CHAPTER 7

ORAL ANATOMY AND PHYSIOLOGY

INTRODUCTION

This chapter covers the oral anatomy and physiology of the teeth, the histology of the tissues and supporting structures, and concentrates on the external features of the teeth. The teeth are identified by different sizes, shape, and other characteristics from one person to another. Such knowledge is useful when filling out the dental forms in the health record.

FORMATION PERIOD

LEARNING OBJECTIVE:

Describe the stages of tooth development.

As living things are forming, they go through a developmental process to reach maturity or a final outcome. When teeth are in the odontogenesis phase (tooth formation) they go through three developmental periods called categories: growth, calcification, and eruption. The term emergence describes the tooth as it breaks through the gingival tissue.

GROWTH PERIOD

Dental development usually begins in the fifth or sixth week of prenatal life. By the seventh week, epithelial skin cells of the mouth thicken along the ridge of the developing jaws creating a horse-shoe shaped band called the dental lamina which follows the curve of each developing tooth socket. The growth period of development is divided into the bud, cap, and bell stages (Fig. 7-1).

Bud Stage

As soon as the dental lamina is formed, patches of epithelial cells located there grow into the underlying tissue to become tooth buds. Usually 10 tooth buds are present in each dental arch and they give rise to future primary teeth. Tooth buds for the permanent teeth form between the 17th-week of fetal life through the age of 5 years. When the primary teeth are lost, permanent teeth will replace them.

Cap Stage

This stage is also known as proliferation (reproduction or multiplication) in which the cells of the tooth grow and the tooth bud takes a hollowed cap-like shape. The epithelium of the cap will give rise to the enamel. The zone under the cap is called the dental papilla, a small nipple shaped elevation. It gives rise to the dentin, cementum, and the pulp.

Bell Stage

The last period of growth is also known as histodifferentiation (the acquisition of tissue characteristics by cell groups) or bell stage. It is here the ameloblast cells form the enamel, odontoblast cells form the dentin, and the cementoblast cells form the cementum.

MORPHODIFFERENTIATION

As the tooth begins the bell stage, it begins to take shape and form through a process called morphodifferentiation. Enamel forming cells (ameloblast) and dentin forming cells (odontoblast) line up on a boundary line called dentinoenamel junction (DEJ). The odontoblast and cementoblast form the cementodental junction. The dentinoenamel junction and cementodental junction are the blueprint of the developing tooth.
APPOSITION

Apposition refers to depositing of the matrix for the hard dental structures. This matrix is deposited by cells along the boundary line (dentine-enamel junction) at the end of morphodifferentiation.

CALCIFICATION

Calcification (Fig. 7-1) is the process by which organic tissue (the matrix formed during apposition) becomes hardened by a deposit of calcium or any mineral salts. Next, the tooth crown receives layers of enamel that start at the top of the crown and go downward over the sides to the cement-enamel junction (CEJ). The cement-enamel junction is a linear junction between the apical border of the enamel cap and the root cementum.

ERUPTION

After the crown of the tooth has formed, the root begins to develop. Now the tooth begins to erupt (Fig. 7-1), movement of the tooth into its proper position in the mouth. For permanent teeth, it takes about 3 years from crown completion to the time the tooth emerges into the mouth. Figures 7-2 and 7-3 list the average emergence periods of primary and permanent teeth.
Figure 7.2—Average Periods for Emergence and Exfoliation of Primary Teeth

Figure 7.3—Average Periods of Emergence of Permanent Teeth
EXFOLIATION (SHEDDING)

When primary teeth prepare to fall out and make way for the eruption of permanent teeth, they go through a process called exfoliation. The root of the primary tooth resorbs (looses structure), and the permanent tooth erupts from beneath the surface of the jaw. The primary teeth act as guides for the developing permanent teeth. The premature loss of primary teeth can have a serious impact on the eruption of permanent teeth and how they will be positioned in the dental arch.

ORAL HISTOLOGY

LEARNING OBJECTIVES:

Identify the tissues of the teeth.

Describe the tissues of the teeth.

Histology is the study of anatomy including the minute structure, composition, and functions of tissues. Oral histology describes in detail the tissues of the teeth, periodontium, and the surrounding oral mucosa.

STRUCTURE OF TEETH

A tooth is divided into two parts: the crown and one or more roots (Fig. 7-4).

The Crown

The crown is divided into the anatomic and clinical crown. The anatomical crown is the portion of the tooth encased in enamel. In young people, areas of the anatomical crown are frequently buried in gingival tissue. As a person gets older, it becomes common for a tooth’s enamel to be completely exposed above the gingiva with the root surface showing (gingival recession). The term clinical crown is applied to the part of the crown exposed (visible) in the mouth.

The Root

The root of a tooth is covered by cementum and embedded in a thin layer of compact bone that forms the tooth socket; this is called alveolar bone. The tooth may have a single root or it may have two or three roots. When teeth have more than one root, the region where the roots separate is called the furcation. When a tooth has two roots it is bifurcated; when it has three roots it is trifurcated (Fig. 7-5). If a tooth has four or more roots, it is said to be multirooted. The tip of each root is called the apex. On the apex of each root, there is a small opening that allows for the passage of blood vessels and nerves into the tooth. This opening is called the apical foramen.

Figure 7-5.—Bifurcated and Trifurcated Roots
The Cervix

The cervix or cervical line (see Fig. 7-4) is a slight indentation that encircles the tooth and marks the junction of the anatomical crown with the root. The cementum joins the enamel at the cervix of the tooth. The point at which they join is called the cementoenamel junction (CEJ) or cervical line.

TISSUES OF THE TEETH

LEARNING OBJECTIVE:

Describe the form and function of enamel, dentin, cementum, and dental pulp.

This section describes the histological structures of enamel, dentin, cementum, and the dental pulp. Figure 7-6 illustrates the tissues of the teeth.

ENAMEL

Enamel is translucent and can vary in color from yellowish to grayish white. The different colors of enamel are attributed to the variation in the thickness, translucent proprieties, the quality of the crystal structure, and surface stains of enamel. Enamel (Fig. 7-6) is the calcified substance that covers the entire anatomic crown of the tooth and protects the dentin. It is the hardest tissue in the human body and consists of approximately 96% inorganic minerals, 1% organic materials, and 3% water. Calcium and phosphorus (as hydroxyapatite) are its main inorganic components.

Figure 7-6.—Tissues of the Teeth

7-5
Enamel can endure crushing pressure of approximately 100,000 pounds per square inch. A layering of the dentin and periodontium, coupled with the hardness of the enamel, produces a cushioning effect of the tooth’s different structures enabling it to endure the pressures of mastication (chewing). Structurally, enamel is composed of millions of enamel rods or prisms. Each rod begins at the dentinoenamel junction (junction between the enamel and dentin) and extends to the outer surface of the crown. Enamel is formed by epithelial cells (ameloblasts) that lose their functional ability when the crown of the tooth has been completed. After formation enamel has no power of further growth or repair.

DENTIN

Dentin (see Fig. 7-6) is the light yellow substance that is less dense (radiolucent) than enamel and is very porous; it constitutes the largest portion of the tooth. The pulp chamber is located on the internal surface of the dentin walls. Dentin is harder than bone but softer than enamel. Dentin consists of approximately 70% inorganic matter and 30% organic matter and water. Calcium and phosphorus are its chief inorganic components. Dentin is a living tissue and must be protected during operative or prosthetic procedures from dehydration (drying) and thermal shock.

The dentin is perforated by tubules (similar to tiny straws) that run between the cementoenamel junction (CEJ) and the pulp. Cell processes from the pulp reach part way into the tubules like fingers. These cell processes create new dentin and mineralize it. Dentin transmits pain stimuli by the way of dentinal fibers. Because dentin is a living tissue, it has the ability for constant growth and repair that reacts to physiologic (functional) and pathologic (disease) stimuli.

CEMENTUM

Cementum is the bonelike tissue that covers the roots of the teeth in a thin layer (see Fig. 7-6). It is light yellow in color, slightly lighter than dentin. The cementum is composed of approximately 55% organic material and 45% inorganic material; the inorganic components are mainly calcium salts. The cementum joins the enamel at the cervix of the tooth forming the CEJ.

In most teeth the cementum overlaps the enamel for a short distance. In some, the enamel meets the cementum in a sharp line. In a few, a gap may be present between the enamel and the cementum, exposing a narrow area of root dentin. Such areas may be very sensitive to thermal, chemical, or mechanical stimuli.

The main function of cementum is to anchor the teeth to the bony walls of the tooth sockets in the periodontium. This is accomplished by the fibers of the periodontal ligament or membrane. Cementum is formed continuously throughout the life of the tooth to compensate for the loss of tooth substance because of occlusal wear and to allow for the attachment of new fibers of the periodontal ligament to the surface of the root.

DENTAL PULP

The dental pulp, (Fig. 7-7), is the soft tissue inside the tooth developed from the connective tissue of the dental papilla. Within the crown, the chamber containing the dental pulp is called the pulp chamber. The coronal pulp and pulp horns are within the crown and the radicular pulp is within the root. The apical foramen is at the end or apex of the radicular pulp. Blood vessels, nerves, and connective tissue pass through this area to reach the interior of the tooth.

Figure 7-7.—Dental Pulp
The chief function of the pulp is the formation of dentin. It furnishes nourishment to the dentin; provides sensation to the tooth; and responds to irritation, either by forming reparative secondary dentin or by becoming inflamed.

PERIODONTIUM

The tissues that surround and support the teeth are collectively called the periodontium. Their main functions are to support, protect, and provide nourishment to the teeth. Figure 7-8 illustrates the supporting tissues of the periodontium. The periodontium consists of cementum, alveolar process of the maxillae and mandible, periodontal ligament, and gingiva.

CEMENTUM

Cementum (Fig. 7-8) is the only tissue considered as both a basic part of the tooth and a component of the periodontium. It is a thin, calcified layer of tissue that completely covers the dentin of the tooth root. Cementum is formed during the development of the root and throughout the life of the tooth. Cementum functions as an area of attachment for the periodontal ligament fibers.

ALVEOLAR PROCESS

The alveolar process (Fig. 7-8) is that bony portion of the maxilla and mandible where the teeth are embedded and tooth roots are supported. The alveolar socket is the cavity within the alveolar process in which the root of the tooth is held by the periodontal ligament.

The bone that divides one socket from another is called the interdental septum. When multi-rooted teeth are present, the bone is called the interradicular septum. The alveolar process includes the cortical plate, alveolar crest, trabecular bone, and the alveolar bone proper, covered below.

Cortical Plate

The cortical plate is composed of facial (toward the face) and lingual (toward the tongue) plates of compact bone. It is dense in nature, provides strength and protection, and acts as the attachment for skeletal muscles. The mandibular cortical plate is more dense than the maxilla cortical plate because it has fewer perforations for the passage of nerves and blood vessels.

Alveolar Crest

The alveolar crest is the highest point of the alveolar ridge and joins the facial and lingual cortical plates.

Trabecular Bone

Trabecular or spongy bone lies within the central portion of the alveolar process, and is the less dense, cancellous bone. When viewed by radiograph, trabecular bone has a web-like appearance.
Alveolar Bone Proper

The alveolar bone proper is a thin layer of compact bone; a specialized continuation of the cortical plate that forms the tooth socket. The lamina dura is a horseshoe shaped white line on a dental radiograph that directly corresponds to the alveolar bone proper.

PERIODONTAL LIGAMENT

The periodontal ligament (Fig. 7-8) is a thin, fibrous ligament that connects the tooth to the bony socket. Normally, teeth do not contact the bone directly; a tooth is suspended in its socket by the fibers of the ligament. This arrangement allows each tooth limited individual movement. The fibers act as shock absorbers to cushion the force of mastication.

TISSUES OF THE ORAL CAVITY

The oral cavity is made up of specialized epithelial tissues that surround the teeth and serve as a lining. These tissues are called the oral mucosa and consist of three types: masticatory mucosa, lining mucosa, and specialized mucosa.

MASTICATORY MUCOSA

Masticatory mucosa is comprised of the tissue that covers the hard palate and the gingival (Fig. 7-9). It is light pink in color (can vary with skin color) and is keratinized. Keratinized tissue has a tough, protective outer layer of tissue. Characteristics of masticatory mucosa are:

- Submucosa lies under and supports the masticatory mucosa
- Held in place firmly to bone and does not move
- Has a dense, hard covering
- Functions to withstand the active process of chewing and swallowing food

Figure 7-9.—Masticatory Mucosa of the Hard Palate

Hard palate (Roof of the Mouth)

The hard palate (Fig. 7-9) is covered with masticatory mucosa and is firmly adhered to the palatine process (bone). Its color is pale pink. Important structures of the hard palate are:

INCISIVE PAPILLA.—Located at the midline, directly posterior of the maxillary central incisors (pear-shaped in appearance).

PALATINE RAPHE.—Extends from the incisive papilla posteriorly at the midline (may be ridge shaped in appearance with a whitish streak at the midline).

PALATINE RUGAE.—Extends laterally (along side) from the incisive papilla and from the palatine raphe (wrinkled, irregular ridges in appearance).
Gingiva

The gingiva shown in (Fig. 7-10), is specialized masticatory mucosa covering the alveolar process. Gingiva is firm and resilient encircling the necks of the teeth. It aids in the support of the teeth, and protects the alveolar process and periodontal ligament from bacterial invasion.

The color of healthy gingiva range from pale pink to darker shades (purple to black) depending on each individual’s pigmentation. Under normal flossing and brushing activities it does not bleed. Like the tongue, the gingiva is highly vascular and receives its blood supply from the lingual, mental, buccal, and palatine arteries. The two types of gingiva are unattached and attached gingiva.

Unattached Gingiva (Free Gingiva)

The portion of gingiva that extends from the gingival crest to the crest of the bone is called unattached gingiva. It can be displaced and is not bound directly to the tooth or bone. In a healthy mouth, this portion is approximately 1 to 3 mm wide and forms the soft tissue wall of the gingival sulcus next to the tooth.

Other structures of unattached gingiva include:

- **Gingival Margin:** The 1mm narrow band of gingiva that forms the immediate collar around the base of the tooth. This area is first to show symptoms of gingivitis.
- **Gingival Sulcus:** Area between the unattached gingiva and the tooth. Popcorn hulls get trapped in this area.
- **Epithelial Attachment:** Joins the gingiva to the tooth surface.
- **Interdental Papilla:** The portion of the free gingiva that fills the embrasures, a triangular space near the gingiva below the contact areas of adjacent teeth. It helps prevent food from packing between the teeth.

Attached Gingiva

It is located apical to the free gingiva on the labial and lingual aspects. It is firmly fixed to the underlying bone of the cortical plates of the alveolar process. The surface of the attached gingiva and interdental papillae may be stippled (resembling the texture of an orange peel).

![Figure 7-10.—Structures of the Gingiva](image)

7-9
Lining Mucosa

Lining mucosa is found on the inside of the lips, cheeks, vestibule, soft palate, and under the tongue. It consists of a thin, fragile tissue that is very vascular. Lining mucosa is brighter red in color than stratified mucous. Included in the lining mucosa is alveolar mucosa which is loosely attached and lies apical to the mucogingival junction (line where the attached gingiva and alveolar mucosa meet).

Specialized Mucosa

Specialized mucosa is the mucous membrane on the tongue in the form of lingual papillae, which are structures associated with sensations of taste. A full description is explained in the “Human Anatomy and Physiology” chapter.

DENTITION PERIODS

LEARNING OBJECTIVES:

Describe the dentition periods and what occurs during them.

Explain the orientation of teeth based upon various descriptive methods.

Humans have two sets of teeth in a lifetime, but there are three dentition periods: primary, permanent, and mixed. The primary dentition consists of 20 primary teeth referred to as baby teeth. The permanent dentition consists of 32 teeth which are called the adult teeth. The mixed dentition is the period at which the primary teeth are shed and the permanent teeth erupt. This happens with each tooth resulting in both primary and permanent teeth being present at the same time.

DENTAL ARCHES

The teeth of the upper arch are called maxillary teeth (Fig. 7-11); their roots are embedded within the alveolar process of the maxilla. Those of the lower arch are called mandibular teeth; their roots are embedded within the alveolar process of the mandible. Each arch contains 16 teeth. The teeth in an arch are composed of 6 anteriors (cusp to cusp) and 10 posterior (all teeth distal to the cuspids).

Figure 7-11.—Maxillary and Mandibular Arches Showing Relationship of the Bones and Teeth

DENTAL QUADRANTS

Each dental arch is divided into a right and a left quadrant. The quadrants are formed by an imaginary line called the midline that passes between the central incisors in each arch and divides the arch in half (Fig. 7-12). There are four quadrants in the mouth (two per arch) that divide the mouth into four equal parts. Teeth are described as being located in one of the four quadrants: right maxillary quadrant, left maxillary quadrant, right mandibular quadrant, or the left mandibular quadrant. In a quadrant, there are 3 anterior and 5 posterior teeth.

Figure 7-12.—Maxillary and Mandibular Arches Divided into Quadrants
LOCATION OF THE TEETH

A human receives two sets of teeth during a lifetime. The first set consists of 20 teeth referred to as deciduous or primary (baby teeth). The second (permanent) set usually consists of 32 teeth. In each quadrant, there are eight permanent teeth: two incisors, one cuspid, two bicuspids, and three molars.

The tooth positioned immediately to the side of the midline is the central incisor, named due to its central location in the arch. To the side of the central incisor in order of appearance are the lateral incisor, the cuspid, the two bicuspids (the first bicuspid, followed by the second bicuspid), and the three molars. After the second bicuspid comes the first molar, followed by the second molar, followed by the third molar called the "wisdom tooth."

Another method of describing the location of teeth is to refer to them as anterior or posterior teeth (Figs. 7-13 and 7-14). Anterior teeth are those located in the front of the mouth, the incisors, and the bicuspids. These are the teeth that are visible when a person smiles. The posterior teeth are those located in the back of the mouth—the bicuspids and molars.

Figure 7-13.—Names of the Teeth in the Right Maxillary and Mandibular Quadrants; Anterior and Posterior Teeth

7-11
TYPES OF TEETH

Man is omnivorous, his teeth are formed for cutting, tearing, and grinding food. The human permanent dentition is divided into four classes of teeth based on appearance and function or position. Figure 7-15 illustrates the types and working surfaces of the four classes of teeth.

Incisors

They are used to incise food. They are located in the front of the mouth and have sharp, thin edges for cutting. The lingual surface can have a shovel-shaped appearance.
Molars

Molars are located in the back of the mouth; their size gradually gets smaller from the first to third molar. Each molar has four or five cusps, is shorter and more blunt in shape than the other teeth, and provides a broad surface for grinding and chewing solid masses of food.

IDENTIFICATION OF TEETH

To avoid confusion, the HM must identify a tooth as completely as possible. Give its full name: Central incisor (not incisor), second molar (not molar), etc. But even the full name of a tooth does not provide adequate identification because several teeth have the same name. Complete tooth identification requires that the HM identifies:

- The quadrant in which the tooth appears
- The full name of the tooth

For example, identify a specific second molar in the following manner: right mandibular second molar. Although there are four second molars in the mouth, naming the quadrant (right mandibular) narrows the field down to one specific second molar.

UNIVERSAL NUMBERING SYSTEM

The Universal Numbering System is a simplified method of identifying teeth that is approved by the American Dental Association (ADA) and used by the Armed Services. This method employs numbers with each tooth designated by a separate number from 1 to 32. Figure 7-14 illustrates the numbering system used on a Standard Dental Chart.

When charting, refer to a tooth by number rather than the name. Instead of referring to the right maxillary third molar, refer to tooth No. 1. Each permanent tooth has its own number. The numbering starts with the maxillary right third molar, (tooth No. 1) and goes across to the maxillary left third molar, (tooth No. 16); down to mandibular left third molar (tooth No. 17) and across to the mandibular right third molar (tooth No. 32).
The 20 primary teeth are identified on the dental chart by the use of capital letters A through T. Lettering starts with upper right second primary molar (tooth A, located above the root of the maxillary second premolar); goes across to the upper left second primary molar (tooth J); down to the lower left second primary molar (tooth K), and across to the lower right second primary molar. Note that the letters of the primary, second and first molars appear above the roots of the permanent teeth of the second and first premolars.

When using a dental form, the right and left sides are reversed. The right side of the patient’s mouth appears on the left side of the dental chart; the left side of the patient’s mouth appears on the right side. This arrangement is necessary for the Dental Officer and the HM to see the sides as they appear when looking into a patient’s mouth.

SURFACES OF THE TEETH

Not only must the HM be able to name and locate a tooth, but must also be able to identify the different types of tooth surfaces. To get a clearer picture of the various tooth surfaces, refer to Figure 7-16. The Standard Dental Chart shows each of the teeth “unfolded” so that the facial, occlusal, incisal, and lingual surfaces of the teeth can be shown. For posterior teeth, the facial surfaces are shown adjacent to the roots, followed by the occlusal surfaces, and then by the lingual surfaces (which are located next to the numbers on the chart). For anterior teeth, the facial surfaces are shown as a line between the facial and lingual surfaces. The lingual surfaces are located next to the numbers on the chart.

Facial

The facial is the surface of a tooth that “faces” toward the lips or cheeks. When required for specificity, terms like labial and buccal are used. The labial is the surface of an anterior tooth that faces toward the lips. The buccal is the surface of a posterior tooth that faces toward the cheek.

Mesial

The mesial is the proximal surface closest to the midline or middle of the arch.

Distal

The distal is the opposite of mesial. The distal is the proximal surface oriented away from the midline of the arch.

Lingual

The lingual is the surface of an anterior or posterior tooth that faces toward the tongue. Incisal edges are narrow cutting edges found only in the anterior teeth (incisors).
Proximal Surfaces

A tooth has two proximal surfaces (Fig. 7-17), one that is oriented toward the midline of the dental arch (mesial) and another that is oriented away from the midline of the arch (distal). Other important surfaces of the proximal area are discussed in the following paragraphs.

Figure 7-17.—Proximal Tooth Surfaces and Spaces

CONTACT POINT

The point on the proximal surface where two adjacent teeth actually touch each other is called a contact point. This is exemplified when the HM passes dental floss in between two teeth and resistance is felt as the dental floss passes through the contact point.

INTERPROXIMAL SPACE

The interproximal space is the area between the teeth. Part of the interproximal space is occupied by the interdental papilla, a triangular fold of gingival tissue. The part of the interproximal space not occupied is called the embrasure.

EMBRASURE

The embrasure occupies an area bordered by interdental papilla, the proximal surfaces of the two adjacent teeth, and the contact point (Fig. 7-18). If there is no contact point between the teeth, then the area between them is called a diastema instead of an embrasure.

Figure 7-18.—Embrasure

OCCLUSAL

The occlusal surface is the broad chewing surface found on posterior teeth (bicuspid and molars).
VERTICAL AND HORIZONTAL OVERLAP

Vertical overlap is the extension of the maxillary teeth over the mandibular counterparts in a vertical direction when the dentition is in centric occlusion (Fig. 7-19). Horizontal overlap is the projection of maxillary teeth over antagonists (something that opposes another) in a horizontal direction.

Figure 7-19.—Vertical and Horizontal Overlap

OCCLUSION

Occlusion is the relationship between the occlusal surfaces of maxillary and mandibular teeth when they are in contact. Many patterns of tooth contact are possible. The reason for the variety is the mandibular condyle’s substantial range of movement within the temporal mandibular joint (TMJ). Malocclusion occurs when any abnormality in occlusal relationships exist in the dentition. Centric occlusion (Fig. 7-20), is the centered contact position of the chewing surfaces of mandibular teeth on the chewing surface (occlusal) of the maxillary teeth.

Figure 7-20.—Centric Occlusion

OCCLUSAL PLANE

Maxillary and mandibular teeth come into centric occlusion and meet along anteroposterior and lateral curves. The posterior teeth do not form a flat plane; they curve slightly, this curve is called the Curve of Spee, (Fig. 7-21). The mandibular arch forms a concave (a bowl-like upward curve). The lateral curve is called the Curve of Wilson (Fig. 7-22). The combination of these curves form a line called the occlusal plane, and is created by the contact of the upper and lower teeth as shown in Figure 7-23. Dental arches are stable when all teeth are present; the absence of one or more teeth causes malocclusion and the functionality and

Figure 7-21.—Curve of Spee

stability of the dentition is affected.
KEY TO OCCLUSION

The occlusal surfaces of opposing teeth bear a definite relationship to each other (Fig. 7-24). In normal jaw relations when teeth are of normal size and in the correct position, the mesiofacial cusp of the maxillary first molar occludes in the facial groove of the mandibular first molar (Fig. 7-25). This normal relationship of these two teeth is called the key to occlusion.
ANGLES CLASSIFICATION

Edward Angle was a dentist who developed a classification of normal and abnormal ways teeth meet into centric occlusion. Angle came up with three classes, Class I, II and III, as illustrated by Figure 7-26.

- **Class I**: Patient’s profile is characterized as normal
- **Class II**: Patient’s profile is deficient in chin length and characterized as a retruded (retrognathic) profile
- **Class III**: Patient’s profile is excessive in chin length and characterized as protruded (prognathic) profile

Figure 7-26.—Angle’s Classification

TOOTH MORPHOLOGY

**LEARNING OBJECTIVE:**

Describe the shape of each tooth in the mouth.

Tooth morphology is the study of the form and shape of teeth, which will be helpful in the following clinical procedures:

- Dental charting
- Selecting rubber dam clamps
- Forming matrix bands before use
- Mounting dental radiographs

A thorough understanding of tooth morphology makes it easier to identify and differentiate between maxillary, mandibular, right and left teeth, maxillary and mandibular.

MAXILLARY CENTRAL INCISORS

The maxillary central incisor (tooth #8 or #9) illustrated in Figures 7-27 and 7-28. Viewed mesially or distally, a maxillary central incisor looks like a wedge, with the point of the wedge at the incisal (cutting) edge of the tooth.

![Maxillary Central Incisor Diagram](image)

Figure 7-27.—Surfaces of a Maxillary Central Incisor

7-18
MAXILLARY LATERAL INCISORS

The maxillary lateral incisor (tooth #7 or #10), illustrated in Figure 7-29, is similar to the maxillary central incisor, except in size: it is shorter, narrower, and thinner.

Facial Surface

The facial surface resembles a thumbnail in outline. The mesial margin is nearly straight and meets the incisal edge at almost a 90° angle. The distal margin meets the incisal edge in a curve. The incisal edge is straight. The cervical margin is curved like a half moon. Two developmental grooves are on the facial surface.

Lingual Surface

The lingual surface (Fig. 7-28) is quite similar to the facial surface in outline except that it is slightly smaller in all dimensions. At the mesial and distal margins there are marginal ridges. Occasionally there is a cingulum occurring on the lingual or palatal aspects, that forms a convex protuberance at the cervical third of the anatomic crown at the junction of the lingual surface with the cervical line. Sometimes a deep pit, the lingual pit, is found in conjunction with a cingulum.

Root

As with all anterior teeth, the root of the maxillary central incisor is single. Usually, the apex of the root is inclined slightly distally.

Facial Surface

The developmental grooves on the facial surface are not as easily evident as those of the central incisor. Of more significance is the distoincisal angle, which is well-rounded with this curvature continuing to the cervical line. The mesiofacial angle is nearly straight to the cervical line.

Lingual Surface

The shape of the lingual surface varies with each patient. In some patients, it is markedly concave, almost spoon-like in appearance, and in others it is flat. The lingual surface is almost the same as the facial surface.

Root Surface

The root is conical (cone-shaped) but somewhat flattened mesiodistally.
MANDIBULAR CENTRAL INCISORS

The mandibular central incisor (tooth #24 or #25) is illustrated in Figure 7-30. These are the first permanent teeth to erupt, replacing deciduous teeth, and are the smallest teeth in either arch. These erupt around the same time as

the mandibular first incisors, usually after them.

Facial Surfaces

The facial surface of the mandibular central incisor is widest at the incisal edge. Both the mesial and the distal surfaces join the incisal surface at almost a 90° angle. Although these two surfaces are nearly parallel at the incisal edge, they converge toward the cervical margin. The developmental grooves may or may not be present. When present, they appear as very faint furrows.

Lingual Surface

The lingual surface is concave from the incisal edge to the cervical margin.

Root Surface
MANDIBULAR LATERAL INCISORS

The mandibular incisor (tooth #23 or #26), illustrated in Figure 7-31, is a little wider mesiodistally than the mandibular central incisor, and the crown is slightly longer from the incisal edge to the cervical line.

Facial Surface

The facial surface is less symmetrical than the facial surface of the mandibular central incisor. The incisal edge slopes upward toward the mesioincisal angle, which is slightly less than 90°. The distoincisal angle is rounded. The mesial border is more nearly straight than the distal border.

Lingual Surface

The lingual surface is similar in outline to the facial surface. The incisal portion of the lingual surface is concave. The cingulum is quite large but blends in smoothly with the rest of the surface.

Root Surface

The root is single and extremely flattened on its mesial and distal surfaces.

Figure 7-31.—Surfaces of a Mandibular Lateral Incisor
MAXILLARY CUSPIDS

The maxillary cuspid (tooth #6 or #11) is illustrated in Figures 7-32 and 7-33. The maxillary cuspid is usually the longest tooth in either jaw. This tooth is called a canine as it resembles a dog’s tooth.

Facial Surface

The facial surface of the crown (Fig. 7-32) differs considerably from that of the maxillary central or lateral incisors. Specifically, the incisal edges of the central and lateral incisor are nearly straight; the cuspid has a definite point, or cusp. There are two cutting edges, the mesioincisal and the distoincisal. The distoincisal cutting edge is longer of the two. The developmental grooves that are so prominent on the facial surface of the central incisor are present here, extending two-thirds of the distance from the tip of the cusp to the cervical line.

Lingual Surface

The lingual surface has the same outline as the facial surface but is somewhat smaller because the mesial and distal surfaces of the crown converge toward the lingual surface. The lingual surface is concave, with very prominent mesial and distal marginal ridges, and a lingual ridge, which extends from the tip of the cusp toward the cervical line. There is often a cingulum in the cervical portion of the lingual surface of the crown.

Root Surface

The root is single and is the longest root in the arch. It is usually twice the length of the crown and helps anchor it in. This is because the cuspid is designed for seizing and holding food.
MANDIBULAR CUSPIDS

The mandibular cusp (tooth #22 or #27) is illustrated in Figure 7-34. These teeth, like the mandibular incisors, are smaller and more slender than the opposing teeth in the maxillary arch.

Figure 7-34.—Surfaces of a Mandibular Cusp

Facial Surface

The facial surface of a mandibular cusp is much the same as that of a maxillary cusp, except that the distoincisal cutting edge is almost twice the length of the mesial edge.

Lingual Surface

The lingual surface as a rule is very smooth, and a cingulum is rarely present.

Root Surface

The single root is not as long as that of the maxillary cusp and is much flatter mesiodistal.

MAXILLARY FIRST BICUSPID

The maxillary first bicuspid (tooth #5 or #12), illustrated in Figure 7-35, is the fourth tooth from the midline. It is considered to be the typical bicuspid. Sometimes bicuspids are called premolars because they are just in front of the molar teeth.

Figure 7-35.—Surfaces of Maxillary First Bicuspid

Facial Surface

The facial surface is somewhat similar to the facial surface of the cusp. However, the tip of the facial cusp is located in the center of the “biting” edge, which is called the occlusal edge or occlusal margin. From the cusp tip to the cervical margin, there is a slight ridge, called the facial ridge, similar to the facial ridge found in cusp teeth.

Lingual Surface

The lingual surface is narrower and shorter than the facial surface, and is smoothly convex in all directions.
Root

The root is quite flat on the mesial and distal surfaces. In about 50 percent of maxillary first bicuspids, the root is divided in the apical third, and when it so divided, the tips of the facial and lingual roots are slender and finely tapered.

Occlusal Surface

The occlusal surface (Fig. 7-36) has a facial cusp and a lingual cusp. There are mesial and distal marginal ridges. Two fossae (pit: a concavity in a surface) are on the occlusal surface—the mesial and distal fossae.

Figure 7-36.—Features of an Occlusal Surface of Maxillary First Bicuspid

MAXILLARY SECOND BICUSPID

The maxillary second bicuspid (tooth #4 or #13), illustrated in Figure 7-37 resembles the first bicuspid very closely, but is smaller in dimensions. The cusps are not as sharp as the maxillary first bicuspid and have only one root.

Figure 7-37.—Surfaces of a Maxillary Second Bicuspid
MANDIBULAR FIRST BICUSPID

The mandibular first bicuspid (tooth #21 or #28), illustrated in Figure 7-38, is the fourth tooth from the midline. It is the smallest of the four bicuspids. The term bell-crowned is used to describe its appearance. The mandibular first bicuspid has many characteristics of a cuspid.

Figure 7-38.—Surfaces of Mandibular First Bicuspid

Root Surface

The root of the mandibular first bicuspid is usually single, but on occasion can be bifurcated (two roots).

Occlusal Surface

A large facial cusp, which is long and well defined, and a small nonfunctional lingual cusp are present on the mandibular first bicuspid.

MANDIBULAR SECOND BICUSPID

The mandibular second bicuspid (tooth #20 or #29), illustrated in Figure 7-39 is the fifth tooth from the midline.

Figure 7-39.—Surfaces of a Mandibular Second Bicuspid

Root Surface

The root of the tooth is single, and in a great many instances, the apical region is found to be quite curved.
MAXILLARY FIRST MOLAR

The maxillary first molar (tooth #3 or #14), illustrated in Figures 7-40 and 7-41, is the sixth tooth from the midline. The first molars are also known as 6-year molars, because they erupt when a child is about 6 years old.

![Figure 7-40.—Surfaces of Maxillary First Molar](image)

**Facial Surface**

The facial surface has a facial groove that continues over from the occlusal surface, and runs down to the middle third of the facial surface.

**Lingual Surface**

In a great many instances, there is a cusp on the lingual surface of the mesiolingual cusp. This is a fifth cusp called the cusp of Carabelli, which is in addition to the four cusps on the occlusal surface.

![Figure 7-41.—Features of Occlusal Surfaces of Maxillary First Molar](image)

**Occlusal Surface**

In all molars the patterns of the occlusal surface (Fig. 7-41) are quite different from those of the bicuspids. The cusps are large and prominent, and the broad grinding surfaces are broken up into rugged appearing ridges and well-defined grooves. An oblique ridge, which is not present on the bicuspids, appears here; it also appears on maxillary second and third molars.

**Root Surface**

The maxillary first molar has three roots, which are named according to their locations - mesiofacial, distofacial, and lingual (or palatal root). The lingual root is the largest.
MAXILLARY SECOND MOLAR

The maxillary second molar (tooth #2 or #15), illustrated in Figure 7-42 is the seventh tooth from the midline. The second molars are often called 12-year molars because they erupt when a child is about 12 years old.

Because it has the same function as the maxillary first molar, its physical characteristics are basically the same. The second molar is smaller, the occasional fifth cusp of Carabelli does not appear, and there is a marked reduction in the size of the distolingual cusp.

![Figure 7-42.—Surfaces of Maxillary Second Molar](image)

MAXILLARY THIRD MOLAR

The maxillary third molar (tooth #1 or #16), illustrated in Figure 7-43 is the eighth tooth from the midline. Third molars are called “wisdom teeth” because they erupt when the young adult is passing into adulthood. The tooth is much smaller than the maxillary first or second molars, with an occlusal outline that is nearly circular.

![Figure 7-43.—Surfaces of Maxillary Third Molar](image)

Occlusal Surface

Numerous fissures and grooves cover the occlusal surface. There is no distinct oblique ridge.

Root

The root may have one to as many as eight divisions. These divisions are usually fused and very often curved distally.
MANDIBULAR FIRST MOLAR

The mandibular first molar (tooth #19 or #30), illustrated in Figures 7-44 and 7-45, is the sixth tooth from the midline. It is the first permanent tooth to erupt.

Figure 7-44.—Surfaces of Mandibular First Molar

Facial Surface

The facial surface has two grooves: the facial groove, an extension of the facial groove from the occlusal surface and the distofacial groove, an extension of the distofacial groove from the occlusal surface.

Occlusal Surfaces

The occlusal surface has five cusps (Fig. 7-45). The fifth cusp is called the distal cusp.

Roots

The tooth has two roots, a mesial and a distal.
MANDIBULAR SECOND MOLAR

The mandibular second molar (tooth #18 or #31), illustrated in Figure 7-46, is the seventh tooth from the midline.

![Figure 7-46.—Surfaces of Mandibular Second Molar]

Facial Surface

The facial surface has only one groove, the facial groove, which arises on the occlusal surface, extends over the facial margin onto the facial surface.

Occlusal Surfaces

The greatest difference between the occlusal surfaces of the mandibular first and second molars is that the occlusal surface of the second molar has no fifth cusp.

MANDIBULAR THIRD MOLAR

The mandibular third molar (tooth #17 or #32), illustrated in Figure 7-47, is the eighth tooth from the midline. It appears in many forms, sizes, and shapes. Since its function is similar to that of the other two mandibular molars, its general appearance is the same. It has smaller surfaces, more supplemental grooves, and four or five cusps, which are not as sharply differentiated as those of the first two molars.

![Figure 7-47.—Surfaces of Mandibular Third Molar]

Roots

The roots, generally two in number, are shorter in length and tend to be fused together. In many instances they show a distinct distal curve.
GLOSSARY OF UNIQUE DENTAL ANATOMY

LEARNING OBJECTIVE:

Describe each of the unique dental anatomy structures and their function(s).

The following list will be helpful in understanding some of the anatomical terms used in this chapter.

**Cusp:** A pointed or rounded elevation of enamel found on cusps and on the chewing surfaces of bicuspid and molars. (Fig. 7-48)

![Figure 7-48.—Cusp](image)

**Cingulum:** Found on the lingual aspect of an anterior tooth. It is a convex mount of enamel localized to the cervical one-third of the crown. (Fig. 7-49).

**Fissure:** A linear fault that sometimes occurs in a developmental groove by incomplete or imperfect joining of the lobes. A pit is usually found at the end of a developmental groove or a place where two fissures intersect (Fig. 7-50).

**Fossa:** A rounded or angular depression of varying size found on the surface of a tooth.

**Central fossa:** Centrally located depression found on the occlusal surface of molars and mandibular second bicuspid. The other bicuspid have mesial and distal triangular fossa, but do not have a central fossa (Fig. 7-51).

![Figure 7-50.—Fissure](image)

![Figure 7-51.—Central Fossa](image)
**Lingual Fossa**: Irregular, shallow depression found on the lingual surfaces of an incisor or cuspid (Fig. 7-52).

![Figure 7-52.—Lingual Fossa](image)

**Triangular fossa**: Located adjacent to the marginal ridges on the occlusal surfaces of posterior teeth. Two types of triangular fossae are mesial and distal (Fig. 7-53).

**Groove**: A small linear depression on the surface of a tooth.

![Figure 7-53.—Triangular Fossa](image)

**Developmental Groove**: Fissure between the cusps on the crown of the tooth. Cusp tips are the initial site where enamel develops. As the enamel develops and spreads laterally, it touches enamel developing from other cusps. This junction forms a developmental groove. Such grooves appear on the labial, buccal, and lingual surfaces, and are least apparent on the labial aspect of anteriors (Fig. 7-54).

![Figure 7-54.—Developmental Groove](image)
**Supplemental Groove:** A minor, auxiliary groove that branches off from a much more prominent developmental groove. They do not represent the junction of primary tooth parts and gives the occlusal surface a wrinkled appearance (Fig. 7-55).

![Supplemental Groove](image)

**Figure 7-55.—Supplemental Groove**

**Mamelons:** Are small, rounded projections of enamel from the incisal edges of newly erupted anterior teeth. The projections wear away soon after eruption (Fig. 7-57).

![Mamelons](image)

**Figure 7-57.—Mamelons**

**Lobe:** Is one of the primary divisions of a crown; all teeth develop from four or five lobes. Lobes are usually separated by readily identifiable developmental grooves (Fig. 7-56).

![Lobe](image)

**Figure 7-56.—Lobe**

**Cusp Ridge:** Each cusp has four cusp ridges radiating from its tip. They are named according to the direction they take away from the cusp tip (for example, mesial, distal, buccal, or lingual) (Fig. 7-58).

![Cusp Ridge](image)

**Figure 7-58.—Cusp Ridge**
**Lingual Ridge:** The ridge of enamel that extends from the cingulum to the cusp tip on the lingual surface of most cuspids (Fig. 7-59).

![Lingual Ridge](image)

**Figure 7-59.—Lingual Ridge**

**Marginal Ridge:** A linear, rounded border of enamel that forms the mesial and distal margins of anterior teeth as viewed from the lingual, and the mesial and distal borders of occlusal surfaces on posterior teeth (Fig. 7-60).

![Marginal Ridge](image)

**Figure 7-60.—Marginal Ridge**

**Oblique Ridge:** The only tooth on which an oblique ridge is found is the maxillary first and second molars. Consists of an elevated prominence on the occlusal surface and extends obliquely from the tips of the mesiolingual cusp to the distobuccal cusp (Fig. 7-61).

![Oblique Ridge](image)

**Figure 7-61.—Oblique Ridge**

**Triangular Ridge:** Two inclines meet to form a triangular ridge and are located either on a facial or a lingual cusp ridge (Fig. 7-62).

![Triangular Ridge](image)

**Figure 7-62.—Triangular Ridge**
Transverse Ridge: The union of a buccal and lingual triangular ridge that crosses the surface of a posterior tooth transversely (roughly 90° to both the buccal and lingual tooth surfaces) (Fig. 7-63).

Sulcus: An elongated valley or depression in the surface of a tooth formed by the inclines of adjacent cusps or ridges (Fig. 7-64).

SUMMARY

This chapter reviewed oral anatomy and physiology. It covered the morphology of teeth to include their various surfaces. With this knowledge the HM will be able to assist the dentist, physician, or IDC with assessing, treating, and documenting oral care provided to patients.