly used in dentistry are packaged in cement and paste forms. The zinc oxide and eugenol type is the cement most often used. The liquid is eugenol, and a typical zinc oxide powder formula may contain several ingredients:

- Zinc oxide—main ingredient.
- Resins—vegetable or mineral oil types.
- Thymol iodide—a bactericide.
- Bismuth subcarbonate—an antacid.

Besides the above ingredients, some formulas contain silver particles or barium sulfate, which add radiopaque (ability to stop radiant energy such as x-rays) qualities. These ingredients are mixed in much the same way as in zinc phosphate cement. Using a glass slab and a noncorroding spatula, incorporate the powder into the liquid until a thick, creamy consistency is reached.

Pit and fissure sealants

The development of occlusal sealants has made caries prevention easier. These materials protect the pits and fissures of the teeth from bacterial activity that creates carious lesions. The key to a significant reduction in pit and fissure caries is to lessen the retentive nature of occlusal anatomy. A fissure less likely to harbor debris and bacteria is less likely to decay.

Purpose

The sealants used are materials that coat the occlusal surface. The sealant acts as a physical barrier to prevent oral bacteria and nutrients from developing acidic conditions that destroy tooth structure.

Sealants are indicated for previously unrestored, deep, narrow pits and fissures that show no evidence of caries. The pits and fissures of permanent first and second molars make these areas the most carious prone in the mouth. Sealants should be placed on these teeth as soon as possible after eruption when the tooth is free of gingival contact and when there is no tissue flap to interfere with application procedures.

Materials

The materials used for this procedure include an etchant or conditioner and a sealant. The conditioner is an acidic gel or a 30 to 40 percent acidic solution that, when applied to the occlusal surface, removes inorganic material and creates tiny crevices or micropores. This rough and reactive porous surface provides an increased amount of surface area and tiny pits that allow the sealant to penetrate the enamel, forming a strong mechanical bond. Most sealants are similar to the resins used in formulating composite resin materials. The sealants, however, must be of low viscosity so they will flow readily into the depths of the pits and fissures to coat the tooth thoroughly. The sealant material may be either self-curing, which requires mixing two components to cure chemically, or light-cured with the use of visible or ultraviolet light. Sealants may be clear, tinted, or white in color with white presenting a good contrast to the tooth structure and not being objectionable to the patient.

Handling

Careful handling of these materials is necessary to ensure success. It is particularly important that the sealant material not be exposed to air during storage. This may cause evaporation, which makes the material less fluid and reduces penetration into the pits and fissures.

Fresh sealant material should be used and other sealant equipment, such as brushes and light sources should be well maintained.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

436. Dental alloys

1. What are the four noble metals primarily used in dentistry?
2. What characteristics of gold make it a desirable restorative material?

3. Why is gold alloyed with copper, silver, platinum, or other metals?
4. List and briefly explain the three forms of direct filling gold.
5. Match the types of gold listed in column B with the description in column A. Each item listed in column B may be used only once.

*Column A**Column B*

- | | |
|---|--------------|
| _____ (1) Soft and subject to very slight stress, and it is used where burnishing is desired. | a. Type I. |
| _____ (2) Extra hard, not easily burnished, used for removable partial denture frameworks and clasps. | b. Type II. |
| _____ (3) Medium, used for restorations, inlays or some crowns subject to moderate stress. | c. Type III. |
| _____ (4) Hard, used for single onlays, crowns and fixed partial denture restorations. | d. Type IV. |

6. What elements are commonly found in noble casting alloys?
7. Match the elements in noble casting alloys listed in column B with the description of its effect in column A. Each item listed in column B may be used more than once.

*Column A**Column B*

- | | |
|---|------------|
| _____ (1) Increased use intended to lighten the color. | a. Zinc. |
| _____ (2) The alloy becomes darker as the content increases. | b. Copper. |
| _____ (3) Prevents the loss of copper by oxidation of the molten metal. | c. Silver. |
| _____ (4) Increases as the content of zinc increases. | |
| _____ (5) Lowers the melting point of the alloy, making it more fluid and easier to cast. | |

8. Other than composition, how do noble metal-ceramic alloys differ from conventional gold casting alloys?
9. What are the uses of solders in dentistry?
10. What are the uses of platinum foil?
11. How are chromium-containing alloys used in dentistry?
12. What are the advantages of chromium alloys for dental castings?

13. What is the disadvantage of chromium alloys for RPD castings?
14. What forms of wrought alloys are available and what are the uses?

437. Impression materials

1. Impression compounds are used for what reasons?
2. How are impression compounds softened to a working consistency?
3. What precautions must be observed when handling impression compounds?
4. How can a master cast be separated from a compound impression?
5. Describe the use of impression wax.
6. How do you extend the setting time of impression paste compounds?
7. What are the advantages of alginate impression material?
8. What are the uses of alginate impression materials?
9. Describe the two types of alginate.
10. What causes the deterioration of alginate impression materials?
11. Why is maximum gel strength required?
12. What manipulative factors affect the gel strength?

13. Why is gel time or setting time important?
14. How does temperature affect alginate setting times?
15. How does spatulation affect the alginate mix?
16. When does the operator remove the alginate impression from the mouth? Why?
17. What care should be used when handling an alginate impression? Why?
18. Briefly explain the use of each consistency type of rubber-base impression material.
19. What are the three types of rubber impression materials? Briefly compare each.
20. How does a polysulfide impression material appear that has been improperly mixed?
21. What happens if the 5-minute working time is exceeded with polysulfides?

438. Gypsum products

1. What is “given off” by all gypsum products as initial solidification takes place?
2. List three dental uses of dental plaster.
3. What are the initial and final setting times for dental plaster?
4. Which process requires more water mixing hydrocol or mixing dental plaster?

5. What properties make stone preferable to plaster as a master cast in partial and complete denture construction?
6. What are the most frequent uses of dental stone?
7. What are the uses of die stone?

439. Waxes

1. Match the wax in column B with its description in column A. Each item listed in column B may be used only once.

| <i>Column A</i> | <i>Column B</i> |
|---|---------------------------|
| ____ (1) A metal-impregnated wax used to transfer the occlusal relationship of the teeth from the patient to the casts. | a. Baseplate wax. |
| ____ (2) A wax supplied in a strip about 1½ inches wide and 12 inches long used to enclose the impression with a matrix when you pour a cast. | b. Bite registration wax. |
| ____ (3) Composed of beeswax, paraffin, and resin, this wax will break rather than bend under pressure. It is used to hold the parts of a broken denture together so that it can be repaired. | c. Boxing wax. |
| ____ (4) The most carefully compounded of all the waxes, it is used to make wax patterns for castings in fixed and removable prosthodontics. | d. Disclosing wax. |
| ____ (5) Used to bead impressions and protect soft tissue during impressions; this wax is pliable and somewhat tacky at room temperatures. | e. Indicator wax. |
| ____ (6) Available in hard and medium types for use in different climates, this wax is used for occlusal rims. | f. Inlay wax. |
| ____ (7) Coated with a water soluble adhesive on one side, this wax is used for registering occlusal contact on teeth, restorations, and dentures. | g. Sticky wax. |
| ____ (8) A high fusing wax used to fill voids or block out undesirable undercuts on casts or defects on dies. | h. Undercut wax. |
| ____ (9) An ivory-colored wax that is low fusing and flows at mouth temperature used to disclose points of unequal pressure when inserting fixed restorations and removable partial denture frameworks. | i. Utility wax. |

440. Acrylic resins

1. What terms apply to the powder and the liquid used to make denture base material?

2. Match the acrylic resin in column B with its use column A. Each item listed in column B may be used only once.

Column A

- ____ (1) Construct night guards and surgical appliances.
- ____ (2) Tooth-shaded acrylic resins in fixed prosthodontics to make provisional and permanent restorations.
- ____ (3) Supplied in a variety of shades to match the oral mucosa of most people, regardless of race or nationality.
- ____ (4) In specific areas of the denture base to highlight anatomical details and simulate the patient's mucosal coloring in the finished denture.
- ____ (5) Construct nightguards and orthodontic appliances.
- ____ (6) Construct record bases and interim removable partial dentures, and repair of any acrylic appliance.
- ____ (7) Customized impression trays.

Column B

- a. Tray acrylic.
- b. Repair resins.
- c. Orthodontic resin.
- d. Denture base stains.
- e. Denture base resin.
- f. Crown and bridge resin.
- g. Clear acrylic.

3. What method of custom tray fabrication uses material that is prepackaged for consistent size and thickness?

441. Other prosthodontic materials

1. What solvent would you use to remove cyanoacrylate glue from your fingers?
2. Which alcohol is preferred for use in an alcohol torch? Why?
3. Briefly describe how dental porcelain is formed.
4. What are the uses for modeling clay?
5. List two uses for mouthguard material.
6. Which separator would be used between gypsum and acrylic resin?
7. What is tray adhesive used for and why?

8. Which solvent would you use to dissolve tray adhesive and remove rubber impression material from a custom tray?
9. What are the uses of treatment liners or tissue conditioners?

442. Miscellaneous dental materials

1. What is the purpose of using abrasives to smooth and polish dental restorations and appliances?
2. What is the basic technique behind using abrasives?
3. What are the three steps involved in the use of abrasives? What is the difference between these steps?
4. What factors affect the rate of abrasion? Explain each.
5. What is the single most important factor affecting abrasion?
6. What are the two grades of pumice and the use of each?
7. What abrasive has largely replaced pumice for polishing teeth?
8. What abrasive is used to polish teeth and restorations?
9. What abrasive is used in the dental laboratory to impart a high luster to gold?
10. Why are surgical packs used?
11. On which patients would a noneugenol type of surgical pack be used?

12. List three reasons why light-cured surgical dressings are gaining popularity?
13. How are paper points used during endodontic treatment?
14. What are the disadvantages when gutta-percha is used as an endodontic material?
15. How are gutta-percha points prepared for insertion?
16. Name the type of root canal cement most often used.
17. What is the purpose of sealants in caries prevention?
18. What are indicators for the use of sealants?
19. Which areas of the mouth are the most carious prone? When should sealants be placed on these teeth?
20. What is the purpose of the conditioner?
21. How do sealants differ from composite resin materials?
22. In what forms are sealants supplied?
23. What must you avoid doing in handling sealants? Why?

Answers to Self-Test Questions

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1. (1) Mixing one part of a material with another part from a different lot number.

- (2) Improperly measuring and mixing materials without following the manufacturer's directions.
2. Read and follow the manufacturer's instructions.
3.
 - (1) Be biologically compatible.
 - (2) Help protect the tooth and oral tissues.
 - (3) Restore the natural contours and functions of missing tooth structures.
 - (4) Be esthetically pleasing.
 - (5) Be easily formed and placed in the patient's mouth, despite limited access and poor visibility.
4. Approximately 28,000 pounds per square inch on a single cusp of a molar tooth.
5. Temperature fluctuations.
6. Foods, such as citrus fruits, are very acidic while others are quite alkaline and acid is liberated when bacteria act upon food debris present in the mouth. The surfaces of teeth and dental restorations make constant contact with the corrosive effects of acid or alkaline substances.
7. Because restorations may be subjected to many substances that can stain them. Chemical action within the oral environment may cause changes within the material itself which results in discoloration.
8.
 - (1) The materials used must be nontoxic.
 - (2) Both organic and inorganic matter are involved.
 - (3) The mouth normally has a wet atmosphere.
 - (4) The preparation surfaces have imperfections, irregularities, and debris.
9. Differing rates of expansion and contraction of tooth structure and restorative materials; the limited amount of tooth structure that may safely be removed; and the limited amount of stress that abutment teeth and oral tissues can withstand in trying to stabilize a fixed or removable denture.
10. A material must be harmless to the individual and preserve or restore the health of the teeth and oral tissues.
11. They do not actually seal the cavity preparation.
12. A microscopic space always exists between the restoration and the tooth permitting fluids, microorganisms, and debris from the mouth to penetrate the outer margins of the restoration and progress down the walls of the cavity preparation through the dentin and into the pulp. The pulp is irritated with severe leakage that may cause the tooth sensitivity or redecay.
13. The temperature at the base of the restoration can be the same as that at the surface and the dentin beneath the restoration may be so thin that it is inadequate to insulate the pulp against these sudden temperature changes causing injury to the pulp.
14. Additional thermal protection can be placed with a layer of suitable insulation under the restoration.
15. Temperature changes produced by chemical reactions that occur during hardening of restorative materials after they have been inserted.
16. A small electrical current created when two different metals are located close together in the oral cavity, such as a small shock created when a silver fork touching a metal restoration.

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1. Tensile force pulls and stretches material, compressive force pushes it together, and shearing force tries to slice it apart.
2. There must be an applied outside force.
3. It is the distortion or change produced in a body as the result of stress.
4. The ability of a body that has been changed or deformed under stress to resume its original shape when the stress is removed.
5. Elastic limit, proportional limit, and yield strength.
6. The greatest stress a structure or material can withstand without fracture or rupture.
7. The ability of a material to withstand permanent deformation under tensile stress without fracture.
8. Allows it to withstand permanent deformation under compressive stress without rupture.
9. Some materials continue to deform permanently under a load, even when the load (stress) is constant.
10. Under compressive stress.

11. The tendency of dental waxes or amalgam alloys to deform under a constant load.
12. In terms of its resistance to indentation.
13. In terms of the Brinell hardness number (BHN); the harder the material, the higher the BHN number.
14. The resulting change in shape or dimension when materials tend to relax and the tension is eased.
15. Such dimensional changes may result in the misfit of a precise dental restoration or appliance.
16. The ability of a material to conduct heat.
17. In some prosthetic appliances; so the patient may have a normal sense of hot and cold while eating.
18. The rate at which a material expands or contracts with temperature changes.
19. The force that causes unlike molecules to attach to each other (the stickiness that allows tape or glue to stick).
20. It involves the interplay of viscosity, wetting, film thickness, and surface tension.
21. The property of a liquid that prevents it from flowing easily. A high viscosity adhesive will not flow easily and is not effective in wetting a surface.
22. The characteristic of a liquid to flow easily over the surface and come into contact with all of the small irregularities present.
23. It is the thickness of adhesive film that affects the strength of the adhesive junction (the thinner the film, the stronger the junction).
24. The higher the surface tension, the more the adhesive reacts; low surface tension is used when sticking is not desirable.
25. An adhesive that adheres to the organic component of the tooth is not as likely to adhere to the inorganic portion.
26. There is always a microscopic, single-molecule layer of water on the tooth surface that prevents the adhesive from coming into intimate contact with the tooth.

430

1. To protect the dental pulp from thermal, chemical, electrical, and any other possible sources of irritation.
2. Because it stimulates the production of secondary dentin.
3. Sterile water or local anesthetic.
4. Simply place small, equal portions of the base and catalyst on the mixing pad and mix together.
5. It is used for pulp capping in pulpectomy procedures and as a cavity liner under cement bases.
6. Surgical dressings, impression materials, root canal sealing materials, base material under restorations, cementing agents, and temporary or sedative-filling materials.
7. Low-crushing strength and its solubility in oral fluids.
8. In paste form; pulp protectors or insulating materials.
9. Place equal lengths of the base material and the catalyst on the mixing pad and mix together.
10. To partially insulate the tooth structures from certain chemicals and to seal the dentinal tubules of the tooth preparation.
11. Add some of the thinner that is supplied with the liners and varnishes. This will return them to a usable consistency.

431

1. (1) Both temporary and permanent cementing agents for fixed restorations.
 (2) Cementing agents for orthodontic bands.
 (3) Insulating bases to protect against thermal shock under metallic restorations.
 (4) Temporary restorations.
 (5) Sedative treatment materials.
 (6) Capping materials for an exposed pulp or to protect the pulp.
 (7) Root canal fillings.

2. They are soft and weak in comparison to metals, dissolve and erode in the mouth (except resin cements), are not adhesive to enamel and dentin under oral conditions (except polycarboxylate cements), and may be irritating to the dental pulp (except zinc oxide-eugenol and polycarboxylate).
3. Almost entirely by the mixing technique.
4. As a permanent cementing agent for crowns, inlays, fixed partial dentures and other dental appliances; a temporary restoration; and an insulating base under amalgam restorations.
5. Zinc oxide.
6. Dispense the liquid immediately before use and recap the bottle promptly.
7. It is easily mixed and manipulated, can be used in a thin consistency, and has low thermal conductivity.
8. Its solubility and disintegration in the oral environment. Recurrent decay (caries) around crowns and inlays.
9. Cavity varnish. The acidity of the cement irritates the tooth pulp, it is used to seal dentinal tubules and minimize pulpal irritation before zinc phosphate cement is used on vital pulp.
10. The strength of the mix is directly proportional to the amount of powder it contains. Therefore, mix the maximum amount of powder that still yields the desired mix consistency.
11. A clean, cool, dry glass slab and a #313 or #324 stainless steel spatula.
12. Cooler slab and spatula temperatures lengthen the setting time.
13. Divided into portions consisting of a total of six portions—three $\frac{1}{4}$ -portions, one $\frac{1}{8}$ -portion, and two $\frac{1}{16}$ -portions.
14. (1) Thin, medium consistency used as a cementing agent for inlays, crowns, and other dental appliances.
(2) Thick mix, which is used as a base material under fillings and sometimes as a temporary filling.
15. Approximately 1½ minutes.
16. 2 minutes.
17. To dissipate the heat created by the chemical action of the ingredients so that tooth pulp will not be injured.
18. A warm mixing slab and spatula; a moist mixing slab; rapid mixing; dilution of the liquid with moisture from the air.

432

1. (1) e.
(2) a.
(3) c.
(4) b.
(5) d.
2. To reduce postoperative sensitivity while the pulp heals, however, because of the relative weakness of this type of cement, the bridge is later cemented permanently with zinc phosphate cement.
3. Strength and solubility are not superior to those of the zinc phosphate cements. Also, they are not irritating to the pulp and help to eliminate or greatly reduce the postoperative sensitivity associated with zinc phosphate cementation of a restoration.
4. Powder-liquid systems in which the liquid is a viscous (thick) aqueous solution of polyacrylic acid and water.
5. The compressive strength is in the range of the reinforced zinc oxide-eugenol cements but inferior to that of zinc phosphate cements. The solubility is comparable to that of zinc phosphate and the reinforced zinc oxide-eugenol cements. The advantage is that it will bond to both enamel and dentin, improving its overall bond strength in these instances and is kinder to the pulp than zinc phosphate cement.
6. They are similar to polycarboxylate cements in that the liquid is an aqueous solution of polymers of acrylic acid, stronger than zinc phosphate cements, an advantage of being anticariogenic due to slow fluoride release, and more difficult to mix.

433

1. Consult manufacturer's instruction. Each of these materials is different from the other and, therefore, requires special handling.

2. They are primarily used to restore anterior teeth and are particularly suitable for incisal restorations; because of their high crushing strength.
3. The composite material and catalyst.
4. The binders are modified acrylates that bind the mix during setting, and the fillers are translucent fiberglass, natural quartz, glass beads, and powdered minerals which transmit light.
5. Two-paste and one-paste systems.
6. By using an ultraviolet or visible blue light source.
7. Macrofilled, microfilled, and hybrid; classified depending on the particle size of its organic filler.
8. (1) c.
(2) c.
(3) a.
(4) b.
9. They have higher amounts of inorganic fillers and lower amounts of organic resin than the microfilled resins, making them superior to microfilled resins in strength, fracture resistance, thermal expansion, and shrinkage.
10. Microfilled.
11. Treatment of the enamel with an acid before insertion of the resin.
12. Phosphoric acid.
13. It is applied after etching the tooth and penetrates into the surface irregularities created by the acid and forms resin "tags" that mechanically interlock the resin with the enamel surface.
14. A clear plastic matrix strip is placed to partially form and hold the composite in place. The composite material is condensed into the preparation with a stellite, plastic condenser, or special syringe. Large buildups of light-cured composites are exposed to the light beam in increments to ensure maximum depth of cure. After the material sets, it is trimmed and smoothed to assume the contour of the natural tooth. A protective coating is placed over the restoration to protect it from premature exposure to oral fluids.
15. Areas involving cervical abrasions and root caries.
16. A 10 percent polyacrylic acid. A strong bonding between dentin and the glass ionomer cement; added advantage of achieving excellent retention with only minimal cavity preparation required.

434

1. A material that has the characteristics of metal and is composed of two or more elements, at least one of which is metal.
2. Amalgam is limited to use in the posterior because its color makes it esthetically undesirable in anterior teeth.
3. 60 percent silver, 27 percent tin, and 13 percent copper.
4. (a) Imparts a high luster and a silver-colored appearance; increases strength, durability, and expansion of the alloy; decreases flow and setting time.
(b) Reduces expansion, strength, and hardness and increase the flow, setting time, and workability.
(c) Increases the hardness and expansion while decreasing the flow and setting time.
5. They expand excessively and corrode badly if moisture is incorporated during mixing or packing.
6. It reacts chemically with the particles of silver in the alloy to bond the particles of silver to the other particles in the alloy.
7. (1) Use precapsulated amalgam and close the capsule after use before discarding it to reduce mercury vapors.
(2) Clean up any known mercury spill at once.
(3) Use water spray and high volume evacuation when grinding or polishing dental amalgam.
(4) Do not heat dental amalgam.
(5) Store dry amalgam scrap in a covered, screw type container.
8. Use vacuum aspiration through a water trap followed by a wet HgX (mercury vapor decontaminant) or calcium polysulfide treatment.

9. Easily adapted to a prepared cavity; sets in appropriate time and resists corrosion; is dimensionally stable; and has adequate strength when set.
10. High thermal conductivity; poor color.

435

1. The combining of the mercury and the alloy particles decreases the total volume, causing the amalgam mass to initially shrink, which continues during the first hour after mixing.
2. Approximately 6 to 7 hours.
3. Improper trituration, manipulation, and condensation.
4. Pressure and postoperative sensitivity in the tooth or protrusion of the restoration from the cavity; with severe contractions the restoration could pull away from the cavity walls and permit gross leakage between the tooth and the restoration.
5. Because the restoration in a tooth is subject to compressive, shearing, and tensile stresses.
6. The manufacturer, the dental assistant, and the dentist.
7. The manufacturer.
8. Mixing and manipulating of amalgam.
9. Faulty timing, overtrituration, and undertrituration.
10. The amalgam may begin to set prematurely. Prepare a fresh mix and dispose of the old mix.
11. Overtrituration decreases the setting time and increases the shrinkage; conversely, undertrituration increases the setting time and expansion and weakens the amalgam. Consult the manufacturer's instructions.
12. Contaminating the mix with moisture or other impurities.
13. Debris on an instrument introduced into amalgam can interfere with the chemical bonding action.
14. Not condensing the amalgam sufficiently results in an increase in expansion and, therefore, a weakened amalgam; the chemical setting action can be interrupted if it takes too long to condense the amalgam, which also weakens amalgam.

436

1. Silver, platinum, palladium, and gold.
2. It is soft, malleable, ductile, and does not oxidize.
3. This develops the hardness, durability, and elasticity necessary for lasting restorations.
4. Foil, rolled into very thin sheets to the point that light can be transmitted through the metal. Mat foil, a fine gold powder compressed and heated to a temperature just below the melting point of the metal, supplied in small, thin strips. Pellet, small particles of gold lightly compressed into a pellet ranging in size from approximately 1 to 3 millimeters, wrapped in gold foil.
5. (1) a.
(2) d.
(3) b.
(4) c.
6. Gold, silver, copper, platinum, palladium, and zinc.
7. (1) c.
(2) b.
(3) a.
(4) b.
(5) a.
8. They are harder, lighter in color, and have a higher melting range; they oxidize, providing a means for chemical bonding of metal to porcelain.
9. Join units of fixed partial dentures, and to make repairs of everything from mending holes in castings to adding proximal contacts.
10. Gold repair procedures (for example, mending holes in castings) and as a matrix for porcelain jacket crowns and veneers.

11. For applications such as denture bases, RPD frameworks, resin-bonded bridges, and dental implants.
12. They are lighter in weight, resist corrosion, have good mechanical properties, and are less expensive than the noble alloys.
13. Requires the use of specialized equipment.
14. Wires and band materials; the construction of orthodontic and prosthodontic appliances.

437

1. For border molding of acrylic custom trays, fabricating an improvised custom tray for complete dentures, and securing broken pieces of a denture, cast mountings, etc.
2. By placing them in a hot water bath or heat them over a flame.
3. Overheating makes impression compounds so sticky that they are extremely difficult to handle. When they cool, impression compounds become hard and brittle.
4. By soaking the impression in warm water for several minutes to soften the compound and aid in removal of the impression without damaging the cast.
5. A low-fusing material that can be used as a “wash” to correct defects or deficiencies in other impressions.
6. By decreasing the amount of hardener.
7. Easy to prepare and handle; does not require extensive equipment and advance preparation; comfortable for the patient; and it is inexpensive.
8. Preliminary impressions for all study casts and most final impressions for removable partial denture working casts.
9. Type I, fast setting; type II, regular setting.
10. Exposure to heat or moisture.
11. To prevent tearing (fracture) and ensure elastic recovery of the alginate impression upon its removal from the mouth.
12. Gel time, temperature—most commonly of the water, proportions of water and powder, and spatulation.
13. Rapid gelling does not permit adequate working time; too long a setting time is tedious for both the operator and the patient. Once gelling starts, it must not be disturbed since distortion of the material is permanent.
14. High temperature can speed the setting time; cold can retard the setting time.
15. Insufficient spatulation causes failure of ingredients to dissolve so that the chemical reactions can proceed uniformly throughout the mass. The strength of the gel is reduced as much as 50 percent if the mixture is incomplete. A prolonged mixing time causes the gel to break up as it is forming, and the strength will decrease.
16. When the material loses its tackiness, at least 2 to 3 minutes after gelation occurs. The strength of the alginate gel increases for several minutes after initial gelation.
17. Poured immediately to avoid syneresis, caused by leaving the impression in the air which causes shrinkage, or imbibition, caused by soaking the impression in water which causes swelling.
18. Light bodied, to be injected with a syringe into preparations for inlays, crowns, and fixed partial dentures; regular bodied, to be used in an impression tray for inlays, crowns and fixed partial dentures and as “wash” impressions for full dentures, relinings, and removable partial dentures; heavy bodied, to be used in a tray to force light bodied impression material into the cavity preparation or with a copper band for impressions of single teeth.
19. (1) Polysulfides—dark color; sulfur type smell; improper mix affects dimensional stability; pour no later than one hour after removal.
- (2) Silicones—lighter in color, translucent when set; subdued odor; available in a heavy putty material; dimensional stability and accuracy of the “addition” silicones (vinyl polysiloxane) superior to all other rubber materials; do not have to be poured immediately and may repoured, if necessary.
- (3) Polyethers—lighter colors than polysulfides, but darker than the silicones; working and setting time much shorter; comparable to polysulfide for long-term dimensional stability; absorbs water; stiff-making it difficult to remove from the mouth and cast; tears easily, especially in thin areas like the subgingival sulcus.

20. It will have streaks in it.
21. The resulting impression will have inadequate expansion, producing a smaller cast.

438

1. Heat.
2. To form casts, construct matrices, and attach casts to the articulators.
3. The initial setting time ranges from 7 to 13 minutes and the final set occurs within approximately 45 minutes.
4. Dental plaster.
5. When it is set, it is harder, denser, and has a higher crushing strength.
6. For pouring and mounting casts and flasking dentures for processing.
7. First pour of a working cast for fixed prosthodontics and working casts for removable prosthodontics.

439

1. (1) b.
(2) c.
(3) g.
(4) f.
(5) i.
(6) a.
(7) e.
(8) h.
(9) d.

440

1. The powder is polymer and the liquid is monomer.
2. (1) g.
(2) f.
(3) e.
(4) d.
(5) c.
(6) b.
(7) a.
3. The light-curing method.

441

1. Acetone.
2. Denatured ethanol. It's safer to use and burns cleaner.
3. The powder is mixed with water and applied to a crown substrate, then heated to a very high temperature in a porcelain furnace, causing it to fuse into a homogeneous mass.
4. It is used in the dental laboratory to block out large tissue undercuts before a master cast is duplicated or used to hold casts in position when they are mounted in an articulator.
5. Used as mouth protectors in sports and as custom fluoride trays for prescribed home treatment with fluoride gels.
6. Commercial alginate-based separator.
7. To coat custom impression trays before they are filled with rubber impression material and ensure that the impression material stays in the tray when it is removed from the mouth.
8. Monomer.
9. Allow oral tissues to recover, improving tone and health, before making a new denture or relining an existing one and also as functional impression materials.

442

1. So surfaces can be kept clean and prevent formation of any permanent deposits.
2. Use progressively finer particles until there is a reflective surface.
3. Rough finishing, smoothing and polishing. The type of abrasive used and the effect it produces on the surface.
4. Particle size, shape, pressure, and rotational speed. Large particles or coarse burs produce deep scratches and require less working pressure. Irregularly shaped particles, like those found on diamond burs, also produce deep scratches when compared to double-cut burs. Increased pressure abrades quickly, causing deep scratches. The faster the rotational speed, the faster the abrasion.
5. The hardness of the abrasive.
6. Flour of pumice is used for polishing restorations. Coarse pumice is primarily used in the dental laboratory to smooth dentures. Coarse pumice should never be used in the patient's mouth.
7. Zirconium silicate.
8. Tin oxide.
9. Rouge.
10. To act as a protective barrier and a soothing and healing agent.
11. On those whose surgery left some exposed bone or those who are allergic to eugenol.
12. No mixing required; translucent; and more esthetic.
13. To dry out root canals and, when saturated with antiseptics, they are inserted into the prepared canal to act as antiseptics and bactericidals. They are never used as permanent root canal material.
14. It shrinks when used with a solvent and is not always easily inserted into the root canal.
15. Disinfected in sodium hypochlorite or washed in alcohol; then air-dried and cemented into the root canal with root canal cement or sealer.
16. Zinc oxide and eugenol.
17. To protect the pits and fissures of the teeth from bacterial activity that creates carious lesions.
18. Previously unrestored, deep, narrow pits and fissures that show no evidence of caries.
19. The pits and fissures of permanent first and second molars. As soon as possible after eruption when the tooth is free of gingival contact and there is no tissue flap to interfere with application procedures.
20. When applied to the occlusal surface it removes inorganic material and creates tiny crevices or micro-pores providing an increased amount of surface area, and tiny pits that allow the sealant to penetrate the enamel, forming a strong mechanical bond.
21. They are lower in viscosity so that they will flow readily into the depths of the pits and fissures to coat the tooth thoroughly.
22. Self-curing or light-cured; clear, tinted, or white resin.
23. Exposing the sealant material to air during storage. This causes evaporation, which makes the material less fluid and reduces penetration into the pits and fissures.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

65. (428) Dental materials must meet all of the demands of the oral environment *except*
 - a. be biologically compatible.
 - b. protect the tooth and oral tissues.
 - c. be formed and placed in the patient's mouth, with limited ease.
 - d. restore the natural contours and functions of missing tooth structures.
66. (428) Dental restorative materials and the natural tooth structure must have *nearly* the same rate of
 - a. expansion and contraction only.
 - b. thermal conduction and expansion only.
 - c. contraction and thermal conduction only.
 - d. thermal conduction, expansion, and contraction.
67. (428) What term describes the deficiency when materials used in the restoration of carious lesions do *not* actually seal the cavity preparation?
 - a. Temperature changes.
 - b. Temperature effects.
 - c. Retention defects.
 - d. Microleakage.
68. (428) The small electrical currents created when two different metals are located close together in the oral cavity is called
 - a. microleakage.
 - b. microvoltage.
 - c. galvanism.
 - d. cavitation.
69. (429) The ability of a body that has been changed or deformed under stress to resume its original shape is called
 - a. flow.
 - b. ductility.
 - c. elasticity.
 - d. malleability.
70. (429) The property of a liquid that causes it *not* to flow easily is termed
 - a. wetting.
 - b. viscosity.
 - c. distortion.
 - d. thermal expansion.
71. (430) Calcium hydroxide, widely used in dentistry as a pulp-capping material, has the ability to
 - a. seal the margins of the restoration.
 - b. provide translucence to anterior restorations.
 - c. stimulate the production of secondary dentin.
 - d. achieve a cementing level between the restoration and the tooth.

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72. (431) In dentistry, zinc phosphate cement should be mixed over a large area of the slab in order to
- increase the powder's liquid consumption for added strength.
 - provide the necessary liquid evaporation needed for setting.
 - dissipate heat that could be harmful to the tooth's pulp.
 - shorten its setting time.
73. (432) In dentistry, which type of cement is probably the *most* effective for temporarily filling teeth *before* a permanent restoration is placed in the mouth?
- Resin.
 - Polycarboxylate.
 - Zinc oxide-eugenol.
 - Zinc silicophosphate.
74. (433) In dentistry, composite restorative materials are primarily used for
- posterior restorations.
 - anterior restorations.
 - facings for crowns.
 - root canal sealers.
75. (433) In dentistry, the bulk of composite resins are comprised of
- 70 percent inorganic fillers.
 - 70 percent organic fillers.
 - 90 percent inorganic fillers.
 - 90 percent organic fillers.
76. (433) In dentistry, hybrid composite resins are composed of
- particles .01 to .1 microns in size.
 - particles to 5 microns in size.
 - particles 5 to 8 microns in size.
 - a combination of both macro and micro inorganic fillers.
77. (433) Which dental resin has higher amounts of inorganic fillers and lower amounts of organic resin?
- Microfilled only.
 - Macrofilled only.
 - Microfilled and hybrid.
 - Macrofilled and hybrid.
78. (433) In dentistry, the acid etch technique uses a solution of
- 0 percent phosphoric acid.
 - 0 percent polyacrylic acid.
 - 35 to 50 percent phosphoric acid.
 - 35 to 50 percent polyacrylic acid.
79. (434) A *typical* composition of dental amalgam alloy would be composed of
- 60 percent silver, 27 percent tin, and 13 percent copper.
 - 60 percent silver, 3 percent tin, and 27 percent copper.
 - 75 percent silver, 10 percent tin, and 5 percent copper.
 - 75 percent silver, 5 percent tin, and 10 percent copper.
80. (434) What metal left uncovered at room temperature will volatilize in air?
- Zinc.
 - Bismuth.
 - Mercury.
 - Beryllium.

81. (435) How long does it take to complete the crystallization of a dental amalgam mix?
- a. 3 to 4 hours.
 - b. 5 to 6 hours.
 - c. 6 to 7 hours.
 - d. 24 hours.
82. (435) To assure high-quality dental amalgam restorations, who must exercise the proper controls to produce an alloy with the metals in the correct proportions?
- a. Dentist.
 - b. Manufacturer.
 - c. Dental assistant.
 - d. Dental supply company.
83. (435) When properly mixing dental amalgam, *overtrituration* is undesirable because it
- a. decreases the setting time, and increases the shrinkage of the amalgam.
 - b. decreases the setting time, and decreases the shrinkage of the amalgam.
 - c. increases the setting, decreases the expansion, and weakens the amalgam.
 - d. increases the setting time, increases the expansion, and weakens the amalgam.
84. (436) The noble metals used in dentistry are primarily
- a. silver and gold only.
 - b. palladium and platinum only.
 - c. silver, platinum, palladium, and gold.
 - d. chromium-cobalt and chromium-nickel.
85. (436) Which casting gold alloy is used for dental restorations subject to moderate stress?
- a. Type I.
 - b. Type II.
 - c. Type III.
 - d. Type IV.
86. (436) Which casting alloy is *not* easily burnished and is used for removable of partial denture (RPD) frameworks and clasp assemblies?
- a. Type I.
 - b. Type II.
 - c. Type III.
 - d. Type IV.
87. (437) What dental impression material is used to border mold a custom tray?
- a. Rubber-base.
 - b. Hydrocolloid.
 - c. Impression paste.
 - d. Impression compound.
88. (437) In dentistry, what is the *most* common temperature variable in mixing alginate and how does it affect the setting time?
- a. Water; higher temperature slows the setting time and colder speeds it.
 - b. Water; lower temperature retards and higher temperature speeds the setting time.
 - c. Room temperature; higher temperature slows the setting time and colder speeds it.
 - d. Room temperature; lower temperature retards and higher temperature speeds the setting time.

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89. (437) What happens to a dental alginate impression soaked in water?
- a. Syneresis, causing the impression to swell.
 - b. Imbibition, causing the impression to swell.
 - c. Syneresis, causing the impression to shrink and distort.
 - d. Imbibition, causing the impression to shrink and distort.
90. (437) Which type of dental impression material is usually a dark color, has a sulfur type smell, and must be poured within hour after removal?
- a. Polysulfide.
 - b. Polyvinyl.
 - c. Polyether.
 - d. Silicone.
91. (438) In dentistry, die stone is used for
- a. master casts in complete and partial denture construction.
 - b. pouring and mounting casts and flasking dentures for processing.
 - c. forming casts, constructing matrices, and attaching casts to the articulator.
 - d. making the first pour of a working cast for fixed prosthodontics and working casts for removable prosthodontics.
92. (439) Which type of wax is a metal-impregnated wax in sheet form used to articulate dental casts?
- a. Utility.
 - b. Boxing.
 - c. Baseplate.
 - d. Bite registration.
93. (439) The *most* carefully compounded of all the waxes, used to make patterns for castings and frameworks in fixed and removable prosthodontics, is called
- a. disclosing wax.
 - b. indicator wax.
 - c. utility wax.
 - d. inlay wax.
94. (440) In dentistry, which term is used to identify acrylic resin liquid?
- a. Methyl methacrylate.
 - b. Fluid resin.
 - c. Monomer.
 - d. Polymer.
95. (440) What type of acrylic resin is supplied in a variety of shades to match the oral mucosa of *most* people?
- a. Crown and bridge resin.
 - b. Denture base resin.
 - c. Denture base stain.
 - d. Repair resin.
96. (441) What material ensures the dental impression material stays in the tray when it is removed from the mouth?
- a. Tray liner.
 - b. Tray adhesive.
 - c. Treatment liner.
 - d. Tray conditioner.

97. (442) What material is used to polish teeth?
- a. Zirconium silicate.
 - b. Course pumice.
 - c. Abrasive paste.
 - d. Rouge.
98. (442) Paper points are primarily used during the treatment of endodontics to
- a. fill root canals.
 - b. seal root canals.
 - c. widen root canals.
 - d. dry out root canals.
99. (442) What is an advantage of using gutta-percha as a restorative root canal material?
- a. Will not shrink when used with a solvent.
 - b. Low thermal expansion.
 - c. Radiopaque to x-rays.
 - d. Good heat conductor.
100. (442) Which teeth are the *most* prone to pit and fissure caries?
- a. Permanent first and second molars.
 - b. Permanent first and second bicuspid.
 - c. Permanent first molars and second bicuspid.
 - d. Permanent second molars and second bicuspid.

Glossary

Glossary of Abbreviations and Acronyms

| | |
|-------------------------------|---|
| °C | degrees Celsius |
| °F | degrees Fahrenheit |
| ADA | American Dental Association |
| ADR | Accepted Dental Remedies |
| ADT | Accepted Dental Therapeutics |
| Ag | silver |
| AgNO ₃ | silver nitrate |
| AIDS | acquired immunodeficiency syndrome |
| Al | aluminum |
| ANUG | acute necrotizing ulcerative gingivitis |
| APF | acidulated phosphate fluoride |
| AqCl | silver chloride |
| Au | gold |
| AZT | azidothymidine |
| BHN | Brinell hardness number |
| Ca | calcium |
| Cc | cubic centimeter |
| Centi | Latin subdivision meaning 100 |
| Cl | chlorine |
| Cm | centimeter |
| CNS | central nervous system |
| Cu | copper |
| Deci | Latin subdivision meaning 10 |
| Deka | Greek multiple meaning 10 times |
| EBA | Ethoxy benzoic acid |
| F | fluorine |
| FDA | Food and Drug Administration |
| Gm, gm | gram |
| H ₂ O ₂ | hydrogen peroxide |
| H ₂ O | water |
| H | hydrogen |

| | |
|-------------------------|------------------------------------|
| HAV | hepatitis A |
| HbcAG | hepatitis B core antigen |
| HbeAG | hepatitis B e antigen |
| HbsAG | hepatitis B surface antigen |
| HBV | hepatitis B |
| HCl | hydrochloride |
| HCV | hepatitis C |
| hecto | Greek multiple meaning 100 times |
| Hg | mercury |
| HgX | mercury vapor decontaminant |
| HIV | human immunodeficiency virus |
| HSV | herpes simplex virus, type 1 |
| IRHS | intraoral recurrent herpes simplex |
| kilo | Greek multiple meaning 1000 times |
| mg | milligram |
| milli | Latin subdivision meaning 1000 |
| ml | milliliter |
| mm | millimeter |
| N.F. | National Formulary |
| Na | sodium |
| NaCl | sodium chloride (table salt) |
| NaNO₃ | sodium nitrate |
| NSN | national stock number |
| NUG | necrotizing ulcerative gingivitis |
| O | oxygen |
| OH | hydroxyl |
| PDR | Physician's Desk Reference |
| pH | presence of hydrogen |
| ppm | part per million |
| RPD(s) | removal partial denture(s) |
| U | uranium |
| U.S.P. | United States Pharmacopoeia |
| Zn | zinc |
| ZnO | zinc oxide |
| ZOE | zinc oxide eugenol |

Glossary of Terms

Acetaminophen—Tylenol.

Acetylsalicylic acid—Aspirin.

Acid—Substances containing hydrogen (H⁺) that donate hydrogen ions in solution.

Acquired pellicle—A substance made of glycoproteins and lipids that continuously forms on the tooth, also known as the secondary cuticle.

Acute necrotizing ulcerative gingivitis—A type of gingivitis in which the tissue of the interdental papilla is either dead or dying.

Aadenocarcinoma—A malignant tumor in which cells appear as glandular tissue.

Alkaline—Substances with greater hydroxide (OH⁻) ions than hydrogen (H⁺) ions (basic).

Alveolar osteitis—A dry socket of the tooth.

Analgesics—Drugs that relieve pain.

Angular cheilitis—A lesion is derived from overclosure of the bite due to loss of vertical dimension in an edentulous or denture wearing patient.

Angular cheilosis—The cracking of the corners of the mouth due to vitamin B complex deficiency.

Antibiotic—A substance that destroys or inhibits the growth of bacteria and other microorganisms.

Antipyretic—Fever-reducing agents.

Aphthous stomatitis—Aphthous refers to vesicles which tend to form and then break down and produce ulcers. Stomatitis refers to any inflammation of the mucous membrane of the mouth. Also called a canker sore.

Ascorbic acid—A reduced form of vitamin C; water-soluble vitamin; prevents scurvy.

Asymptomatic—Without or absent of symptoms.

Atoms—The smallest basic particles of an element that still maintain the characteristics of the element.

Avitaminosis—Conditions due to the lack of specific vitamins.

Buffer—A solution which does not change pH upon the addition of significant quantities of hydrogen or hydroxyl ions.

Bupivacaine—Marcaine.

Calor—Heat.

Candidiasis—A fungal infection, also known as candida albicans or moniliasis.

Carbocaine—Mepivacaine hydrochloride.

Carcinoma—Cancer, malignant tumor.

Carpules—Glass-type cartridge used to administer local anesthetic.

Cellulitis—A hard, boardlike swelling that spreads through the tissue and wide areas of the face and neck.

Chancre—The primary lesion of syphilis.

Chlorhexidine—An antimicrobial mouthwash available by prescription only.

Compounds—Substances that result from the chemical union of two or more elements.

Contraindicate—Any condition, disease, symptom, sign, or manifestation which renders a particular method of treatment improper or undesirable.

Creosote—Phenolic compound used to disinfect root canals during endodontic procedures.

Curettage—Scraping or cleaning with a curet.

Demerol—Meperidine.

Dentifrices—Therapeutic aids used in conjunction with a toothbrush to clean the dentition.

Desquamated—Sloughed off.

Diazepam—A fast-acting antianxiety drug also known as Valium.

Dilantin—A drug used in the treatment of epilepsy.

Diplopia—Double vision.

Dolar—Pain.

Dyscrasia—Abnormal composition of the blood.

Edema—Excessive fluid in tissues, swelling.

Elements—The simplest forms of matter which cannot be broken down by ordinary chemical or physical means into simpler substances.

Endogenous—Stains built into the tooth at the time of formation.

Epinephrine—The most widely used vasoconstrictor in dentistry.

Epulis fissuratum—A lesion of hyperplastic tissue, consisting of two or more flaps of soft tissue separated by a central groove into which the denture border fits.

Eucalyptol—A solvent used in treating root canals to partially dissolve and soften gutta-percha points before they are inserted as root canal-filling materials.

Exogenous—Stains which develop on the outside surface of the tooth.

Extrinsic—Induced from external sources.

Exudate—Pus.

Febrile—Feverish.

Fibroma—A benign lesion of the gingiva that develops from the connective tissue or the periodontal ligaments.

Fuorosis—A discoloring of the enamel due to excess fluoride ingestion during tooth development.

Follicle—Small sac or gland.

Functio laeso—Loss of function.

Gingivitis—Inflammation of the gingiva.

Glossitis—Inflammation of the tongue.

Granuloma—A mass of granulation tissue, usually surrounded by a fibrous sac.

Gumma—The lesion produced in the third stage of syphilis.

Gutta percha—Temporary restoration and a root canal restorative material which is the refined, coagulated, milky exudate of certain trees in the Malay Peninsula of Southeast Asia.

Hemangioma—A tumor is made up of small blood vessels and usually congenital, or may appear soon after birth.

Hemostatics—Agents which act to inhibit blood movement.

Herpes labialis—A form of the herpes simplex virus also known as a fever blister or cold sore.

Herpetic whitlow—A herpes simplex virus of the fingers.

Hutchinson's incisors—Malformed teeth in a patient who had congenital syphilis.

Hybrid—Composite resins having a combination of both macro and micro inorganic fillers.

Hydrocal—Dental stone.

Hyperplasia—A fibrous growth at the site of irritation.

Hypnotics—Drugs which produce sleep.

Hypoplastic—Incomplete or arrested development of an organ or part.

Ibuprofen—A nonnarcotic analgesic possessing both antipyretic and anti-inflammatory action, also known as Motrin.

Idiopathic—An unknown cause.

Imbibition—The intake of water.

Intrinsic—Independent of external sources; located within something.

Kaposi's sarcoma—A common cancer which occurs in the AIDS' patient. The lesions may appear on the skin or in the mouth as bluish, blackish, or reddish blotches.

Leukocytes—White blood cells.

Levonordefrin—A vasoconstrictor commonly used in dental anesthetic solutions.

Lidocaine hcl—Xylocaine.

Lymphadenopathy—Any disease process that involves lymph nodes.

Lysis—Decomposition.

Macrofilled—Resins having particles ranging from 1 to 5 microns in size.

Marcaine—Bupivacaine.

Medazolam—A drug, also known as Versed, used for its sedative and hypnotic effect which is similar to Valium but is more potent.

Meperidine—Demerol.

Mepivacaine hydrochloride—Carbocaine.

Microfilled—Resins having much smaller particles ranging from .01 to .1 microns.

Mixture—A substance composed of two or more elements or compounds that have been physically mixed.

Molecule—The simplest particle of the compound that maintains the characteristics of the compound.

Moniliasis—A fungal infection, also known as candida albicans or candidiasis.

Monomer—Liquid portion of a synthetic resin.

Motrin—A non-narcotic analgesic possessing both antipyretic and anti-inflammatory action, also known as Ibuprofen.

Mucin—A by-product of saliva which gives stickiness to the substance.

Mucobuccal—The area of the oral mucous as it passes from the mandible or maxillae to the cheek.

Mucocoele—Retention cysts which occur most commonly on the lower lip.

Mycobacterium tuberculosis—The bacillus bacteria which causes tuberculosis.

Necrosis—Physical and physiological changes in cells, tissues, and organs indicating death of these structures.

Necrotizing—Death and disintegration of the cells and other structural elements.

Nembutal—Pentobarbital sodium which is a short-acting barbiturate.

Neoplasm—A tumor which is any growth of tissue that exceeds the normal form and serves no useful purpose to the host.

Operculum—A flap of gingival (gum) tissue which extends over the unerupted portion of the tooth.

Papilloma—Epithelial tumors that appear as a cauliflower-like attachment to the surface epithelium.

Parulis—Gum boil.

Pellicle—A nonbacterial matrix composed of complex sugar-protein molecules that are a product of the saliva.

Pentobarbital sodium—Nembutal.

Periapical—A location at the apex of the pulp.

Pericoronitis—Inflammation around the crown of the tooth.

Peridex—Chlorhexidine, an antimicrobial mouthwash available by prescription only.

Periodontal—Area pertaining to the area surrounding the teeth.

Periodontitis—An inflammation of the periodontium, including both the gingiva and tooth attachment apparatus.

Periodontium—Tissues surrounding and supporting the teeth including the periodontal ligaments, gingiva, cementum, and alveolar and supporting bone.

pH scale—A scale indicating the measure of the acidity or alkalinity of a substance.

Polymer—Powder portion of a synthetic resin.

Preanesthetic—A drug used for producing preliminary anesthesia.

Protons—Particles with a positive charge found inside the nucleus of an atom.

Psychosedative—A calming agent that reduces anxiety and tension without depressing mental or motor functions.

Pulpectomy—Complete removal of the pulp from the pulp chamber and canals.

Pulpitis—Inflammation of the pulp.

Pulpotomy—Removal of the coronal portion of the pulp.

Pyogenic—Pus producing.

Rubor—Redness.

Salicylism—A condition characterized by ringing in the ears, mental confusion, and profuse sweating caused by frequent, large doses of aspirin.

Sedatives—Drugs which reduce excitement and activity but do not produce sleep.

Sialadenitis—Inflammation or infection of a salivary gland.

Solubility—How well something dissolves.

Solution—A mixture in which compounds are dissolved in water or similar substance.

Solvent—Dissolving medium or fluid in a solution.

Squamous—Scalelike.

Subgingival—Below the crest of the gingival margin.

Supragingival—Above the margin of the gingiva.

Syneresis—The loss of water.

Tetracycline—An antibiotic contraindicated during periods of tooth development also for use with oral contraceptives.

Trenchmouth—Also known as Vincent's infection or Acute Necrotizing Ulcerative Gingivitis (ANUG or NUG), it is a type of gingivitis in which the tissue of the interdental papilla is either dead or dying.

Treponema pallidum—A spirochete bacteria which causes syphilis.

Trismus—A spasm of the masticatory muscles.

Trituration—The mixing together of the mercury and alloy.

Tylenol—Acetaminophen.

Urticaria—Hives.

Vasoconstriction—Constriction (narrowing) of the blood vessels.

Vasoconstrictors—Drugs which produce hemostasis by constricting blood vessels which reduces blood flow to the area.

Ventral—Front or anterior.

Vesicles—Blisters.

Xerostomia—Dry mouth.

Xylocaine—Lidocaine HCl.

Student Notes

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