1.

Anatomy of Facial and Oral Structures

❖ *Introduction to Anatomy*

The study of anatomy has a language all its own. The terms have evolved over many centuries. Most students think anatomical terms are hard to remember and pronounce and, in some cases, they are. In any event, you must learn and understand the terms that apply to the anatomical structures of dental interest and you must be familiar with oral and dental anatomy.

■ Basic Terminology

♦ General Reference Terms

- ***Anterior and Posterior.*** **Anterior and posterior describe the front-to-back relationship of one part of the body to another. For example, the ear is posterior to (in back of) the eye, the nose is anterior to (in front of) the ear, etc.**
- ***Internal* (*Medial*) *and External* (*Lateral*).** **The words internal and medial are synonyms, so are external and lateral. These two terms describe the sideways relationship of one part of the body to another using the midsagittal plane (see definition below) as a reference. For example, the ear is external (or lateral) to the eye because the ear is further from the midsagittal plane; the eye is internal (or medial) to the ear because it is closer to the midsagittal plane.**
- ***Long Axis.*** **The longitudinal center line of the body or any of its parts.**

♦ Body Planes (See Figures 1-1 and 1-2.)

The study of geometry shows that a plane is perfectly flat, is infinitely long and wide, and has no depth. For our purposes, a plane is a real or imaginary slice made completely through a body. In anatomy, the slice is made to study the details of the cut surfaces. The cut surfaces are called sections or views. Planes can pass through a body in an infinite number of ways. There are common, standard planes that produce standard views:

- *gittal Plane.* A plane
  t parallels the long
  s and divides a body
  o right and left parts. A
  dsagittal plane divides
  dies into equal right
  d left sides.
- *ontal Plane.* A plane
  t parallels the long
  s and divides a body
  o anterior and
  sterior parts.
- *nsverse* (*Horizontal*)
  ne. A plane that
  ides a body into upper
  d lower parts. More
  ecifically, it is a slice
  t passes through a
  dy at right angles (90
  grees) to the sagittal
  d frontal planes.

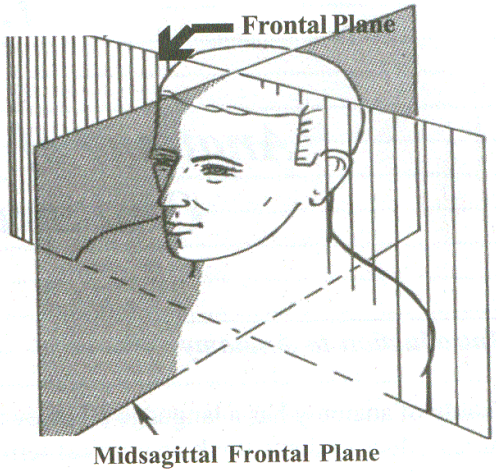


Figure 1-1. Sagittal and Frontal Planes

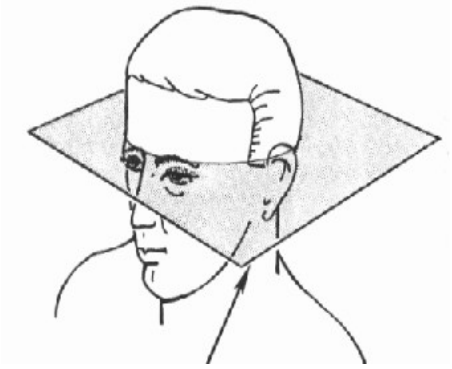


Figure 1-2. Tranverse Planes

❖ *Anatomical Terminology*

Since anatomy is a descriptive science, a good deal of the effort involved in learning it is associated with memorizing terms. However, as more knowledge is acquired in this specialty through association, structures and their functions are easily recalled. Nevertheless at the outset, description of structures is generally remembered through a process of memorization. Bear in mind that relating the function of a structure to its morphology as

well as to other structures is the basis for an in-depth retention of anatomy.

While anatomical structure, some years ago, was described in Latin, in most cases (although there are exceptions) this terminology has given way to an anglicized version of the Latin. Other problems in anatomical terminology relate to the fact that frequently a structure may have several names. In fact in the latter part of the nineteenth century, estimates show that there were some 50,000 terms in use but these only related to some 5,000 structures, for an average of 10 names per structure! Various systems have been developed and reviewed for a structured arrangement for naming in anatomy. In the 1950's and 1960's, the *Nomina Anatomica* was developed in Paris on which all official terminology is based.

Anatomical terminology can be divided into 2 types: terms that refer to components of the body and terms that refer to direction, e.g., proximal or distal.

Body Components

Head - caput, skull - cranium

Neck - collum or more commonly cervical

Trunk - 4 regions: dorsum (back), thorax (chest), abdomen, pelvis.

Limbs - shoulder, arm, forearm, hand; hip, thigh, leg, foot.

Terms of Position

These terms are really the most complex. All references to position refer to the living body standing in what is termed the anatomic position. This is defined as: standing erect with the palms facing forward, feet straight ahead. To this basic position all anatomic terms of direction are referred.

***Anterior/posterior* - in man these terms are synonymous with ventral/dorsal. However, in 4- legged animals they are not. Anterior refers to toward the front of the body while posterior refers to toward the back.**

***Superior/inferior* - synonymous with cranial or caudal. Superior refers to toward the head while inferior refers to**

the opposite direction.

***Proximal/distal* - refers to "closer to" or "further from."**

Planes

***Sagittal* - is a plane passing through the body from the front to the back. Thus the body is divided into 2 halves. Note that the body does not have to be divided into 2 equal portions unless divided by a midsagittal plane.**

***Coronal* - divides the body by a plane passing at right angles to the sagittal plane. Note that both sagittal and coronal also refer to sutures in the skull which pass in the corresponding direction.**

***Transverse* - a horizontal plane through the body.**

In addition to these general descriptive terms we also employ terms of movement.

***Flexion/extension* - these specify movement in muscles at a joint in the opposite directions. Flexion indicates a movement which decreases the angle between two bones while extension indicates a movement that increases the angle. For example, in the anatomic position (i.e., with the palms of the hands facing forward) muscles which cause movement at the elbow such that the forearm bends upward toward the arm are considered "flexors" of the forearm or of the elbow. On the contrary, muscles which cause the forearm to move away from the arm are termed extensors.**

***Abduction/adduction* - refer to the movement away from or towards the median plane (a midsagittal plane) respectively.**

***Protraction/retraction* - refer to an anterior movement or posterior movement respectively. Used with movements of the mandible.**

***Rotation* - refers to the movement of a body part about its longitudinal axis.**

♦ Bony Elevations

- **Tubercle, Eminence, or Tuberosity. All of these words describe rather small, somewhat circular areas that are raised above the general level of the surrounding bone. An elevation of bone that falls in this**

category was specifically labeled as an eminence, a tuberosity, or a tubercle by the person who originally described it. There might be little to distinguish among these kinds of elevations as far as relative shape and size are concerned. They just have to be memorized according to the names they carry.

- ***Ridge.*** **A linear elevation on the surface of a bone.**
- ***Process*****. A very prominent projection from the central mass of a bone.**
- ***Condyle*****. A rounded, convex, smooth surface on one of the bones that forms a movable joint.**

♦ ***Bone Depressions and Channels***

- **Fovea. A shallow, cup-shaped depression or pit.**
- ***Fossa*****. A more or less longitudinal, rounded depression in the surface of a bone.**
- ***Canal*****. A tubular channel through bone. The channel has at least one entrance and one exit hole. A canal's entrance or exit hole is called a foramen.**

♦ ***Joints***

Joints can be classified in a number of ways, one of the ways being the kind of movement that the structure of the joint allows. There are three kinds of joints found in the human skull.

- **Synarthrosis or Immovable Joint. Most bones of the skull are joined together along highly irregular, jigsaw puzzle-like lines called sutures. A suture joint is classified as a synarthrosis. Bones joined along suture lines in the skull are not totally immobile. Movement occurs, but it is very limited.**
- ***Ginglymodiarthrodial Joint*****. Literally defined, this is a freely movable, gliding, hinge joint. This relationship of one bone to another allows the greatest range of movement of any joint type. The term ginglymodiarthrodial specifically describes the temporomandibular joint that unites the lower jaw with the rest of the skull.**
- ***Ellipsoidal Joint.*** **The type of joint that exists between the occipital bone of the skull and the first vertebra of the spinal column. There are two axes of motion at right angles to each other in this joint, and both axes pass through the same bone. This arrangement enables you to nod your head and rotate it from side-to-side.**

♦ ***Muscles***

The mass of a muscle is composed of many individual cells that are capable of contracting. The force generated by the muscle as a whole

depends on how many cells in the muscle's mass are contracting at any given time. Muscles can pull (contract or shorten); they cannot push. A relaxed muscle cannot get any longer unless another contracting muscle somewhere else is forcing the extension. It should be obvious that a simple act like flexing and extending a finger requires at least two different muscles. The muscles used in flexing and extending a finger perform actions that are opposite one another. The performance of an action by one muscle that is opposed to the action of another is called antagonism. Besides having definite names, muscles are described in terms of:

- **Origin. A structure where a muscle attaches that moves the least when a muscle contracts.**
- ***Insertion*. A structure where a muscle attaches that has the greater movement during contraction.**
- ***Action.* The performance expected when a particular muscle contracts.**

❖ *Bony Anatomy of the Head*

■ *Overview*

The skull is that portion of the human skeleton which makes up the bony frame work of the head. For descriptive purposes, the skull is divided into an upper, dome-shaped, cranial portion; and a lower or facial portion composed of the eye sockets, nasal cavities, and both jaws. The adult skull is composed of 22 bones (8 cranial and 14 facial) (Figure 1-3).

♦ ***Cranial Bones. The 8 bones of the cranium are:***

- **Frontal**
- **Parietal (right and left)**
- **Occipital**
- **Temporal (right and left)**
- **Sphenoid**
- **Ethmoid**

NOTE: The shape and arrangement of these 8 bones form a bony shell (cranium) that has a central cavity containing the brain. The arched roof of the cranial cavity is called the vault and the floor of the cavity is called the base.

♦ ***Facial Bones. There are 14 bones in the facial portion of the skull:***

- **Maxilla**
- **Palatine**
- **Zygomatic**
- **Lacrimal**
- **Nasal**
- **Inferior concha**
- **Vomer**
- **Mandible**

NOTE: There is only one vomer and one mandible in a skull: the other facial bones are paired.

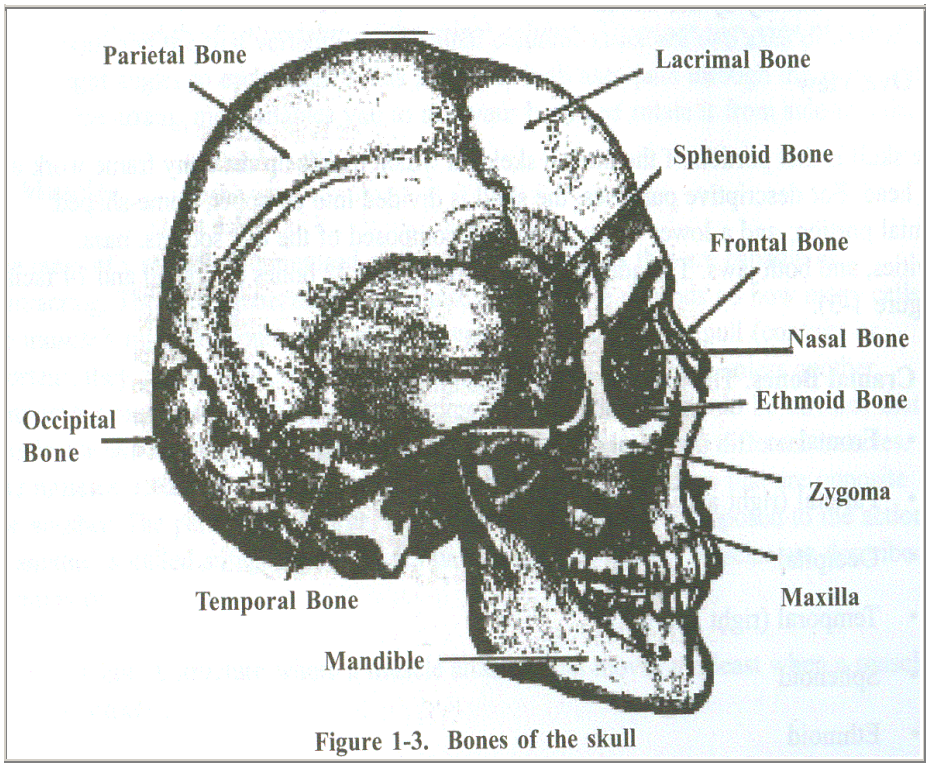


Figure 1-3. Bones of the skull

■ ***Cranial and Facial Bones of Primary Interest in Prosthetic Dentistry***

Artificial replacements for missing natural teeth (dental prostheses) must be made to fit jaw contours and work in harmony with muscle activity. Therefore, we will discuss only those facial bones which give

shape to soft tissues within the mouth, serve as anchorage sites for muscles which move the lower jaw, and give shape to the lower one-half of the face.

♦ ***Cranial Bones of Primary Interest***

- **Frontal**
- **Parietal**
- **Temporal**
- **Sphenoid**

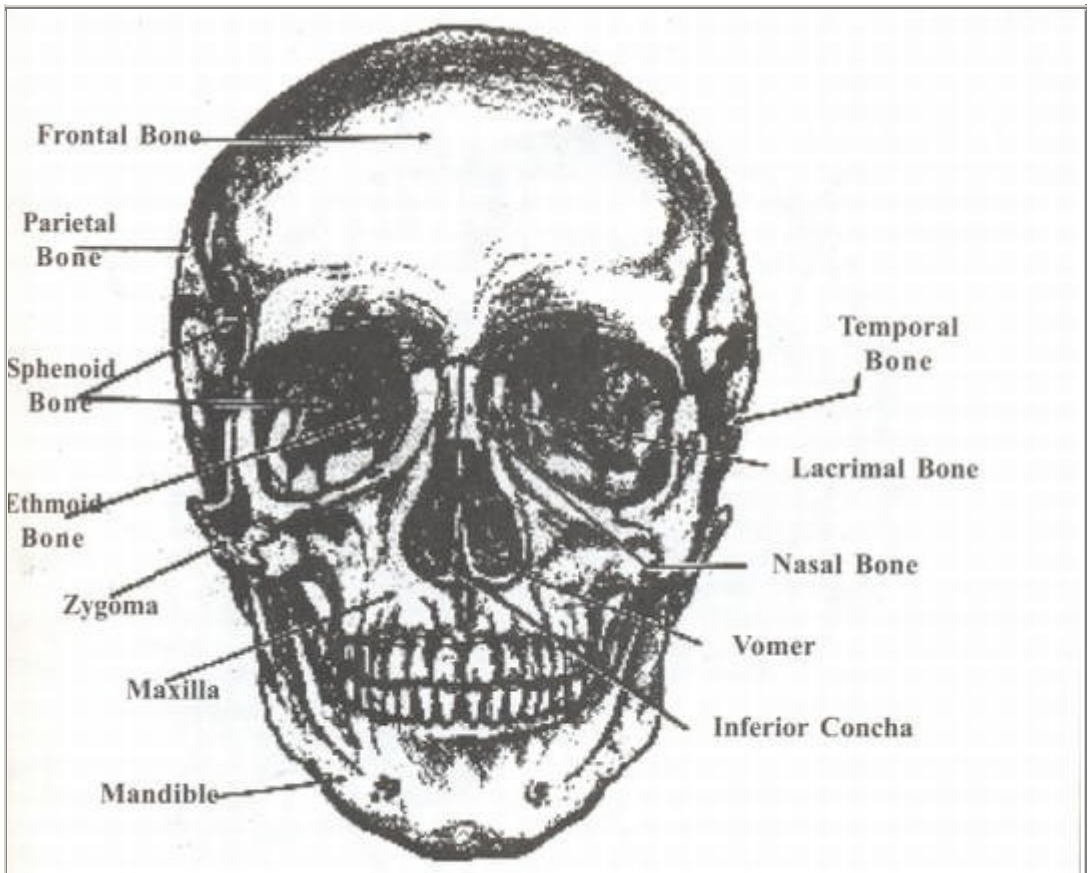


Figure 1-3. Bones of the Skull (cont.)

♦ ***Facial Bones of Primary Interest***

- **Maxilla**
- **Palatine**
- **Zygomatic**
- **Mandible**

Particular features of these bones are important to remember for subsequent reference in this publication and indeed, for the remainder of your technical career.

■ *Particular Features of Cranial and Facial Bones*

♦ *Frontal Bone*

The frontal bone is a single bone that forms the anterior of the cranial vault, the roof of the eye sockets, and a small portion of the nasal cavity. A temporal line can be found on both lateral surfaces of the frontal bone. The line begins in the region of the eye socket and proceeds posteriorly, often dividing into superior and inferior temporal lines near the posterior border of the frontal bone (Figure 1-4).

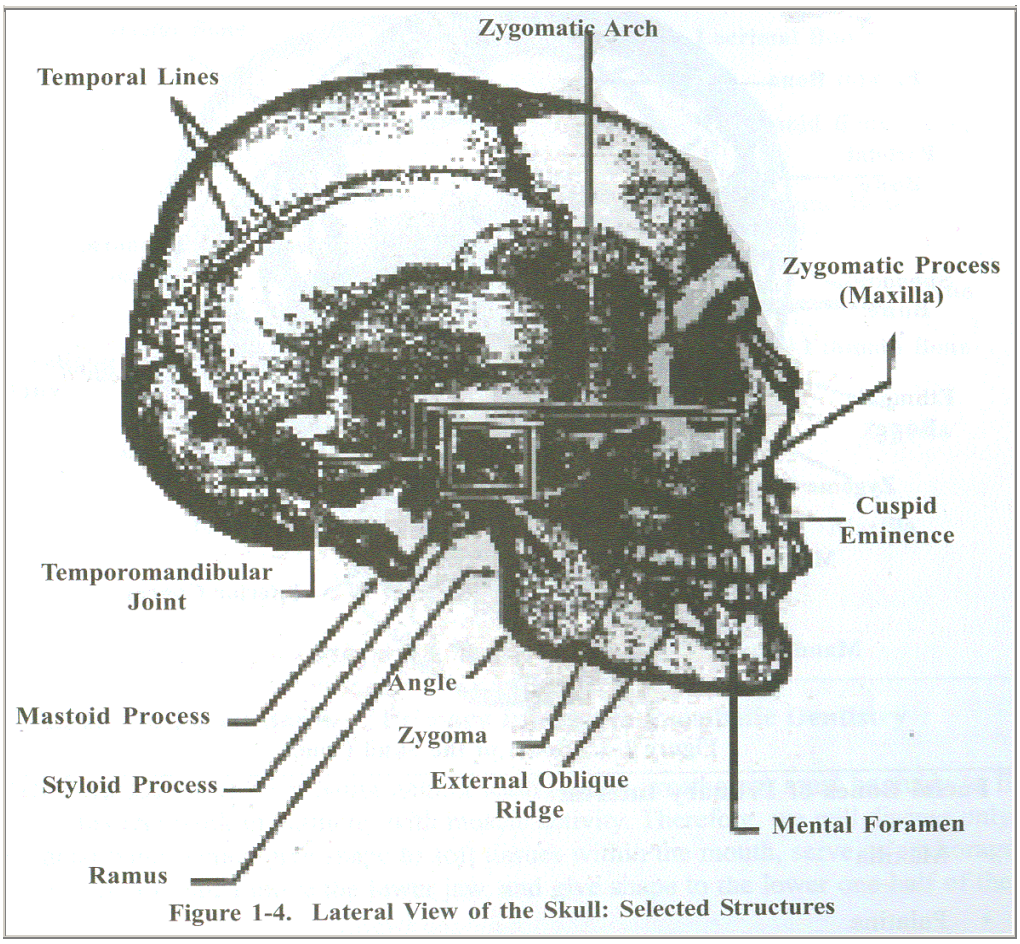


Figure 1-4. Lateral View of the Skull: Selected Structures

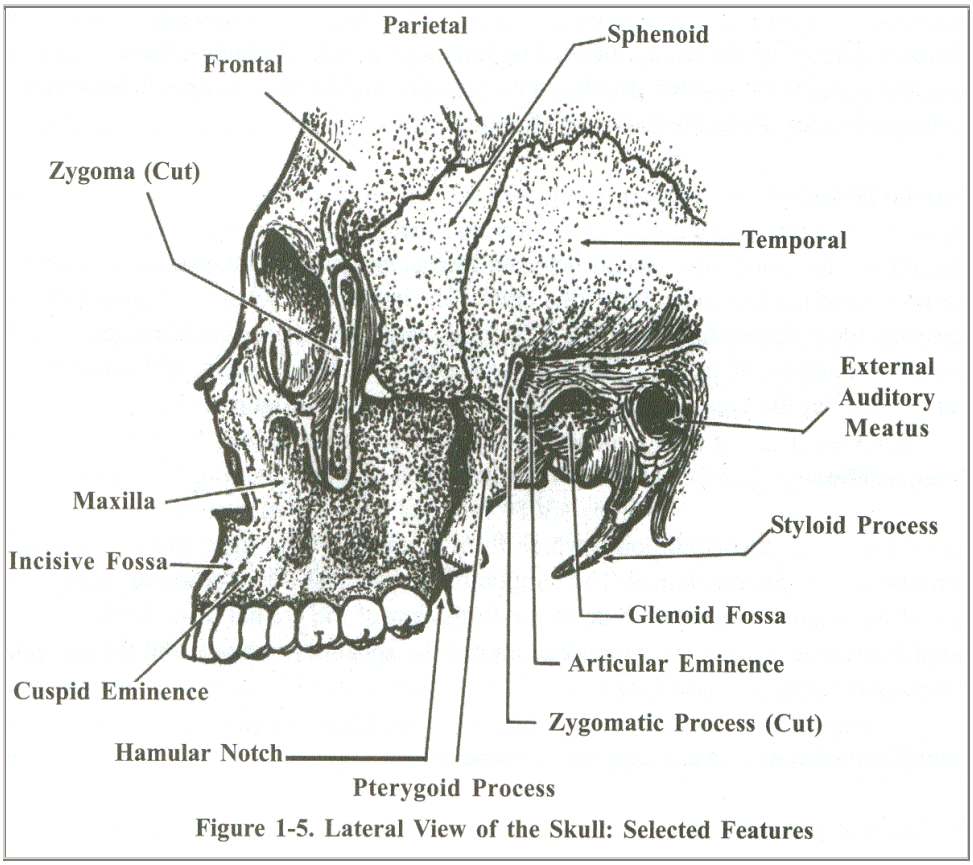


Figure 1-5. Lateral View of the Skull: Selected Features

- ***Parietal Bones***

The paired parietal bones are located between the occipital and frontal bones to form the largest portion of the top and sides of the cranium. The parietal bones are marked by two semicircular bony ridges, the superior and inferior temporal lines, which are the posterior continuation of the frontal bone's temporal line. The superior and inferior temporal lines rim the area of origin of the temporal muscle (Figure 1-4).

- ***Temporal Bones***

Temporal bones are the paired bones which form a portion of the right and left sides of the skull below the parietal bones. The temporal bones extend down onto the under surface of the cranium and contribute to the formation of the cranial base. Each temporal bone articulates with the parietal above, the sphenoid in front, and the occipital bone behind (Figures 1-4 and 1-5).

The significant features of the temporal bone are:

- ***Mastoid process***
- ***Styloid process***
- ***Zygomatic process***

- ***Glenoid fossa***
- ***Articular eminence***
- ***Auditory canal or external auditory meatus***
    - ***The convex posterior part of the temporal bone (mastoid portion) is characterized by a rounded, downward projecting mastoid process. The mastoid process presents a roughened exterior surface for attaching several muscles of the neck.***
    - ***The styloid process is a slender, tapering spur of bone projecting downward from the under surface of the temporal bone. The styloid process has sites of attachment for multiple muscles and ligaments which then go to the mandible, the hyoid bone, the throat, and the tongue.***
    - ***The zygomatic process is a projection from the approximate center of each temporal bone which extends forward to form a part of the zygomatic arch or cheek bone. This arch or so-called cheek bone is not one continuous bone, but is made up of a number of parts. The zygomatic process of the temporal bone forms the posterior part.***
    - ***The glenoid fossa is a deep hollow on the under surface of the base of the zygomatic process. The base of the zygomatic process is the place where the process originates from the central mass of the temporal bone.***
    - ***The articular eminence is a ramp-shaped prominence which extends forward and downward from the anterior boundary of the glenoid fossa.***
    - ***The auditory canal or external auditory meatus is a hole in the bone found posterior to the glenoid fossa. It leads from the outside surface of the base of the zygomatic process to the inner portions of the ear.***

♦ ***Sphenoid Bone***

The sphenoid bone resembles a bat with wings extended. It consists of a central portion or body which is situated in the middle of the base of the skull and three pairs of processes: two laterally extended greater wings, two downward projecting pterygoid processes, and two lesser wings. The features of the sphenoid bone we will discuss are:

- ***Greater wings***
- ***Spine of the sphenoid***

- *Pterygoid processes*
  - *Greater Wings (Figure 1-5). A greater wing forms part of the surface contour of the cranium anterior to the temporal bone, and also forms part of the eye socket.*
  - *Spine of the Sphenoid. This is just inferior to the lateral, posterior, inferior border of the greater wing of the sphenoid bone. The spine of the sphenoid is the site of attachment of the sphenomandibular ligament.*
  - *Pterygoid Process (Figures 1-6 and 1-7). Extends downward from the junction of the body and greater wing of the sphenoid on the right and left side. The pterygoid process is formed by the union of two bony plates. The depression between the two plates is called the pterygoid fossa. The pterygoid process is a site of origin for the internal and external pterygoid muscles.*

- *Maxilla (Plural = Maxillae)*

The maxillae or upper jawbones are paired bones which unite in the midline to give shape to the middle face, form a portion of the floor of the eye socket and lateral wall of the nose, form the anterior two-thirds of the hard palate, and support natural teeth in bony sockets (Figures 1-6, 1-7, and 1-8). Each maxilla is irregularly shaped and is made up of a body and these four processes:

- *Nasal process*
- *Zygomatic process*
- *Alveolar process*
- *Palatine process*
  - *The nasal process forms a portion of the lateral wall of the nose. Another name for nasal process is frontal process.*
  - *The zygomatic process of the maxilla joins with the zygomatic bone (zygoma) which, in turn, unites with the zygomatic process of the temporal bone to form the zygomatic arch or cheekbone. The term cheekbone, although popular, is incorrect. This so-called single bone is actually made up of the three parts specified.*
  - *The roots of the maxillary teeth are surrounded by the alveolar process. The alveolar processes of both maxillae unite to form the maxillary arch. A maxillary tuberosity is found on both of the distal ends of the maxillary arch. Proceeding even further posteriorly, the maxillary tuberosities abruptly rise into deep*

depressions called the hamular notches. The pterygoid process of the sphenoid bone joins with the posterior aspect of a maxilla to form a hamular notch. The labial portion of the alveolar bone follows the contours of the natural tooth roots; when a root is large and prominent, the labial alveolar bone over the root is raised in comparison to an alveolar area between roots. The labial alveolar bone covering the root of the maxillary cuspid stands out so much that it has a specific name, the cuspid eminence.

- ***The palatine processes of the maxillae join in the midline to form the anterior two-thirds of the hard palate. The midline junction of the right and left palatine processes is called the median palatine suture. An incisive foramen is found in the suture line immediately behind the central incisor teeth. The foramen is an exit hole for nerves and blood vessels which supply palatal tissue (Figure 1-8).***

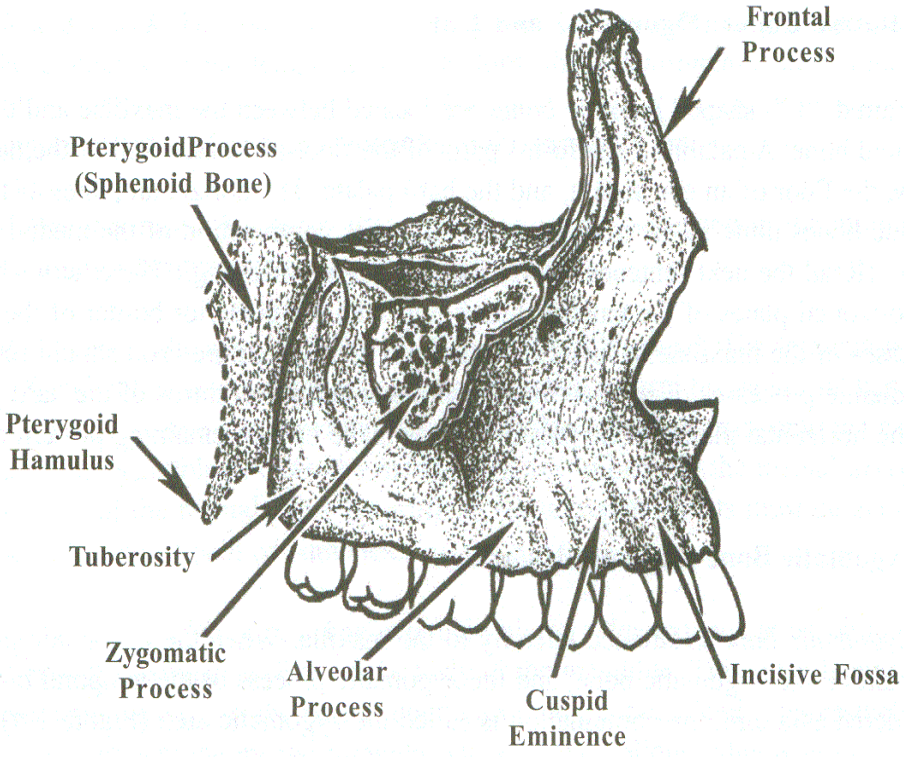


Figure 1-6. Lateral View of a Maxilla

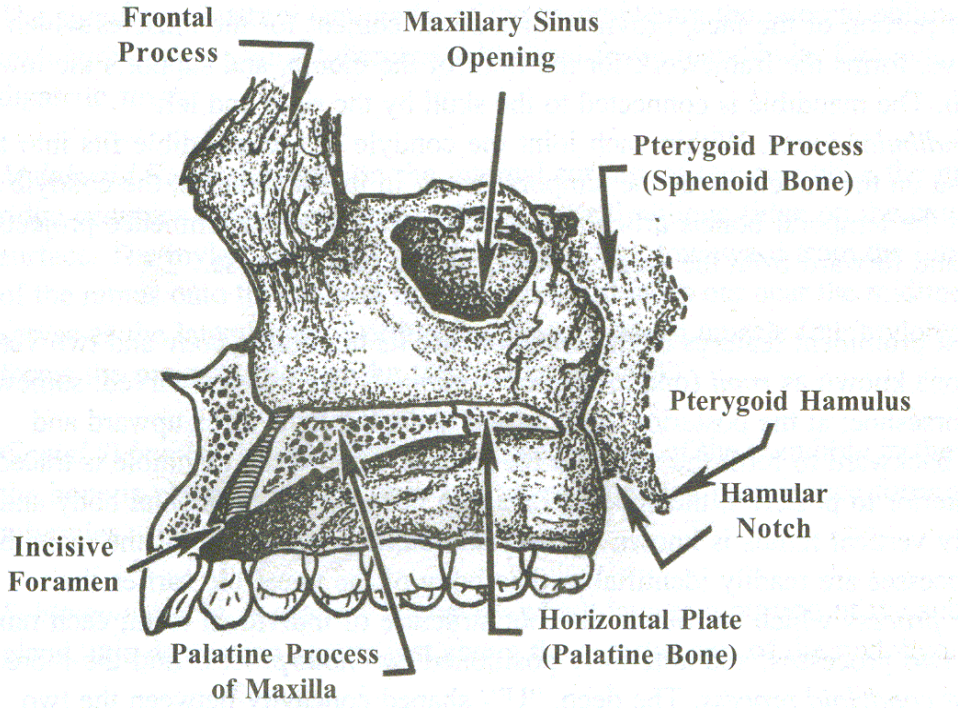


Figure 1-7. Medial View of Maxilla and Selected Adjacent Bones

■ ***Palatine Bones (Figures 1-7 and 1-8)***

The paired, "L"- shaped palatine bones are located between the maxillae and the sphenoid bone. A palatine bone forms parts of the floor and outer wall of the nasal cavity, the floor of an eye socket, and the hard palate. The horizontal plates of the palatine bones unite in the midline as the posterior continuation of the medial palatine suture. (Read the next sentence slowly and analyze its meaning.) The anterior border of the horizontal plates of the palatine bones join with the posterior border of the palatine processes of the maxillae to form the transverse palatine suture. You should recall that the palatine processes of the maxillae form the anterior two-thirds of the hard palate, and the horizontal plates of the palatine bones make up the remaining posterior one-third.

■ ***Zygomatic Bone (Zygoma, Malar Bone)***

The zygomatic bone is situated laterally to the maxilla. When the zygomatic process of the maxilla, the zygomatic bone, and the zygomatic process of the temporal bone are considered as a unit, the combination is called the zygomatic arch (Figure 1-4).

■ ***The Mandible (Figure 1-9)***

The mandible or lower jaw is the only movable bone of the skull. This bone gives shape to the lower portion of the face, provides sites of attachment for the muscles which make it move, forms the framework for the floor of the mouth, and supports the lower natural teeth. The

mandible is connected to the skull by the right and left temporomandibular joints. Within each joint the condyle of the mandible fits into the glenoid fossa on the underside of the temporal bone. In its movements, the condyle also travels onto the temporal bone's articular eminence. The articular eminence projects downward and forward from the anterior border of the glenoid fossa.

- *The most prominent features of the mandible are its horizontal body and two vertical projections known as rami (one projection = ramus). The body is curved, somewhat like a horseshoe; at the posterior limits of the body, the bone turns upward and slightly backward to form the rami. As the inferior edge of the mandible is traced from anterior to posterior, the sudden transition between the horizontal body and the relatively vertical ramus is known as the mandibular angle (angle of the mandible). Five processes are readily identifiable. The body of the mandible carries the alveolar process which surrounds the root structure of individual teeth; each ramus ends in two processes, and anteriorly positioned coronoid process and the more posterior condyloid process. The deep, "U"- shaped concavity between the two processes is called the mandibular notch. A condyloid process can be divided into a condyle and a neck. The top part of the condyle articulates with the glenoid fossa and articular eminence of the temporal bone to form the temporomandibular joint.*

- *The important external surface landmarks of the mandible are:*

  Mental Protuberance. A roughly triangular prominence occurring in the midline near the inferior border of the mandible (chin point).

  Mental Foramen. The anterior opening of the mandibular canal. The foramen is usually found between and slightly below the first and second bicuspid root tips. The inferior alveolar nerve passes within the mandibular canal and exits onto the exterior surface of the mandible through the mental foramen to become the mental nerve. Compression of the mental nerve by artificial dental replacements must be avoided. It causes a feeling of pain or numbness.

  External Oblique Ridge (Line). The external oblique ridge extends at an oblique angle across the external surface of the body of the mandible. This ridge begins at the lower anterior edge of the ramus, continues onto the body, and progressively thins out to end near the mental foramen. The external oblique ridge is most prominent in the molar area and forms a distinct ledge with relation to the base of the alveolar process. This ledge is called the buccal shelf.

- ***The significant internal landmarks of the mandible are the internal oblique or mylohyoid ridge, genial tubercles, sublingual fossa, mandibular foramen, lingula, and digastric fovea.***

  Mylohyoid Ridge. Located on the internal surface of the mandible, the mylohyoid ridge occupies a position similar to the external oblique ridge on the external surface. The mylohyoid ridge passes forward and downward from the internal aspects of the ramus onto the body of the mandible and fades out near the midline. This ridge serves as the lateral line of origin for the mylohyoid muscle (the mylohyoid muscle forms the major portion of the floor of the mouth).

  Genial Tubercles. Slightly above the lower border of the mandible in the midline, the bone is elevated to a more or less sharply defined prominence forming the genial tubercles.

  Sublingual Fossa. A shallow concavity which houses a portion of the sublingual gland, this depression occurs just above the anterior part of the mylohyoid ridge.

  Mandibular Foramen. The foramen is located in almost the exact center of the inner surface of the mandibular ramus. It opens into the mandibular canal.

  Lingula. A bony prominence on the anterior border of the mandibular foramen.

  Digastric Fovea. A depression found on both sides of the midline near the inferior lingual border of the mandible.

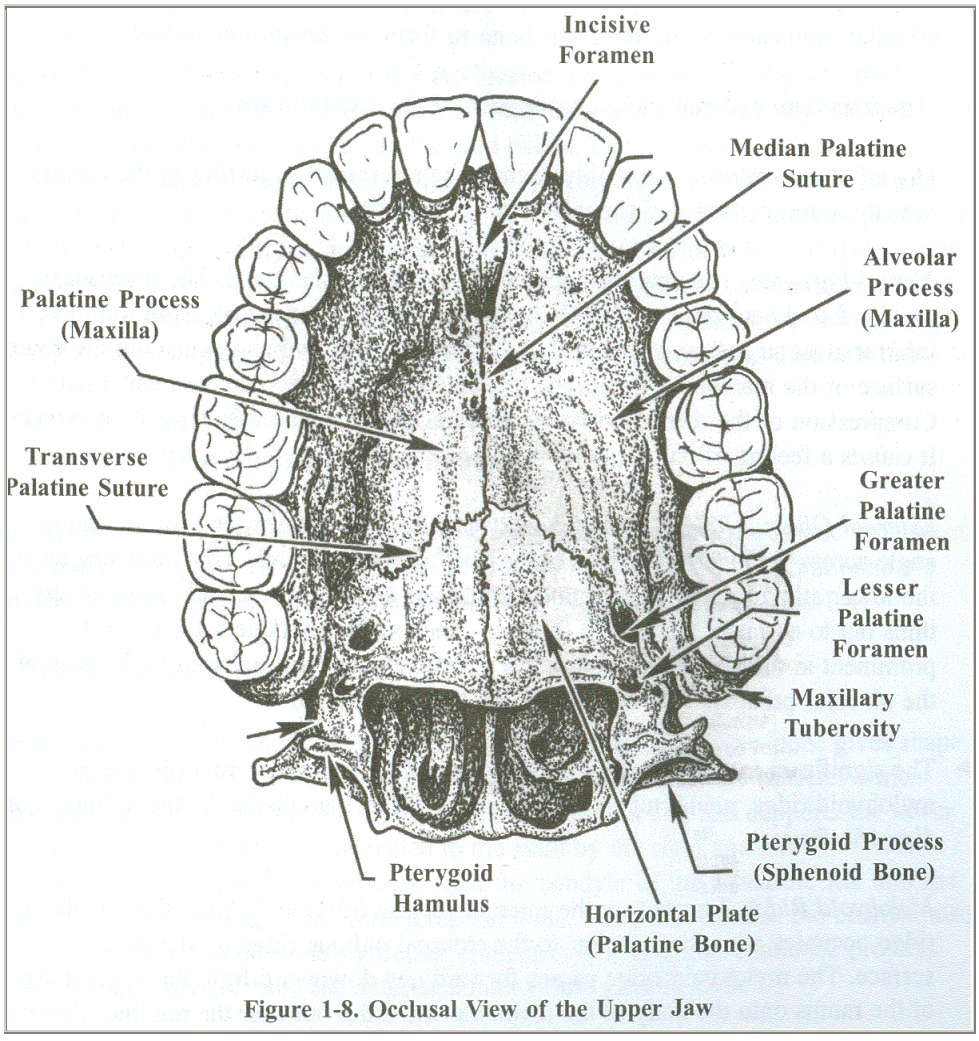


Figure 1-8. Occlusal View of the Upper Jaw

■ *The Hyoid Bone*

Since dentists and technicians are concerned with sites of anchorage for muscles which move the lower jaw, the hyoid bone which is not a part of the skull must be mentioned. The hyoid is a "U"- shaped bone located anterior to the spinal column between the mandible and the larynx (voice box). There is no joint-like union between the hyoid and any other bone. It is suspended between the mandible above and the clavicle (collar bone) below by suprahyoid (above the hyoid) and infrahyoid (below the hyoid) muscle groups. Some of the syprahyoid muscles act to depress the lower jaw. Those suprahyoid muscles which act to depress the mandible are described below.

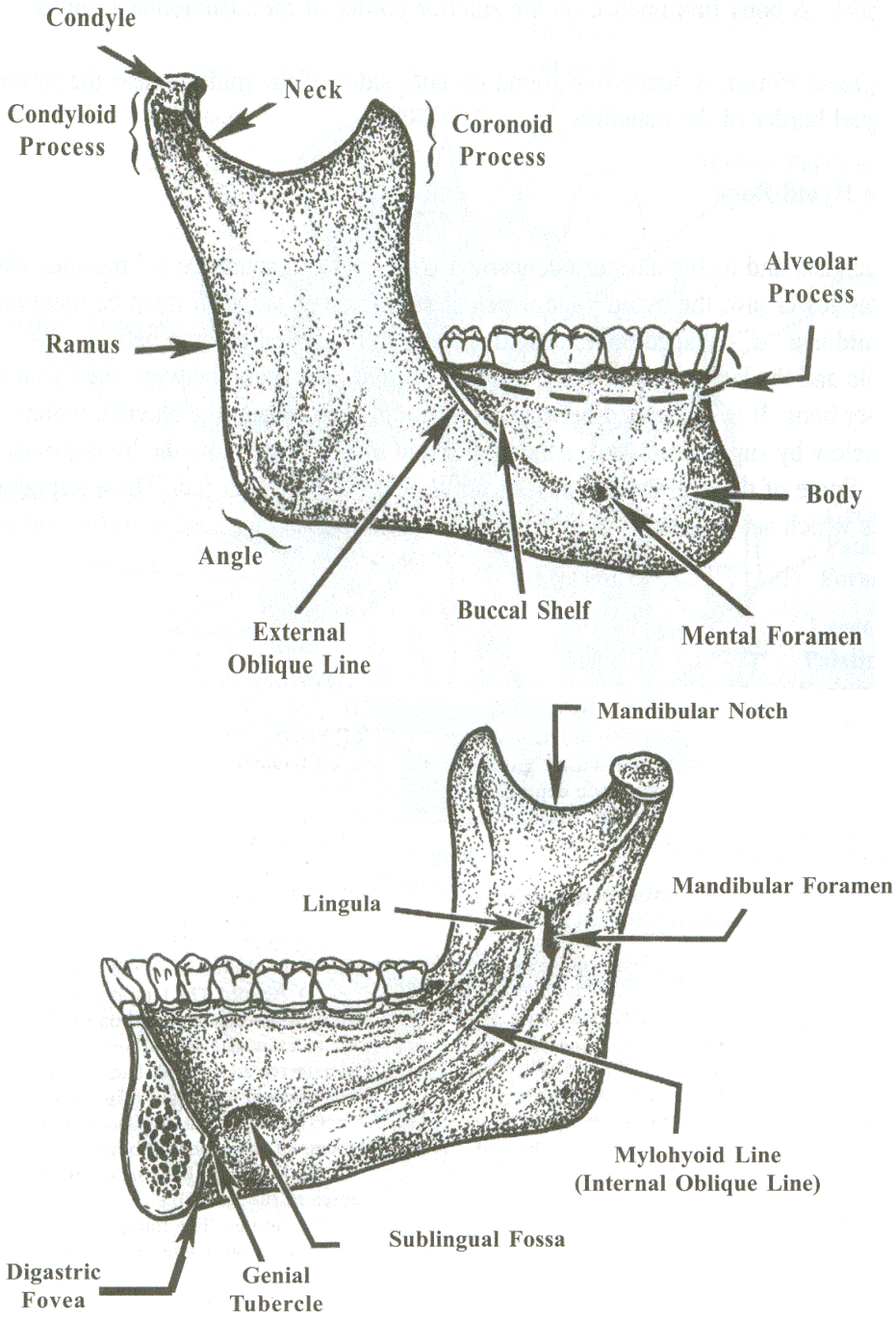


Figure 1-9. Lateral and Medial View of the Mandible

❖ *The Muscles of Mastication and Depressors of the Mandible*

■ *Overview*

A person's ability to move part of the body depends on a group of specialized cells called the muscle fibers. Muscle fibers have the ability to contract or shorten when stimulated by nerve impulses. A typical muscle consists of a mass of muscle fibers bound together by connective tissue. A muscle can generate varying degrees of power. This variation in power is directly proportional to the number of fibers

within the muscle that are contracting at any given time. Muscles can also stretch, but only because a muscle located elsewhere has contracted and forced the extension. The simplest way to express this is that muscles can only pull; they cannot push.

The two ends of a voluntary muscle usually attach to different bones. In some instances, one end of a muscle may attach in soft tissue such as skin. Some of the very small muscles that give expression to the face have both ends attached to soft tissue. In any case, the muscle attachment site which remains relatively stationary when the muscle contracts is known as the origin. The muscle attachment site having the greater movement during the contraction is called the insertion. A description of the movements which take place as a result of muscle contraction is called the action.

Two muscle groups are responsible for executing the movements that the mandible is capable of making. They are the muscles of mastication, and the depressor muscles of the mandible. The muscles of mastication enable the lower jaw to make closing, opening, protrusive, and retrusive movements along with movements to the right and left sides. The depressors of the mandible act to open the lower jaw widely, a function which the muscles of mastication cannot perform.

■ *Muscles of Mastication*

There are four, paired muscles of mastication. They are the masseters, the temporals, the internal pterygoids, and the external pterygoids.

♦ *Masseter (Figure 1-10):*

- **Origin. Zygomatic arch.**
- ***Insertion.*** **Lateral surface of the ramus of the mandible.**
- ***Action*****. The masseter has two actions. They are elevation of the mandible and elevation of the mandible combined with retrusion.**

♦ *Temporal (Figure 1-10):*

- ***Origin.*** **The origin of this muscle is broadly spread out (fan-shaped) on the side of the skull. It covers the majority of the temporal bone and lesser portions of the frontal and parietal bones. The upper margin of the muscle follows the superior temporal line.**
- ***Insertion.*** **The temporal muscle inserts on the coronoid process of the mandible.**
- ***Action.*** **The temporal muscle acts in unison with the masseter and internal pterygoid muscles to close the jaws. Very importantly, it also**

helps to retrude or pull back the mandible.

♦ ***Internal Pterygoid (Figure 1-11):***

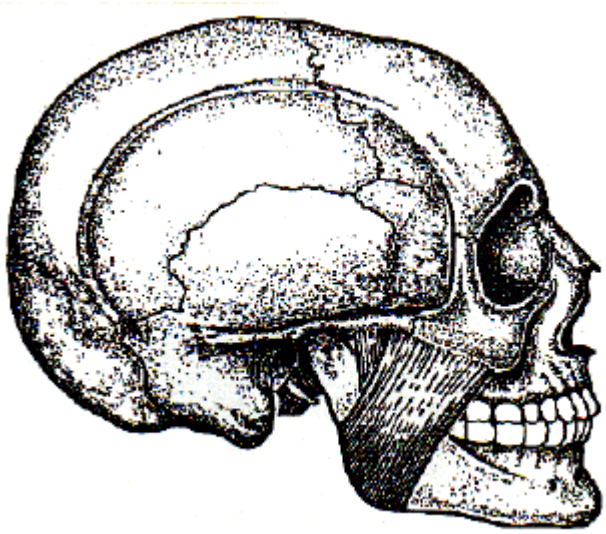
- **Origin. Palatine bone and the pterygoid process of the sphenoid bone.**
- ***Insertion.*** **Internal (medial) surface of the ramus of the mandible.**
- ***Action.*** **The internal pterygoid acts with the masseter and temporal muscles to close the lower jaw. Some authors claim that when one internal pterygoid muscle contracts independently of its paired mate, the internal pterygoid muscle assists in moving the mandible sideways.**

♦ ***External Pterygoid (Figure 1-12)***

- **Origin. Pterygoid process and greater wing of the sphenoid.**
- ***Insertion.*** **Neck of the condyloid process of the mandible.**
- ***Action.*** **When both external pterygoid muscles contract together, the mandible is pulled forward into protrusion. (Coincident with a protrusive movement, the mandible opens slightly.) When one muscle contracts independently of the other, the mandible pivots and shifts to the opposite side (lateral excursion).**

■ ***Depressor Muscles (Figures 1-13 and 1-14)***

The depressor muscles of the mandible all have the hyoid bone in common as an attachment site. When the hyoid bone is immobilized by a contraction of the muscles below it, the contraction of the depressor muscles located between the hyoid bone and the mandible pulls the mandible downward (open the mouth). The suprahyoid depressors of the mandible are the mylohyoid, geniohyoid, and digastric muscles.



Masseter Muscle

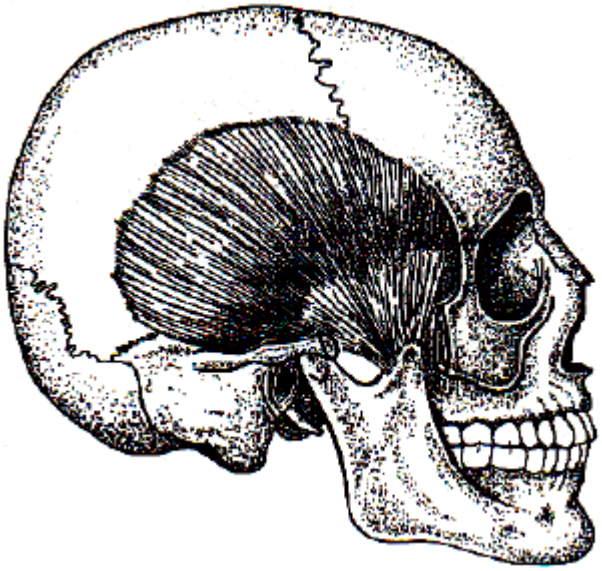


Figure 1-10. Temporal Muscle

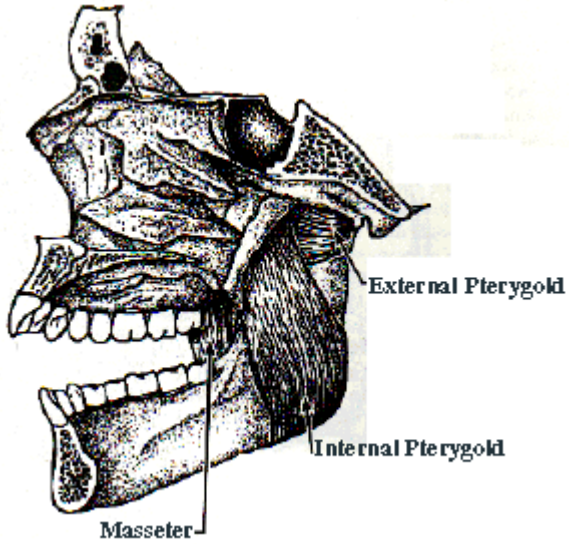


Figure 1-11. Medial View of the Internal Pterygoid Muscle

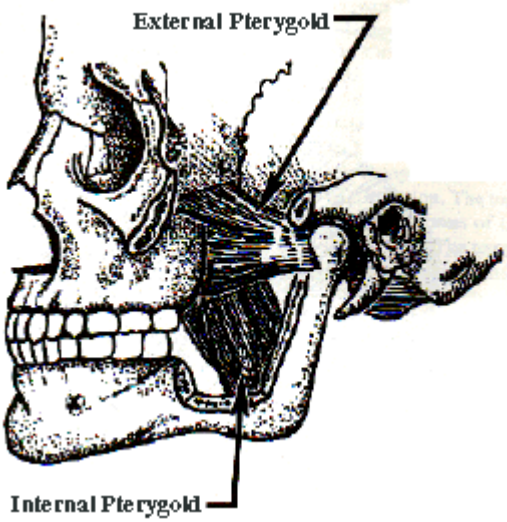


Figure 1-12. Lateral View of the External Pterygoid Muscle

- ***Mylohyoid Muscle Attachment Sites***

The paired mylohyoid muscles are attached to the mylohyoid lines on the internal surfaces of the mandible, the right and left mylohyoid muscle join in the midline to form the floor of the mouth, and the posterior end of this midline junction attaches to the hyoid bone.

- ***Geniohyoid Muscle Attachment Sites***

The two geniohydid muscles are found next to each other, on each side of the midline, directly on top of the mylohyoid muscles. The sites of the attachment are the genial tubercles and the hyoid bone.

- ***Digastric Muscle Attachment Sites***

The digastric muscle bundle is divided into an anterior belly and a posterior belly by a short tendon. This intermediate tendon passes through a loop of fibrous tissue secured to the body of the hyoid bone. The end of the anterior belly attaches to the digastric fovea and the posterior belly fastens onto the mastoid process of the temporal bone.

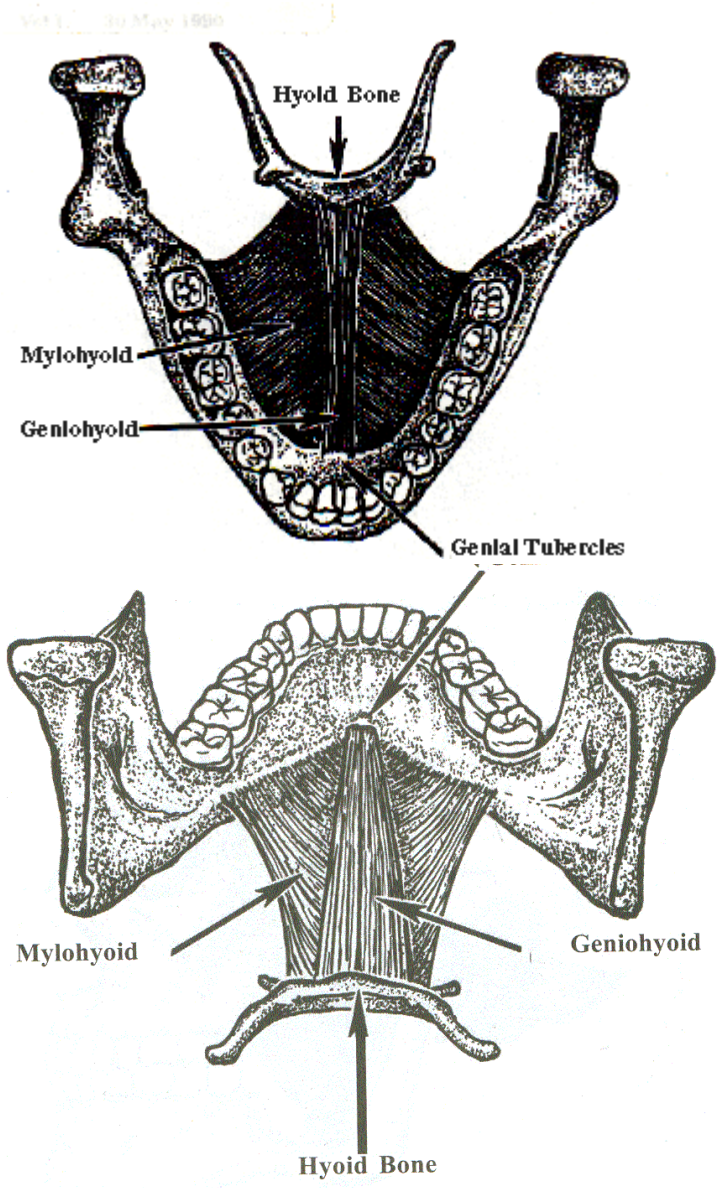


Figure 1-13. Mylohyoid and Geniohyoid Muscles

❖ *Facial Expression Muscles*

■ *Overview (Figure 1-15)*

Eight paired muscles of expression in combination with the single, orbicularis oris muscle control movements of the lips and cheeks. The teeth and alveolar processes of the jaws support this group of muscles against collapse into the oral cavity. When natural teeth are extracted,

facial muscle support must be maintained by replacing the missing teeth. A person's appearance can be dramatically affected by the position of the artificial teeth. Inadequate support makes people look older, and excessive support distorts a person's features by making them appear stretched.

The muscles of facial expression also play an important part in forming the anterior and lateral portions of maxillary and mandibular impression borders. This is because all of these muscles can alter the depth of vestibular sulci (below) in one way or another. If impression borders are not properly extended and shaped, the muscles act to unseat the dentures.

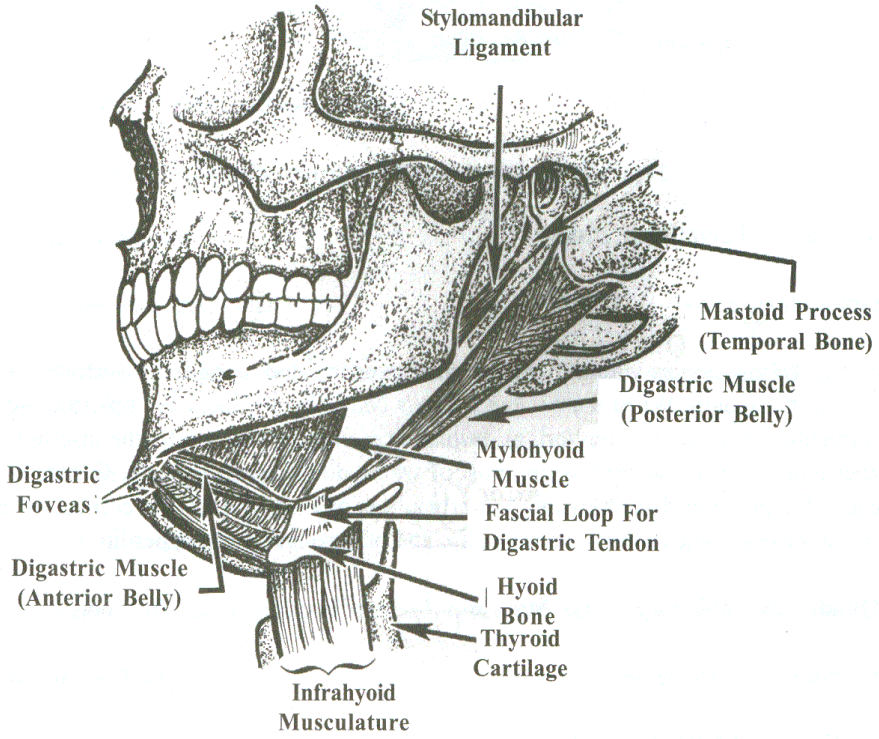


Figure 1-14. Oblique View of the Mylohyoid and Digastric Muscles

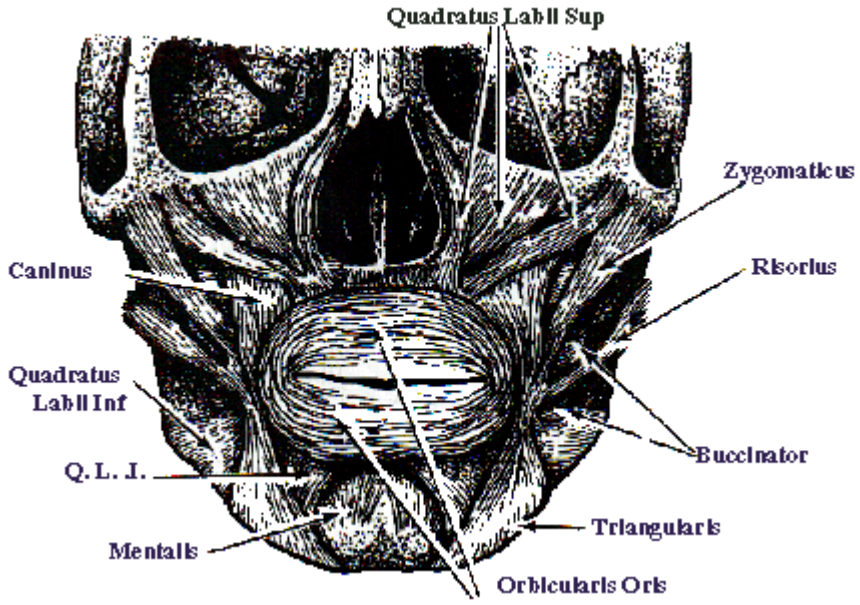


Figure 1-15. Muscles of Facial Expression

■ *Muscles of Facial Expression*

♦ *Orbicularis Oris*

This ring-like muscle lies within the upper and lower lips and completely surrounds the opening to the mouth. When the orbicularis oris contracts, it causes the lips to close. The orbicularis has no real bony origin. Instead, it is entirely rimmed by the insertions of other muscles of facial expression, most of which do originate on bone. Certain muscles of expression that insert into the orbicularis oris act to draw the corners of the mouth backward, some depress the lower lip, and others elevate the upper lip.

♦ *Quadrates Labii Superioris Muscle*

- **Form. Flat, triangular.**
- ***Position.*** **Lateral to the nose.**
- **Origin (by three heads).**

- Angular. Frontal process of the maxilla.

- Infraorbital. Inferior margin of the orbit.

- Zygomatic. Anterior surface of the zygomatic bone.

- **Insertion. Fibers of the orbicularis oris beneath the nostrils.**

- **Action. Elevates the upper lip, widens the nasal opening, and raises the corner of the nose.**

♦ ***Zygomaticus Muscle***

- ***Form.*** **Oblong, flat, and cylindrical.**
- ***Position*****. Lateral to, and above, angle of mouth.**
- ***Origin*****. Zygomatic bone, lateral to quadrates labii superioris muscle.**
- ***Insertion.*** **Skin at angle of mouth.**
- ***Action.*** **Draws angle of mouth laterally and upward.**

♦ ***Caninus Muscle***

- **Form. Flat, triangular.**
- ***Position*****. In canine fossa of the maxilla, covered by the quadrates labii superioris muscle.**
- ***Origin.*** **Canine fossa.**
- ***Insertion*****. Angle of mouth.**
- ***Action*****. Lifts angle of mouth upward, lifts lower lip, and helps to close mouth.**

♦ ***Risorius Muscle***

- **Form, Flat, triangular.**
- ***Position*****. Lateral to angle of mouth.**
- ***Origin*****. Tissue over the masseter muscle and parotid gland.**
- ***Insertion.*** **Unites at angle of mouth with triangularis muscle.**
- ***Action*****. Draws angle of mouth laterally, causes smile and dimple.**

♦ ***Quadrates Labii Inferioris Muscle***

- **Form. Flat, quadrangular.**
- **Position. Covers mental foramen.**
- **Origin. Lower border of mandible.**

- **Insertion. Skin of lower lip.**
- **Action. Depresses and inverts lower lip.**

♦ ***Triangularis Muscle***

- **Form. Flat, quadrangular**
- ***Position*. Covers mental foramen.**
- ***Origin.* Lower border of mandible just beneath mental foramen.**
- ***Insertion.* Angle of mouth.**
- ***Action.* Draws angle of mouth downward.**

♦ ***Mentalis Muscle***

- **Form. Thick, cylindrical, short.**
- ***Position.* On chin, deep to quadrates labii inferioris muscle.**
- ***Origin.* Mandible, deep to quadrates labii inferioris muscle.**
- ***Insertion.* Obliquely downward to skin of chin.**
- ***Action*. Lifts and wrinkles skin of chin.**

♦ ***Buccinator Muscle***

The buccinator muscle is a thin, broad band of muscle tissue that forms the innermost muscle wall of a cheek. A buccinator muscle has three sites of origin. They are the pterygomandibular raphe (ligament) that originates behind the maxillary tuberosity and inserts at the posterior end of the mandible's mylohyoid line; in the maxilla, the buccinator muscle originates on the buccal surface of the alveolar process, immediately above the root tips of the molar teeth; the third area of origin is the external oblique ridge of the mandible.

The muscle fibers of the buccinator run parallel to the occlusal plane of the teeth, and have a broad zone of insertion into the orbicularis oris at the corner of the mouth. Besides being muscles of facial expression, some anatomists classify the buccinators as accessory muscles of mastication. The primary functions of these muscles are to pull the corners of the mouth laterally and to hold food between the teeth while chewing.

❖ *Intraoral Soft Tissue Anatomy*

■ *General Overview*

The muscles that form the sides, the entrance, and the floor of the oral cavity are the buccinators, the orbicularis oris, and the mylohyoids (in that order) (Figure 1-16). The skin of the interior of the mouth is called oral mucous membrane or mucosa. In places like the alveolar processes and the hard palate of the upper jaw, the mucous membrane is firmly and directly attached to bone. This kind of mucosa presents a stable surface.

In other areas like the lips and the floor of the mouth, the mucous membrane covers active muscles that are constantly in motion; for example, the strong, muscular tongue is almost always moving. A removable prosthesis is built to use stable mucosa for support, and avoid areas of high muscle activity. There are soft tissue landmarks in the mouth that stay in the same places after natural teeth are extracted; these landmarks are valuable aids in prosthesis construction. Knowing where they are is the first step in being able to use the landmarks to advantage.

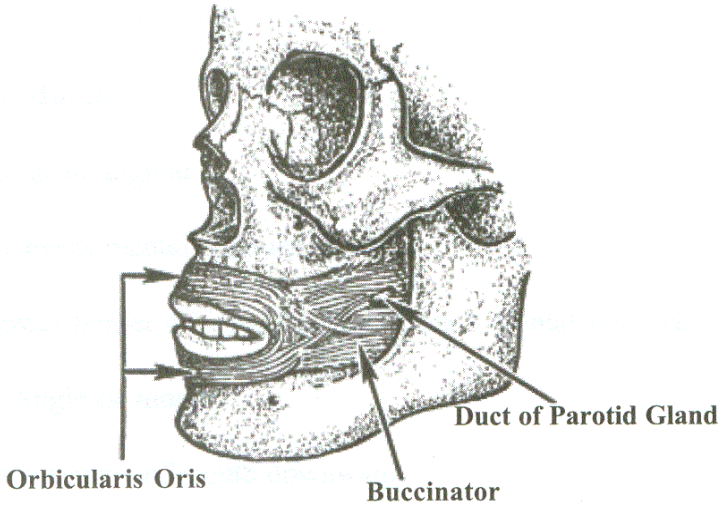


Figure 1-16. Entrance and Sides of the Oral Cavity

■ *Mucous Membrane (Figure 1-17 and 1-18)*

Mucous membrane is the skin that lines the mouth.

♦ *Mucous Membrane of the Alveolar Process*

The mucous membrane of the alveolar process is divided into gingiva and alveolar mucosa.

- **Gingiva. *Gingiva* covers the crestal three-fourths of the alveolar process. There are two kinds of gingiva, *free and attached*. Free**

gingiva is about 0.5 mm wide and is found at the neck of a tooth. The attached gingiva is continuous with the free gingiva and is tightly bound to bone. The attached gingival band varies between 2 and 9 mm wide, the widest part is found in the anterior regions.

- ***Alveolar Mucosa. Covers*** **the basal one-fourth of the** ***alveolar process*****. Alveolar mucosa is very mobile because it is loosely bound to underlying bone.**

♦ ***Mucous Membrane of the Hard Palate***

The mucous membrane of the hard palate consists of attached gingiva.

■ ***Vestibule***

The vestibules consist of two potential spaces. One vestibule is found between the facial aspect of the teeth and the internal surfaces of the cheeks and lips, and the other vestibule is found between the lingual aspect of the mandibular teeth and the tongue.

■ ***Upper Jaw (Figures 1-18, 1-19, 1-31)***

♦ ***Alveolar Process***

The alveolar process is a process of the maxilla that surrounds the roots of natural teeth. The right and left alveolar processes combine to form the maxillary arch.

♦ ***Alveolar Ridge (Residual Ridge)***

The residual ridge is the remnant of the alveolar process which originally contained sockets for natural teeth. After natural teeth are extracted, the alveolar ridge can be expected to get smaller (resorb). The rate of resorption varies considerably from person to person.

♦ ***Maxillary Tuberosity***

The maxillary tuberosity is the most distal (posterior) portion of the maxillary alveolar ridge.

♦ ***Hamular Notch***

The hamular notch is a deep depression located posterior to the maxillary tuberosity. The depths of this depression is part of a series of guides used to determine the posterior border of a maxillary denture.

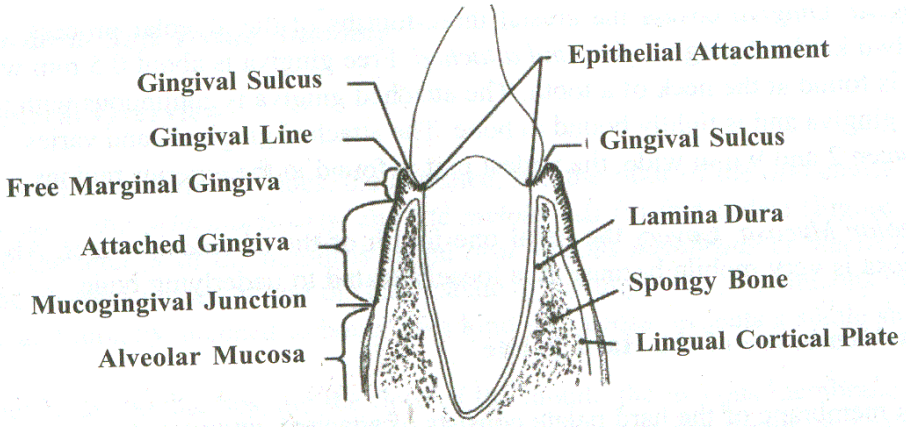


Figure 1-17. Mucous Membrane of the Alveolar Process

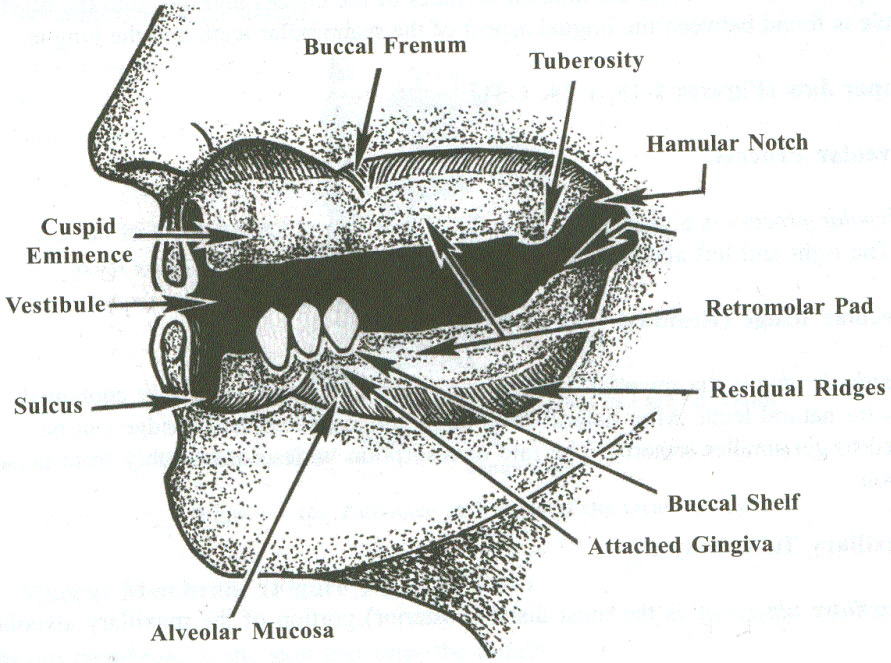


Figure 1-18. Lateral View of the Oral Cavity

♦ ***Palate***

The palate extends from the roof of the mouth all the way back to the uvula:

- **Hard Palate. The hard palate is made up of the anterior two-thirds of the palatal vault supported by bone (palatine processes of the maxillae and the horizontal plates of the palatine bones).**

- ***Soft Palate.*** **The soft palate is made up of the posterior one-third of the palatal vault that is not supported by bone. The soft palate is a muscular extension from the posterior edge of the hard palate, and the soft palate is very mobile, especially while speaking and swallowing.**

♦ ***Incisive Papilla***

You will recall that the incisive foramen is located in the midline of the hard palate, immediately behind the central incisor teeth. The foramen is an exit hole for blood vessels and nerves. There is a definite bump or prominence in the oral mucosa which covers this hole in bone. The soft tissue bump immediately over the incisive foramen is called the incisive papilla. Since the incisive papilla is visible in the exact midline of the hard palate, just behind the natural central incisors, the papilla is a reliable guide for determining the midline relationships of upper anterior denture teeth.

- *Rugae*

Rugae are irregular ridges of fibrous tissue found in the anterior one-third of the hard palate.

- *Median Palatine Raphe*

The medial palatine raphe is a slight tissue elevation which occurs in the midline of the hard palate, immediately over the median palatine suture.

- *Vibrating Line*

When a dentist looks at a patient's entire palatal vault, it is easy to see an abrupt transition between the unmoving hard palate and the highly mobile soft palate. The vibrating line is the line of flexion between the hard and soft palates. The line most frequently falls between the two hamular notches, on or near the palatine foveae in the midline.

- *Palatine Fovea*

There are two palatine foveae. The two fovea are located on either side of the midline on, or very near the vibrating line. The palatine foveae are depressions made by two groupings of minor palatine salivary glands.

NOTE: The vibrating line is the dentist's guide to determining the posterior border of an upper denture. In the absence of specific instructions from a dentist, the hamular notches and the palatine foveae are your guide for determining the posterior border of an upper denture.

- *Labial Frenum*

The labial frenum is a narrow fold of oral mucosa, which is found in the approximate midline. It extends from the inner surface of the lip to the labial surface of the alveolar ridge. The labial frenum is not a reliable guide for determining the midline of the face when natural teeth are absent.

- *Buccal Frenum*

There are two buccal frena. These frena are located on each side of the arch, usually in the first bicuspid region. Each frenum extends from the mucosa of the cheek to the buccal aspect of the alveolar ridge.

♦ *Sulci*

The maxillary sulcus is a groove formed by the mucosa of the cheek or lip and the mucosa at the base of the alveolar ridge. The portion of the sulcus which lies between the labial and buccal frena is called the labial sulcus, and the part of the sulcus between the buccal frenum and the hamular notch is the buccal sulcus. The muscles shaping the sulcus cause its depth to change with every facial expression a person makes.

■ *Lower Jaw (Figures 1-18, 1-20, and 1-21)*

♦ *Alveolar Process*

The alveolar process is the process of the mandible that surrounds the roots of the natural teeth. The right and left alveolar processes combine to form the mandibular arch. After natural teeth are extracted, the remnant of the alveolar process is called the alveolar or residual ridge. As time goes on, a residual ridge usually resorbs (gets smaller).

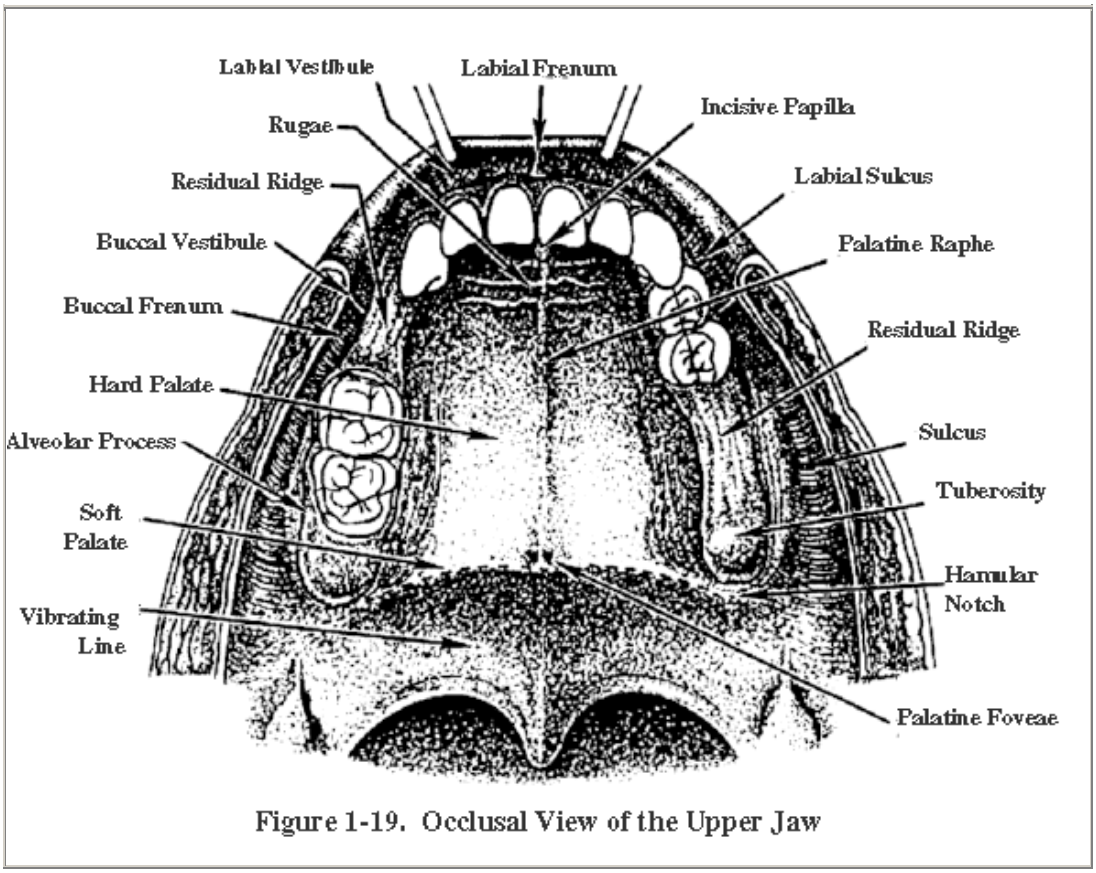


Figure 1-19. Occlusal View of the Upper Jaw

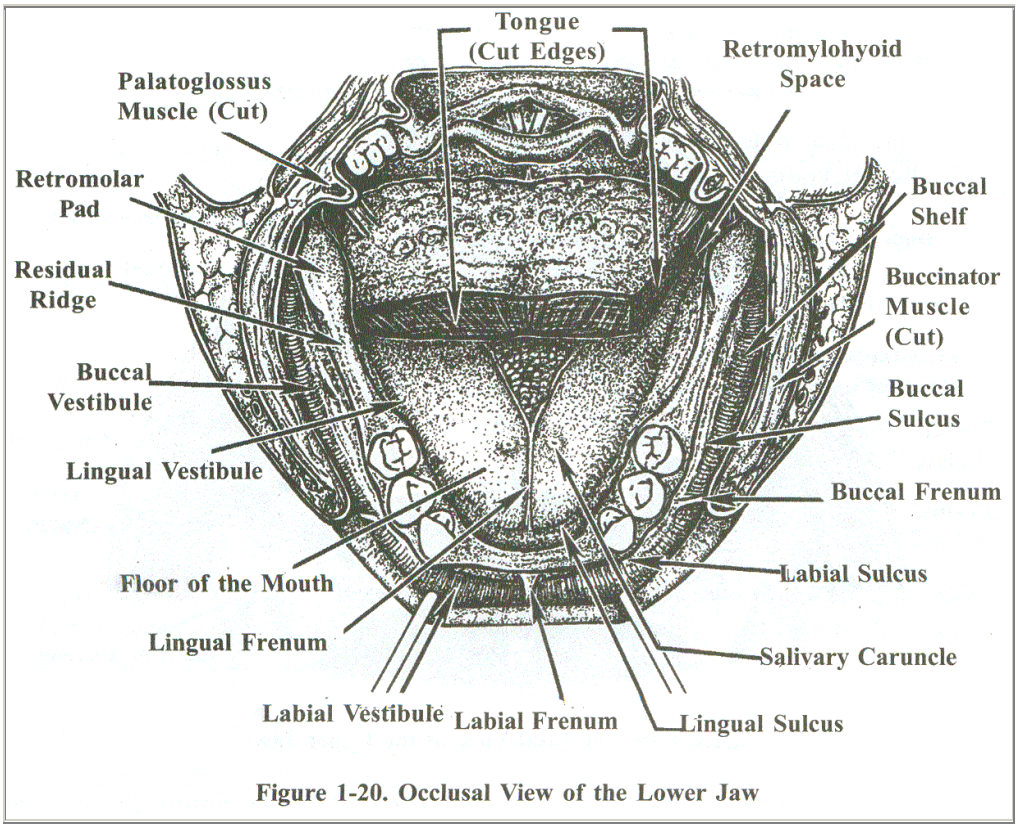


Figure 1-20. Occlusal View of the Lower Jaw

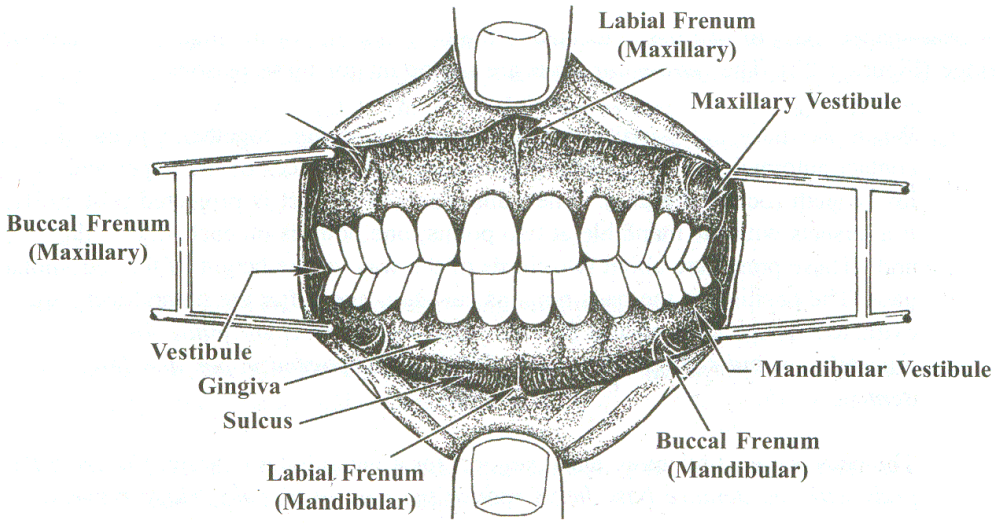


Figure 1-21. View of the Labial Vestibule

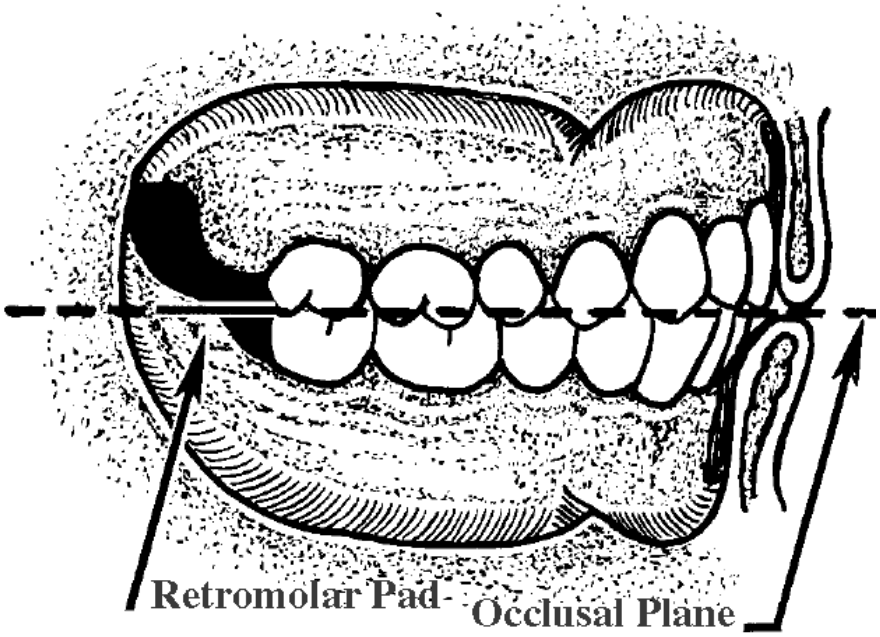


Figure 1-22. Relationship of the Retromolar Pads to the Occlusal Plane

♦ *Retromolar Pad*

A pear-shaped mass of soft tissue located at the posterior end of the mandibular alveolar ridge (Figure 1-22). The retromolar pads are important for these reasons:

- **When maxillary and mandibular natural teeth are brought together, a plane of contact automatically forms between the occlusal surfaces of the upper and lower teeth (occlusal plane). When this plane of contact is projected posteriorly, it intersects with the mandible at two points; one point is on each side of the arch. These points are about two-thirds of the way up the height of the retromolar pads. The position of the pads remains constant, even after the natural teeth are extracted. These facts ensure that the pads are an excellent guide for determining and setting the plane of occlusion between upper and lower denture teeth.**

- **The pads serve as bilateral, distal support for a mandibular denture. Covering the pads with the denture base helps reduce the rate of alveolar ridge resorption.**

♦ *Buccal Shelf*

The buccal shelf is a ledge located buccal to the base of the alveolar ridge in the bicuspid and molar regions. Laterally, the shelf extends from the alveolar ridge to the external oblique line. A buccal shelf is barely observable when the alveolar ridge is large (the shelf increases in size as the ridge resorbs). The buccal shelf is a support area for a

mandibular denture, especially when the remaining alveolar ridge is relatively small.

- ***Mental Foramen***

As described previously, the mental foramen is a hole in bone ordinarily found on the buccal surface of the alveolar ridge. It is located between and slightly below the root tips of the first and second bicuspid teeth. There is no tissue bump over the hole as in the case of the incisive foramen. When resorption of the alveolar ridge is drastic, the mental foramen is found below the oral mucosa on the crest of the alveolar process. In these cases, relief of the denture is necessary to avoid excessive pressure on the nerve fibers which exit from this foramen, compression results in loss of feeling in the lower lip. Relief in this case is defined as space provided between the under surface of the denture and the soft tissue to reduce or eliminate pressure on certain anatomical structures.

- ***Frena***

The labial and buccal frena of the mandible are in corresponding positions to their counterparts in the upper jaw. Also, a lingual frenum can be seen in the floor of the mouth when the tongue is raised. The lingual frenum is present in the approximate midline and extends from the floor of the mouth to the lingual surface of the alveolar ridge.

- ***Sulci***

Sulci rise and fall with facial expressions and tongue movements:

- **Labial Sulcus. The labial sulcus of the lower jaw lies at the base of the alveolar ridge between labial and buccal frena.**
- ***Buccal Sulcus*. The buccal sulcus extends posteriorly from the buccal frenum to the buccal aspect of the retromolar pad.**
- ***Lingual Sulcus*. The lingual sulcus is the groove formed by the floor of the mouth as it turns up onto the lingual aspect of the alveolar ridge.**

- ***Floor of the Mouth***

The anterior two-thirds of the floor of the mouth is formed by the union of the right and left mylohyoid muscles in the midline. The depth of the floor of the mouth in relation to the mandibular alveolar ridge constantly changes due to factors such as mylohyoid muscle contractions, tongue movements, and swallowing activities. The posterior one-third of the lingual sulcus area is called the retromylohyoid space; distally, the area is shaped by the palatoglossus muscle.

■ *The Tongue (Figures 1-23 and 1-24)*

The tongue is a muscular organ that contains specialized cells for detecting the presence of chemicals in the food we eat. The brain interprets this chemical detection process as taste. The tongue's many different sets of muscles enable it to make the complex movements associated with speaking and with chewing food. The constant motion of the tongue represents a powerful force, and no artificial dental replacement can restrict that motion for long. If a prosthesis is not constructed to work in harmony with the tongue, it will fail. For example, the tongue can maintain a denture in position or throw it out, depending on how the lingual surfaces and borders of the denture are shaped. The tongue is animated by two muscle groups, the intrinsic and extrinsic.

♦ *Intrinsic Muscles*

Intrinsic muscles represent the substance of the tongue. They are responsible for the tongue's ability to change shape.

♦ *Extrinsic Muscles*

Extrinsic muscles originate at sites like the hyoid bone, the styloid process of the temporal bone, and the genial tubercles. The extrinsic muscles proceed from their sites of origin and insert into the tongue's mass. The extrinsic musculature enables the mass of the tongue to move from place to place within the mouth. Intrinsic and extrinsic muscles do not act in isolation from one another. The smooth, precise tongue movements that we take for granted are the result of finely coordinated contractions generated by appropriate muscles in both groups.

■ *Salivary Glands (Figures 1-25 and 1-26)*

♦ *Major Salivary Glands*

There are three pairs of major salivary glands. The parotid glands lie in front of and below the ears. Each discharges its secretion through the parotid duct (Stensen's duct), which enters the mouth in the maxillary buccal vestibule opposite the second molar tooth.

The opening is usually marked by a papilla called the parotid papilla. The sub-mandibular glands are also called the submaxillary glands. The submandibular glands are found on the right and left sides, between the mandible and the midline, mostly below and partially above the mylohyoid muscle's posterior edge. Each submandibular gland discharges its secretion through the submandibular duct (Warton's duct) which opens onto the floor of the mouth. The sublingual glands are found beneath the surface of the floor of the mouth, on top of the mylohyoid muscles; the lateral border of each gland rests in a corresponding sublingual fossa. The sublingual duct (duct of Bartholin)

either opens independently onto the floor of the mouth or joins the submandibular duct. The openings of the sublingual and submandibular ducts are located on an elevated line of mucous membrane on each side of the lingual frenum. These elevations are the sublingual caruncles.

♦ *Minor Salivary Glands*

Small, minor salivary glands can be found in many places around the interior of the mouth. The ones of particular interest are located in the palate. The greatest concentrations of minor palatine glands are found in the hard and soft palates, below the surface of the mucosa, and behind a line drawn between the first molar teeth. Skin surface exit holes for gland ducts are liberally scattered throughout this area. A palatine fovea is a depression resulting from a number of palatine salivary gland ducts entering the mouth in the same place. The palatine foveae are on or near the vibrating line (junction between the hard and soft palates).

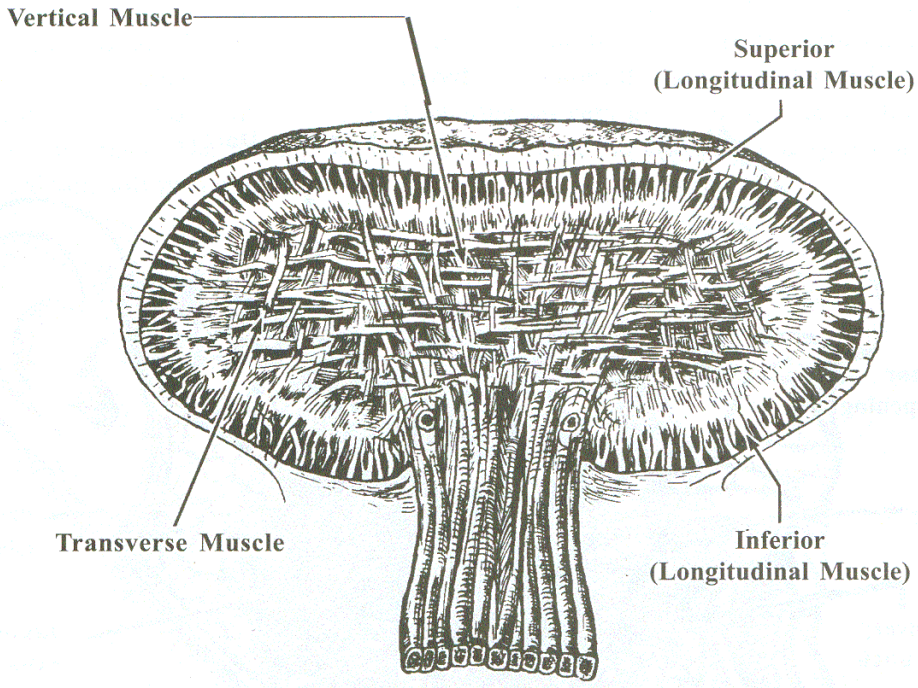


Figure 1-23. Intrinsic Muscles of the Tongue

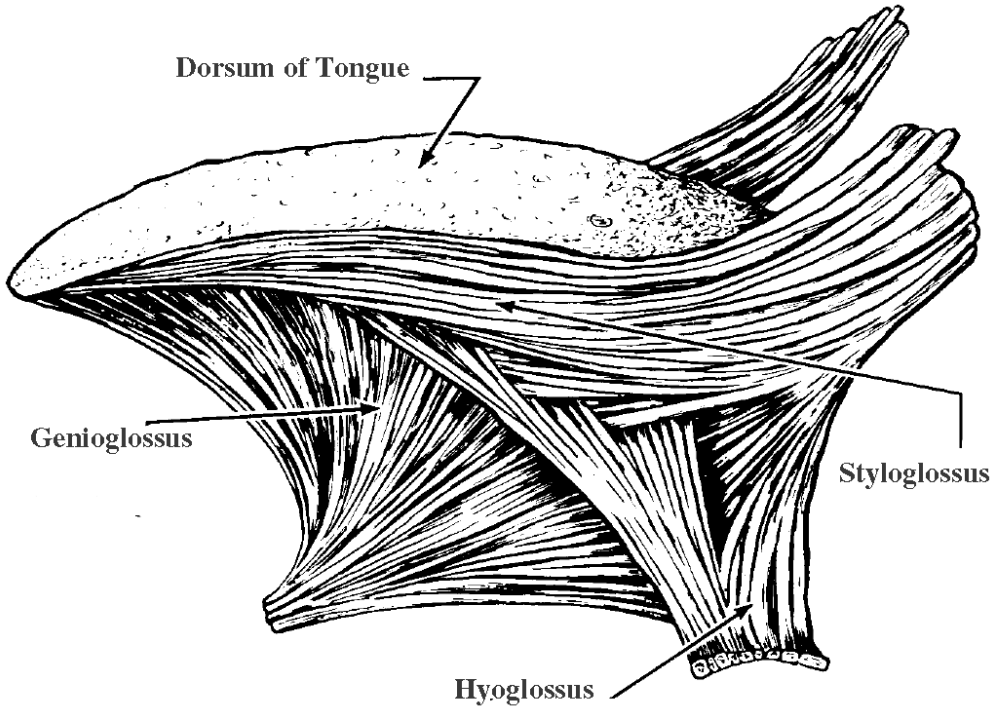


Figure 1-24. Extrinsic Muscle of the Tongue

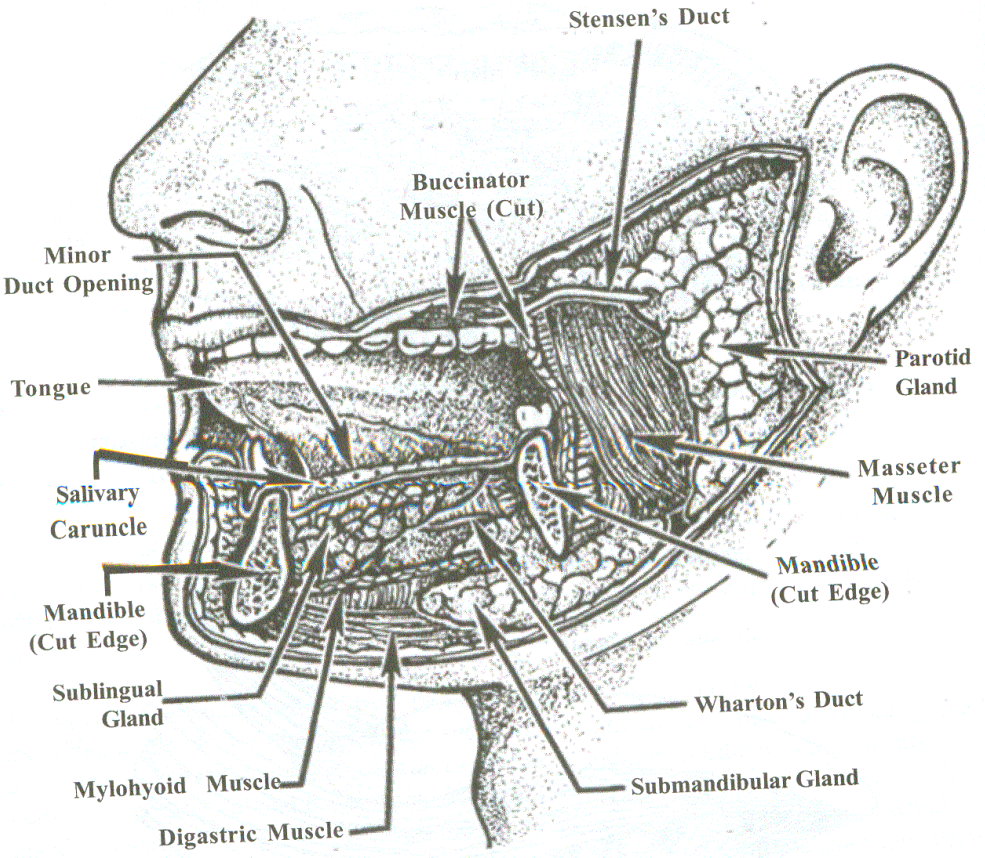


Figure 1-25. Major Salivary Glands

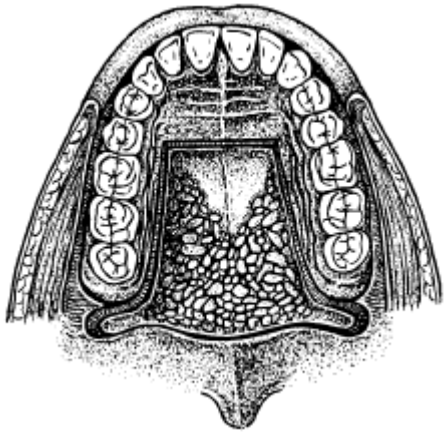


Figure 1-26. Minor Palatine Salivary Glands

❖ The Temporomandibular Joint

■ Overview (Figure 1-27)

The right and left temporomandibular joints are the two places where the mandible connects with the rest of the skull. In general terms, the temporomandibular joint is formed by the glenoid fossa and articular eminence of the temporal bone and by the condyle of the mandible. The fossa and eminence are separated from contact with the condyle by an articular disc.

■ Temporomandibular Joint Structure

♦ Glenoid Fossa

The glenoid fossa is a deep hollow on the under surface of the zygomatic process of the temporal bone. The base of the zygomatic process is the place where the process originates from the central mass of the temporal bone. The condyle stays in the fossa during ordinary opening and closing (hinge) movements.

♦ Articular Eminence

The articular eminence is a ramp-shaped prominence which extends forward and downward from the anterior boundary of the glenoid fossa. During forward (protrusive) movements of the entire mandible, both condyles leave their fossae and move onto eminences. In lateral movements, one condyle usually stays in a fossa and the other condyle moves out of the fossa onto its eminence.

♦ Condyle

The condyle is the oval- or kidney-shaped structure found on the end of the condyloid process of the mandible.

♦ *Articular Disc*

The articular disc is a pad of tough, flexible fibrocartilage situated between the condyle and the glenoid fossa. The disc is a shock absorbing mechanism. When the condyle moves out onto the articular eminence the disc travels with it.

♦ *Synovial Cavities*

The synovial cavities are also referred to as the upper and lower joint compartments:

- **Upper. The upper synovial cavity is found between the top of the disc and the glenoid fossa.**
- ***Lower*. The lower synovial cavity is found between the bottom of the disc and the condyle of the mandible.**

♦ *Synovial Membrane and Associated Synovial Fluid*

The synovial membrane is the lining of a synovial cavity. The cells of the lining make a lubricating liquid called synovial fluid.

♦ *Capsule*

The capsule is the major ligament of the temporomandibular joint. This ligamentous sleeve or capsule originates from the entire rim of the glenoid fossa and articular eminence, attaches to the edges of the articular disc, and passes to insert around the rim of the condyle. The capsule holds the disc in place between the condyle and the fossa, it retains the synovial fluid in the upper and lower joint compartments, and it acts to prevent dislocation of the mandible. Some authors of anatomy texts mention a temporomandibular ligament, which is an anterior thickening of the capsule, not a separate ligament.

♦ *Auxiliary Ligaments (Figure 1-28)*

Auxiliary ligaments generally act to restrict the condyle to a normal range movement and prevent dislocation:

- **Stylomandibular Ligament. The stylomandibular ligament originates on the styloid process of the temporal bone and inserts on the posterior border of the ramus near the angle.**
- ***Sphenomandibular Ligament.* The *sphenomandibular ligament* originates on the spine of the sphenoid bone and inserts on the**

***anterior superior of the mandibular foramen* (*lingula*). The mandibular foramen is found on the internal surface of the ramus of the mandible.**

■ *Basic Mandibular Movements*

♦ *Opening and Closing*

From a position of centric relation, pure hinge movements are possible in opening and closing. In a hinge movement, the condyles rotate within the glenoid fossa. Opening and

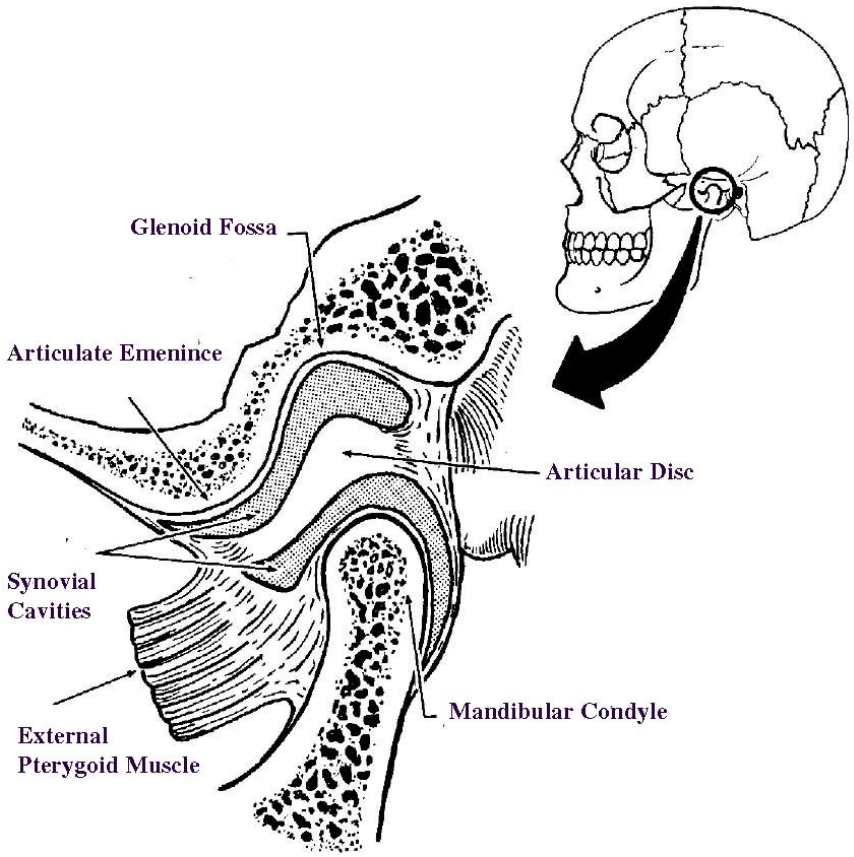


Figure 1-27. Temporomandibular Joint

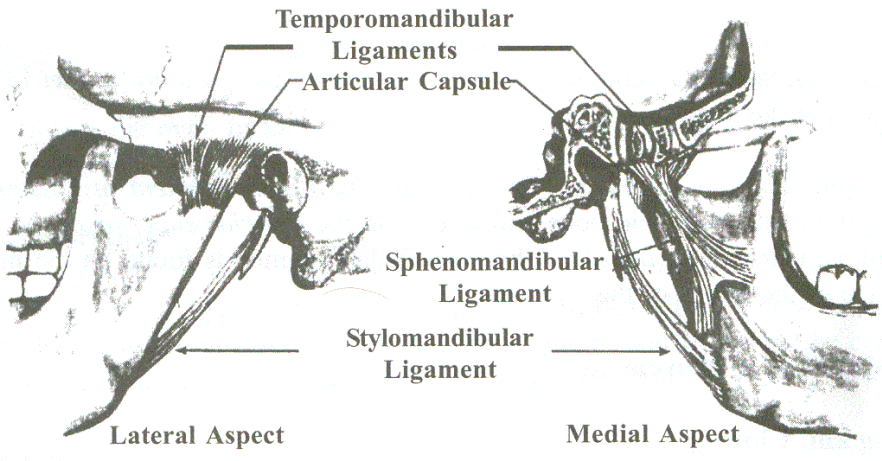


Figure 1-28. Auxilliary Ligaments of the Temporomandibular Joint

closing movements, where the measured distance between maxillary and mandibular incisors is greater than 25 mm, result in combined rotation and translation of the condyles. Translation occurs whenever a condyle leaves the glenoid fossa.

- ***Protrusion and Retrusion***

Protrusion is when the mandible moves forward and both condyles leave their respective fossae and move down their eminences. The opposite process is called retrusion. Protrusion and retrusion are translatory movements.

- ***Right and Left Lateral***

- **Working Side. The side toward which the mandible moves. When the mandible moves laterally, the condyle on the working side stays in its fossa, rotates and moves laterally.**
- ***Balancing Side*. The side opposite the working side. In a lateral movement, the balancing side condyle leaves the fossa and moves forward down the eminence, and medially.**

2.

Dental (Tooth) Anatomy

❖ *Terminology*

■ Groups of Teeth

Teeth, as they exist in the mouth, can be placed into any of three broad groupings, the maxillary or mandibular, right or left, anteriors or posteriors. These groupings apply to both the natural dentition and to artificial teeth:

♦ Maxillary or Mandibular

A person has two jaws, a maxillary (upper) and a mandibular (lower). The teeth in these jaws are called either *maxillary* or *mandibular teeth*. The combination of natural teeth and supporting alveolar bone that is found in an upper or a lower jaw is called a *dental arch* . When natural teeth are extracted, the healed alveolar process is called the *residual ridge*. Artificial teeth sit over residual ridges so they coincide with the original arch form.

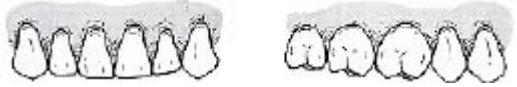
♦ Right or Left

If we split the two dental arches down the midline from front to back, the arches can be divided into upper and lower right sections and upper and lower left sections. Since one of these sections represents one-fourth of the upper and lower arches taken together, the section is called a quadrant (Figure 2-1). If a tooth is located to the left of the midline in the upper arch, the tooth is part of the maxillary left quadrant (etc.).

♦ Anteriors or Posteriors (Figure 2-2)

Teeth can also be classified as anteriors (incisors and cuspids) or posteriors (bicuspids and molars). A complete adult natural dentition has 32 teeth; each arch contains 16. The teeth in an arch are composed of 6 anteriors (cuspid to cuspid) and 10 posteriors (all teeth distal to the cuspids). There are 3 anteriors and 5 posteriors in a quadrant.

Figure 2-1. Mandibular Right Quadrant



Anterior Posterior Teeth
Figure 2-2. Anterior and Posterior Teeth

NOTE: Complete dentures for the upper and lower arches usually consist of 28 teeth. The 4 third molars are not used.

■ Names of Teeth (Figure 2-3)

♦ Anteriors

- ***Central and Lateral Incisors.*** **In each quadrant, the two teeth nearest the midline of the dental arches are called *incisors*. The first incisor on either side of the midline is called a *central incisor*. The second incisor from the midline of either arch is called a *lateral incisor*. The word incisor describes their functions of incising or cutting food.**

- ***Cuspids*** **. A cuspid is so named because its cutting edge is a single, pointed elevation or *cusp*. Cuspids are sometimes called *canines*. They are used to tear food. Each dental arch has two cuspids.**

♦ Posteriors

- ***Biscuspids.*** **Biscupids are so named because most have two cusps on their chewing surfaces. They are also called *premolars* because they occupy an anatomical position mesial to the molars. There are eight biscupids, two in each quadrant, functioning as seizing and grinding teeth.**

  The two biscupids in any given quadrant are further called *first* and *second biscupids*, the first being located immediately behind the cuspid.

- ***Molars*****. molars, the largest teeth in the dental arches, lie directly behind the bicuspids and funstion as grinders during mastication (chewing). under normal conditions, there are six molars in each arch (three in each quadrant). They are called *first, second,* and *third molars*, the first molarbeing the first tooth distal to the second bicuspid.**

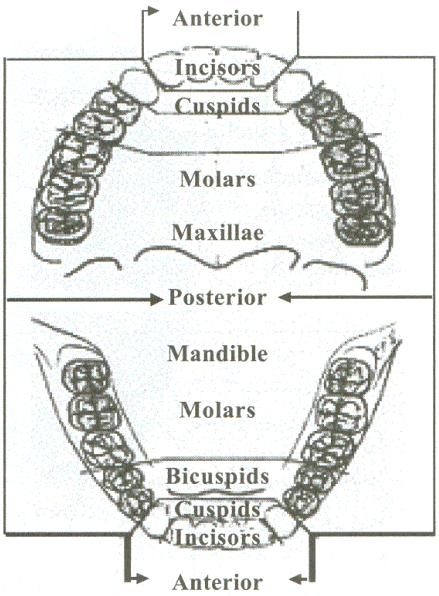


Figure 2-3. Names of Teeth

■ **Number Substitutes for Names of Teeth (Figure 2-4)**

Formal descriptions like "maxillary right molar" and "mandibular left lateral incisor" can be time- consuming when many people must be examined in a short time, and too lengthy when space on forms is limited. Dentists often use numerical shorthand as a substitute for complete, formal tooth names. The full complement of natural teeth is numbered #1 through #32. Numbers 1 through #16 are in the maxillary arch; the upper right third molar is #1, the upper right second molar is #2, and as you proceed in consecutive order around the maxillary arch to the upper left third molar, you end with #16. Numbers 17 through #32 are in the mandibular arch; the lower left third molar is #17, the lower left second molar is #18, and as you proceed around the mandibular arch to the lower right third molar you end with #32.

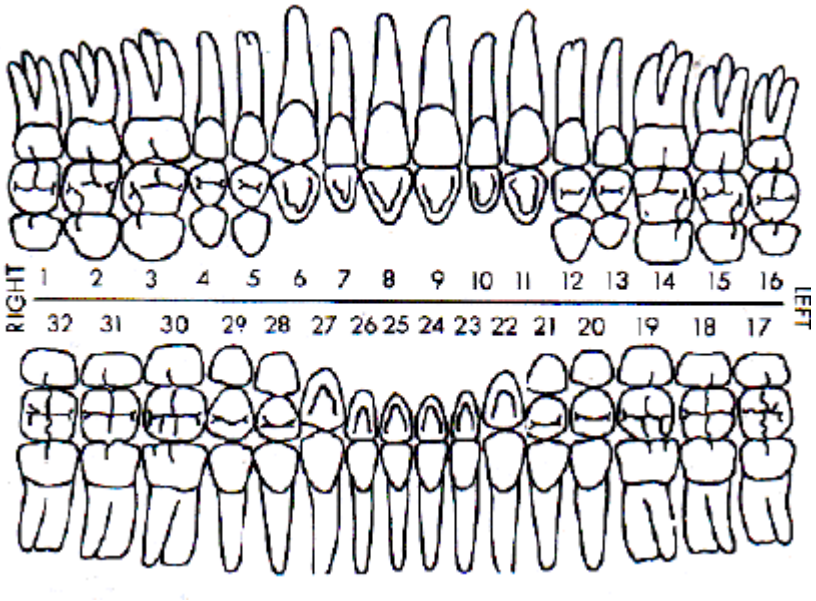


Figure 2-4. Number Substitutes for Names of Teeth

1. Right maxillary third molar.
2. Right maxillary second molar.
3. Right maxillary first molar.
4. Right maxillary second bicuspid.
5. Right maxillary first bicuspid.
6. Right maxillary cuspid
7. Right maxillary lateral incisor.
8. Right maxillary central incisor.
9. Left maxillary central incisor.
10. Left maxillary lateral incisor.
11. Left maxillary cuspid.
12. Left maxillary first bicuspid.
13. Left maxillary second bicuspid.
14. Left maxillary first molar.
15. Left maxillary second molar.
16. Left maxillary third molar.
17. Left mandibular third molar.
18. Left mandibular second molar.
19. Left mandibular first molar.
20. Left mandibular second bicuspid.
21. Left mandibular first bicuspid.
22. Left mandibular cuspid.
23. Left mandibular lateral incisor.
24. Left mandibular central incisor.
25. Right mandibular central incisor.
26. Right mandibu!ar lateral incisor.
27. Right mandibular cuspid.
28. Right mandibular first bicuspid.
29. Right mandibular second bicuspid.
30. Right mandibular first molar.
31. Right mandibular second molar.
32. Right mandibular third molar.

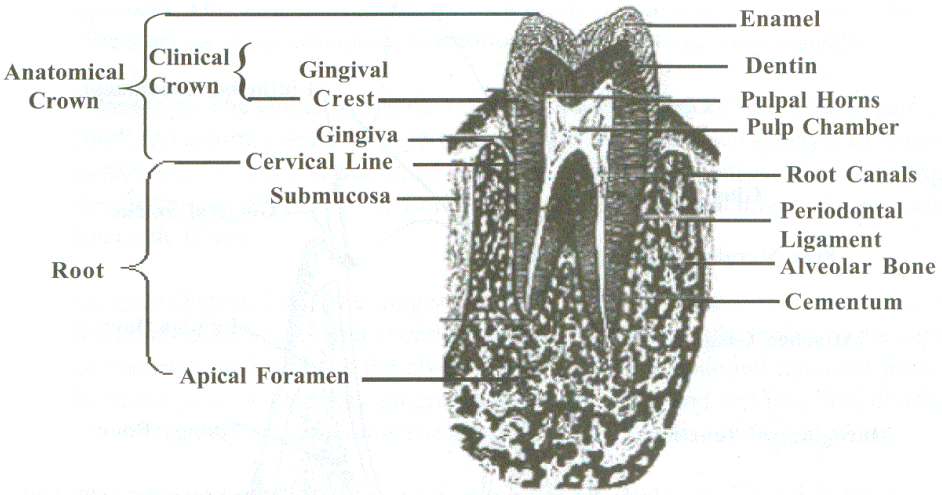


Figure 2-5. Structure of the Teeth and Supporting Tissues

■ Structure of the Teeth and Supporting Tissues (Figure 2-5)

♦ Teeth

A tooth is divided into two parts, the *crown* and the *root.* The *anatomical crown* is the part of the tooth covered with enamel. The root of a tooth is embedded in alveolar bone and covered with cementum.

NOTE: 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 and to

have root surface showing. The term *clinical crown* is applied to the part of the tooth that is visible above the gingiva to include root surface.

The bulk of a tooth is composed of a bone-like substance called *dentin* which is covered by enamel to form the crown and *cementum* to form the root. The line of division between the crown and root is called the *cervical line or cemento enamel junction.* The dividing line is found in a somewhat constricted region on the tooth's surface called the *cervix or neck.* The tip of the root is known as the *apex.*

The tooth contains an aggregate of blood vessels, nerves, and cellular connective tissue called the *dental pulp.* The dental pulp is housed within a pulp chamber and root canal of a tooth. Anterior teeth ordinarily have one root canal; multiple canals occur in posterior teeth. The nerves and blood vessels enter and leave the tooth through an opening called the *apical foramen* at or near the apex of the root.

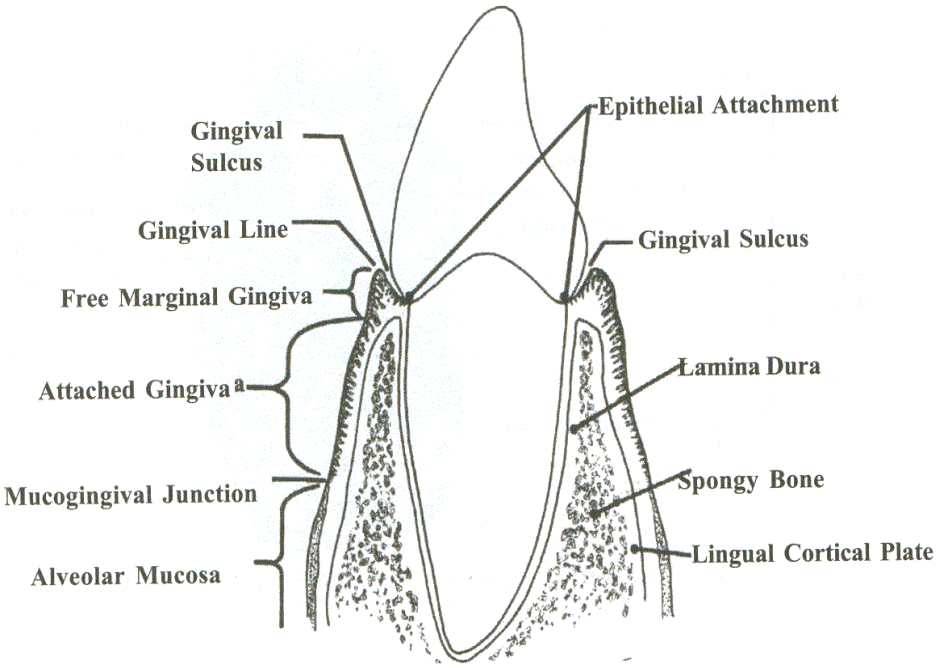


Figure 2-6. Free and Attached Gingiva

♦ Supporting Structures of the Teeth

The supporting tissues of the teeth are collectively called the *periodontium.* The periodontium consists of the alveolar process of the maxillae and the mandible, the periodontal ligament, the cementum of the tooth, and the gingiva.

- ***Alveolar Process.*** **The alveolar process is the portion of the maxillae or mandible in which the roots of the teeth are embedded and by which tooth roots are supported. An alveolar process consists of three kinds of bone. They are the outer cortical plate, lamina dura, and spongy**

bone. The outer cortical plate is a compact layer of bone on the bone's surface. The lamina dura is a thin, dense layer of bone that lines tooth sockets. The lamina aura is a specialized continuation of the cortical plate. Spongy bone is the less dense, cancellous bone representing the alveolar process' central mass.

- ***Periodontal Ligament.*** **The periodontal ligament is a thin, fibrous ligament connecting a tooth to the lamina aura of 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 chewing impacts.**

- ***Cementum.*** **The cementum 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 a tooth's root. Cementum is formed during the development of the root. It functions as an area of attachment for periodontal ligament fibers.**

- ***Gingiva (Figure 2-6).*** **The gingiva is the specialized mucous membrane covering the alveolar processes and 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. Healthy gingiva is pale pink, firm, and resilient. It is divided into two types, free and attached gingiva.**

  Free gingiva **is "free" to the extent that it can be displaced; it is not tightly bound to anything underneath it. Free gingiva extends from the gingival crest to the bottom of the gingival sulcus. At the bottom of the sulcus, an epithelial attachment joins the free gingiva to the tooth surface. The interdental papilla is the portion of the free gingiva that fills the proximal space below the contact areas of adjacent teeth. It helps prevent food from packing between the teeth.**

  Attached gingiva **covers the labial cortical plate of the alveolar process. It is firmly fixed to underlying bone.**

■ Crown Morphology (Contours)

As you study anatomy, you will discover there are almost no perfectly flat or perfectly straight surfaces; most surfaces are curved. The contour of a crown is a combination of convex and concave curves. A convex surface is one which is curved outward; a concave is curved inward.

♦ Tooth Surfaces (Figure 2-7)

- ***Proximal.*** **A tooth has two proximal surfaces, one that is oriented toward the midline of the dental arch and another that is oriented away**

from the midline of the arch.

- *Mesial.* The mesial is the proximal surface closest to the midline of the arch.

- *Distal .* The distal is the proximal surface oriented away from the midline of the arch.

- ***Facial.*** **The facial is the surface of a tooth that "faces" toward the lips or cheeks. When there is a requirement to be more specific, terms like labial and buccal are used:**

- *Labial .* The labial is the surface of an anterior tooth that faces toward the lips.

- *Buccal.* The buccal is the surface of a posterior tooth that faces toward the cheek.

- ***Lingual .*** **The surface of a tooth facing toward the tongue is called the lingual.**

- ***Incisal.*** **The cutting edge of an anterior tooth.**

- ***Occlusal.*** **The chewing surface of a posterior tooth.**

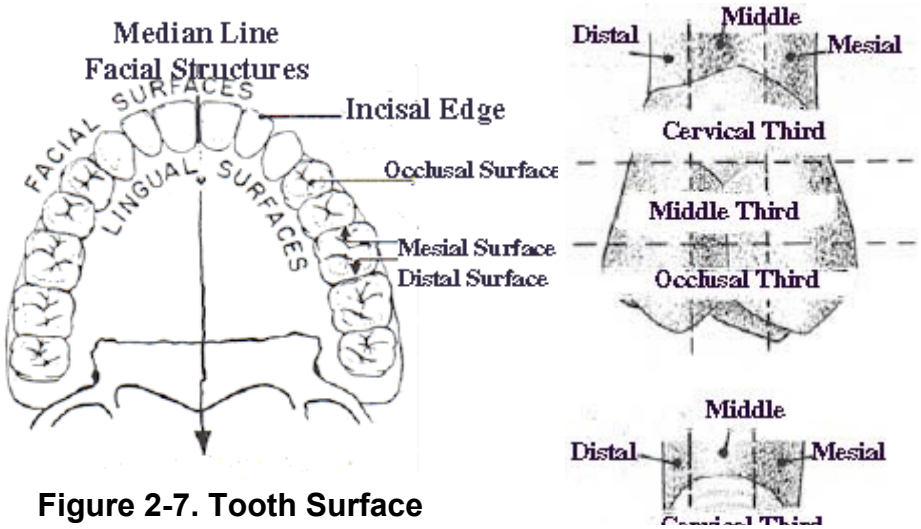


Figure 2-7. Tooth Surface

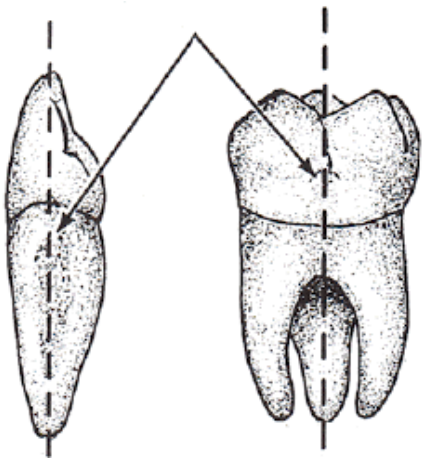


Figure 2-8. Long Axis

Figure 2-9. Anterior and Posterior Crown Divisions

- **Long Axis and Axial Surface (Figure 2-8). The long axis of a tooth is an imaginary line that goes through the crown and root around which the substance of a tooth is most symmetrically distributed. Any surface of a tooth that is parallel to the long axis is called an axial surface (for example, mesial, distal, facial, or lingual surfaces).**

- ***Division of a Crown Into Thirds* (Figure 2-9). The facial, lingual, mesial, and distal surfaces of a crown can be divided into thirds, both horizontally and longitudinally:**

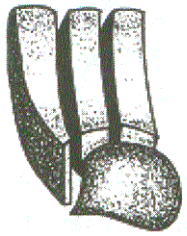
- ***Horizontal Division.* Each axial surface of a crown is divided horizontally into a cervical, a middle, and an occlusal (or incisal) third.**

- ***Longitudinal Division.* Each mesial or distal axial surface may be divided into a facial, a middle, and a lingual third; each facial or lingual surface may be divided into a mesial, a middle, and a distal third.**

- ***Line Angle.* An angle formed by the junction of two crown surfaces. It derives its name from those surfaces. There are eight line angles per tooth:**

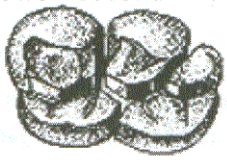
- *Anterior Tooth Line Angles*

1. **Mesiolabial**
2. **Mesiolingual**
3. **Distolabial**



Lobes of a Central Incisor

Lower Second Molar



Lower First Molar

Figure 2-10. Lobes

4. Distolingual
5. Labioincisal
6. Linguoincisal
7. Mesioincisal
8. Distoincisal

- Posterior Tooth Line Angles

1. Mesiobuccal
2. Mesiolingual
3. Distobuccal
4. Distolingual
5. Bucco occlusal
6. Linguo occlusal
7. Disto occlusal
8. Mesio occlusal

Point Angle. **A point angle is formed by the junction of three crown surfaces; the name of the point angle is derived by combining the names of the three surfaces.**

- Anterior Tooth Point Angles

1. Mesiolabioincisal
2. Mesiolinguoincisal
3. Distolabioincisal
4. Distolinguoincisal

- Posterior Tooth Point Angles

1. Mesiobucco-occlusal
2. Mesiolinguo-occlusal
3. Distobucco-occlusal
4. Distolinguo-occlusal

♦ **Distinctive Crown Convexities and Concavities**

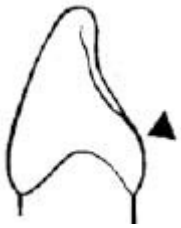
Convexities

Lobe **(Figure 2-10) . A lobe is one of the primary anatomical divisions of a crown; all teeth develop from either four or five lobes (for example, a central incisor forms from four lobes**	

while first molars develop from five lobes.) Lobes are usually separated by readily identifiable developmental grooves.

Mamelons **(Figure 2-11). Mamelons are small, rounded projections of enamel from the incisal edges of newly erupted anterior teeth. The projections wear away soon after eruption.**

Figure 2-11. Mamelons



Cingulum **(Figure 2-12). A cingulum is 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.**

Figure 2-12. Cingulum

Cusp **(Figure 2-13). A cusp is a pointed or rounded elevation of enamel found on cuspids and on the chewing surfaces of bicuspids and molars. Cuspids have one cusp that represents the tooth's cutting edge. Maxillary bicuspids and the mandibular first bicuspids have two cusps, one buccal and one lingual. The mandibular second bicuspid normally has three cusps, one buccal and two lingual. The lingual cusps are subdivided into a mesiolingual and a distolingual.**

Figure 2-13. Cusp

All *maxillary molars* have four cusps, two buccal and two lingual. The two buccal cusps are subdivided into a mesiobuccal and a distobuccal. The two lingual cusps are subdivided into a mesiolingual and a distolingual. (Once in a while, the mesiolingual cusp of a maxillary first molar carries an underdeveloped, rudimentary cusp called *the cusp of Carabelli.)*

The *mandibular first molar* has five cusps, three buccal and two lingual. From anterior to posterior, the three buccal cusps are subdivided into a mesiobuccal, a distobuccal, and a distal. The two lingual cusps are divided into a mesiolingual and a distolingual.

The *mandibular second molar* has four cusps called the mesiobuccal, distobuccal, mesiolingual, and distolingual.

***Ridge*. Any linear elevation found on the surface of a tooth.**

Marginal Ridge **(Figure 2-14). A marginal ridge is 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.**

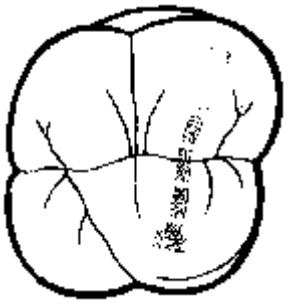


Figure 2-14. Marginal Ridge

Lingual Ridge **(Figure 2-15). The ridge of enamel that extends from the cingulum to the cusp tip on the lingual surface of most cuspids is called the lingual ridge.**

Figure 2.15. Lingual Ridge

Cusp Ridge **(Figure 2-16). 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, facial, or lingual).**

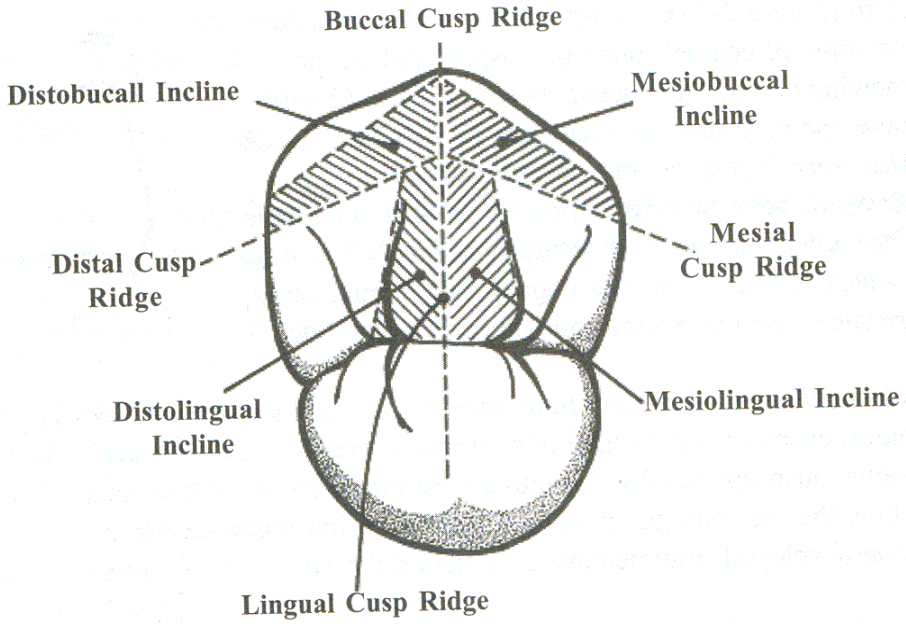


Figure 2-16. Cusp Ridges

Triangular Ridge **(Figure 2-17). The occlusal surface of a cusp is composed of a mesial and a distal incline. These two inclines meet to form a triangular ridge of enamel that descends from the tip of the cusp to the central portion of the occlusal surface. A triangular ridge is either a facial or a lingual cusp ridge, depending on where the cusp is located. Cusps are described in some mouths as being "pointy" and in others as being "flat" or "blunt." Most "pointy" posterior teeth have high cusp angle values (Figure 2-18). A cusp angle is the angle that a triangular ridge makes with a plane perpendicular to the long axis of the tooth.**

Figure 2-17. Triangular Ridge

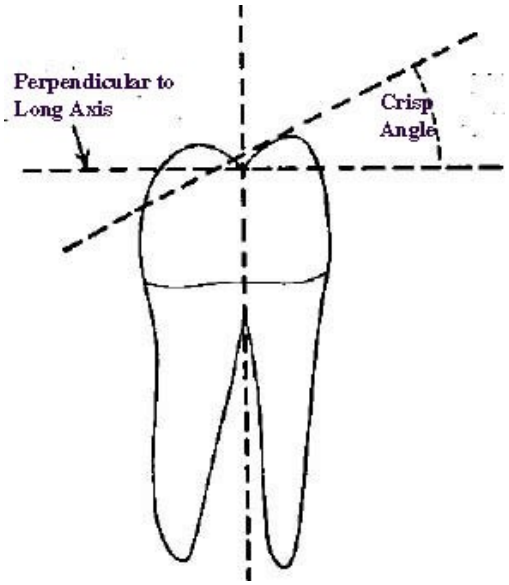


Figure 2-18. Cusp Angle

Tr ansverse Ridge **(Figure 2-19). A** ***transverse ridge*** **is the union of a buccal and lingual triangular ridge that crosses the surface of a posterior tooth transversely (roughly 90 degrees to both the buccal and lingual tooth surfaces).**

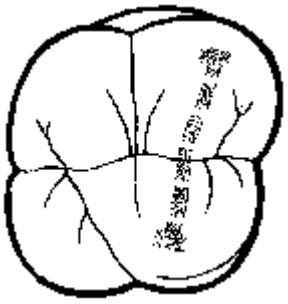


Figure 2-19. Tranverse Ridge

Oblique Ridge **(Figure 2-20).**

The only tooth on which an *oblique ridge* is found is the maxillary molar. An oblique ridge consists of a union between the triangular ridge of the distobuccal cusp and the distal cusp ridge of the mesiolingual cusp.

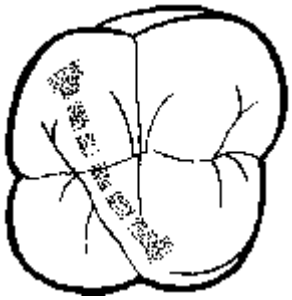


Figure 2-20. Obligue Ridge

***Cusp Inclines.* A *cusp incline* or *inclined plane* is the sloping area found between two cusp ridges. To name an incline, you must combine the names of the cusp ridges that define a large part of its borders, for example, the *distolingual incline* of the buccal cusp of a maxillary first bicuspid (Figure 2-16).**

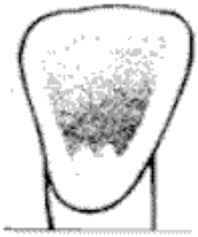


Figure 2-21. Lingual Fossa

- ***Crown Concavities***

Fossae

***Lingual Fossa* (Figure 2-21). The *lingual fossa* is an irregular, rounded concavity bound by the mesial marginal ridge, distal marginal ridge, cingulum, and incisal edge of the lingual surface of an incisor tooth. Lingual fossae are also found on both sides of the lingual ridge of a cuspid tooth.**

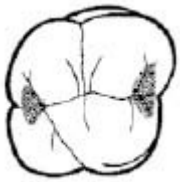


Figure 2-22. Triangular Fossa

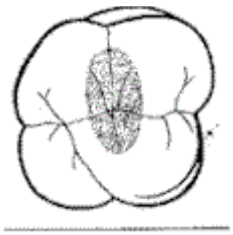
***Triangular Fossa* (Figure 2-22). *Triangular fossae* are located adjacent to marginal ridges on the occlusal surfaces of posterior teeth. There are two kinds of triangular fossae, a mesial and a distal.**

Central Fossa **(Figure 2-23). A *central fossa* is a centrally located depression or concavity found on the occlusal surface of molars and mandibular second bicuspids. The other bicuspids have mesial and distal triangular fossae, but do not have a central fossa.**

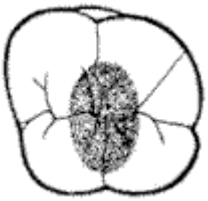
Sulcus **(Figure 2-24). A *sulcus* is an elongated valley or depression in the surface of a tooth formed by the inclines of adjacent cusps or ridges. As an example, a central sulcus is a major linear depression that traverses the occlusal surface of a posterior tooth from mesial triangular fossa to distal triangular fossa. Developmental grooves are found in the bottoms of sulci.**

Developmental Groove **(Figure 2-25). A *developmental groove* is the junction line between the inclined walls of a sulcus. Developmental grooves represent lines of union between lobes of the crown during its formation. These grooves appear on labial, occlusal, buccal, and lingual surfaces, and are least apparent on the labial aspect of anteriors.**

Supplemental Groove **(Figure 2-26). A minor, auxiliary groove that branches off from a much more prominent developmental groove. *Supplemental grooves* do not represent the junction of**



Maxillary Molar



Mandibular Molar

Figure 2-23. Central Fossa

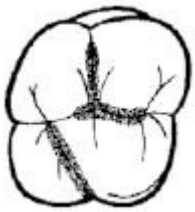
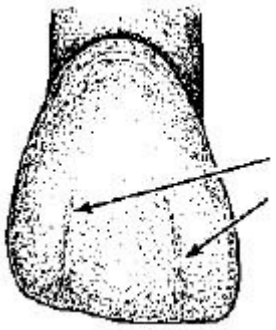


Figure 2-24. Sulcus

primary tooth parts.

Fissure **(Figure 2-27). A linear fault that sometimes occurs in a developmental groove. A *fissure* represents a lack of union between the inclined walls of a sulcus.**

Pit **. A *pit* is a small, pinpoint fault on the surface of a tooth; a pit is usually found at the end of a developmental groove or at a place where two fissures intersect.**



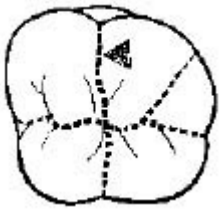


Figure 2-25. Developmental Grooves

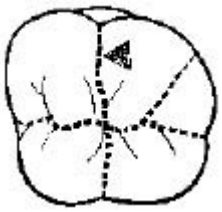
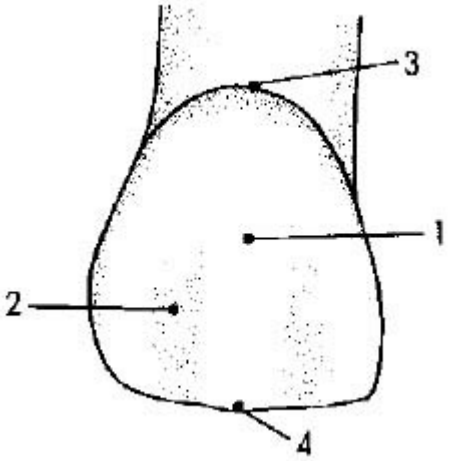


Figure 2-26. Supplemental Groove

Figure 2-27. Fissure

Maxillary Central Incisor (Facial View)



1. Lobe
2. Developmental Groove
3. Cemento–Enamel Junction
4. Incisal Edge

Figure 2.28. Maxillary Central Incisor (Facial View)

Application. **Figures 2-28 through 2-33 show specific convexities and depressions on anterior and posterior teeth. You should be able to name the coronal features of teeth after you study these figures closely.**

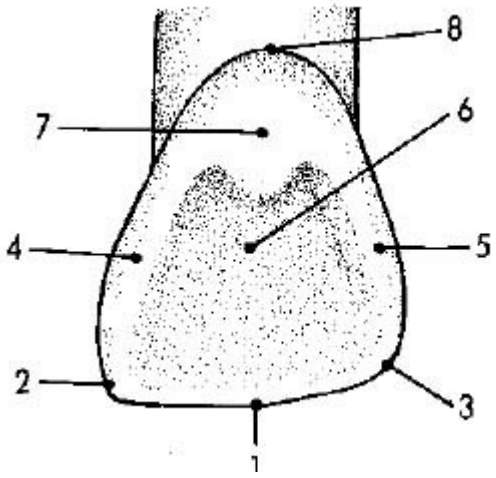
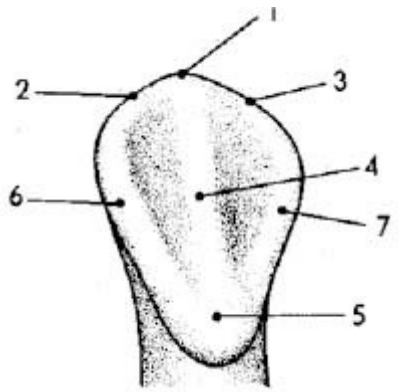


Figure 2-29. Maxillary Central Incisor (Lingual View)

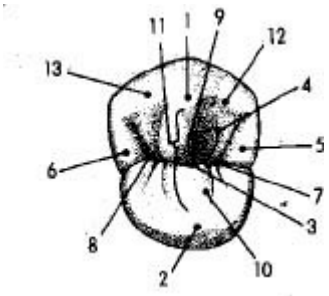
1. Incisal Edge
2. Mesio-Inciso Angle
3. Disto-Inciso Angle
4. Mesial Marginal Ridge
5. Distal Marginal Ridge
6. Lingual Fossa
7. Cingulum
8. Cemento-Enamel Junction



Mandibular Cuspid (Lingual View)

1. Cusp Tip
2. Mesial Cusp Ridge
3. Distal Cusp Ridge
4. Lingual Ridge
5. Cingulum
6. Mesial Marginal Ridge
7. Distal Marginal Ridge

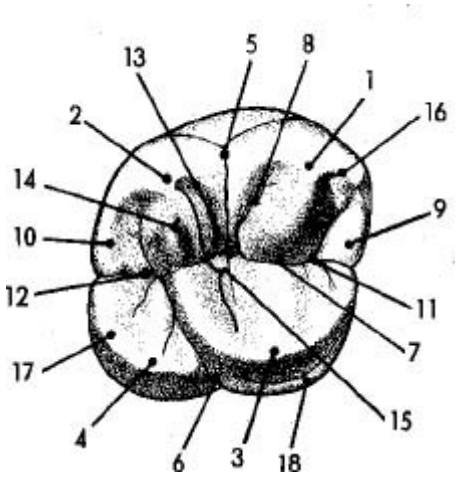
Figure 2-30. Mandibular Cuspid (Lingual View)



Maxillary Second Bicuspid (Occlusal View)

1. Buccal Cusp
2. Lingual Cusp
3. Central Sulcus (Developmental Groove)
4. Supplemental Groove
5. Mesial Marginal Ridge
6. Distal Marginal Ridge
7. Mesial Triangular Fossa
8. Distal Triangular Fossa
9. Buccal Triangular Ridge (Crest)
10. Lingual Triangular Ridge (Mesial Incline)
11. Transverse Ridge
12. Mesial Cusp Ridge
13. Distal Cusp Ridge

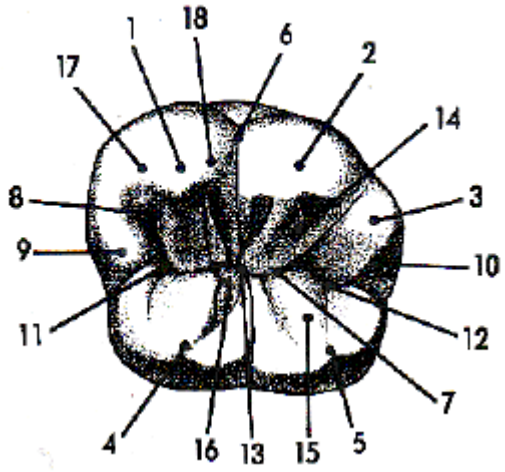
Figure 2.31.Maxillary Second Bicuspid (Occlusal View)



Maxillary First Molar (Occlusal View)

1. Mesio-BuccalCusp
2. Disto-Buccal Cusp
3. Mesio-Lingual Cusp
4. Disto-Lingual Cusp
5. Buccal Developmental Groove
6. Lingual Developmental Groove
7. Central Sulcus (Developmental Groove)
8. Supplemental Groove
9. Mesial Marginal Ridge
10. Distal Marginal Ridge
11. Mesial Triangular Fossa
12. Distal Triangular Fossa
13. Central Fossa
14. Disto Buccal Triangular Ridge (Crest)
15. Oblique Ridge
16. Mesial CuspRidge
17. Distal Cusp Ridge
18. Cusp of Carabelli

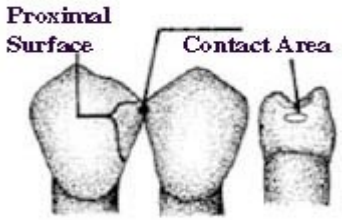
Figure 2.32 Maxillary First Molar (Occlusal View)



Mandibular First Molar (Occlusal View)

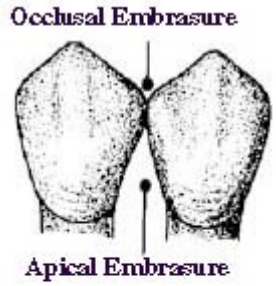
1. Mesio-Buccal Cusp
2. Disto-Buccal Cusp
3. Distal Cusp
4. Mesio-Lingual Cusp
5. Disto-Lingual Cusp
6. Buccal (Developmental Groove)
7. Central Sulcus
8. Supplemental Groove
9. Mesial Marginal Ridge
10. Distal Marginal Ridge
11. Mesial Triangular Fossa
12. Distal Triangular Fossa
13. Central Fossa
14. Disto-Buccal Triangular Ridge (Distal Incline)
15. Disto-Lingual Triangular Ridge (Crest)
16. Tranverse Mesial
17. Mesial Cusp Ridge
18. Distal Cusp Ridge

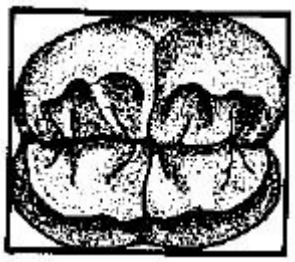
Figure 2.33. Mandibular First Molar (Occlusal View)



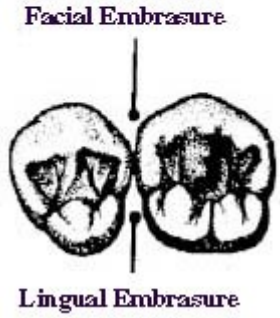
Round

Figure 2.34. Contact Area





Rectangular



Trapezoid

Figure 2-35. Embrasures

Rhomboid

Figure 2.36. Occlusal Surface Outlines of Posterior Teeth

■ Proximal Surface Contact Characteristics

♦ Contact Points or Areas (Figure 2-34)

Teeth make contact with one another at points or areas on the greatest contour of their proximal surfaces. The places where adjacent teeth make point contact are called contact points. Contact points become wider and flatter in time from wear that occurs during functional movements (chewing) or parafunctional movements (grinding). A flattened contact point is called a contact area.

♦ Embrasure (Figure 2-35)

An embrasure is a space diverging from the contacting proximal surfaces of two adjacent teeth. There are four of these spaces or embrasures recognized. They are the facial, lingual, gingival, and occlusal or incisal (depends on whether they are posterior or anterior teeth). The gingival embrasure is located cervical to the contacting areas of adjacent teeth. A gingival embrasure has other names like cervical embrasure, apical embrasure, interproximal space, and septal space. Interdental palillae (gingival tissue) fill interproximal spaces to a greater or lesser extent.

■ Occlusal Surface Outlines of Posterior Teeth (Figure 2-36)

♦ Circular Rounded in Outline

The occlusal surfaces of the lower bicuspids are circular in outline.

♦ Rectangular

The occlusal surfaces of the lower second molar and the upper bicuspids are often described as being rectangular or oblong in outline.

♦ **Trapezoid**

A trapezoid is a plain four-sided figure with two parallel sides. The occlusal surface of the lower first molar is said to be trapezoidal in outline.

♦ **Rhomboidal**

A rhomboid is shaped as an equilateral parallelogram having two opposing oblique angles. The occlusal surfaces of the upper molars are rhomboidal in outline.

❖ *Descriptions of Individual Teeth*

■ Overview

In the following pages each tooth of the permanent dentition is described, except for the third molars, which are not reproduced in artificial teeth. In each instance, the tooth from the right side of the mouth is illustrated. The teeth are described as they usually look, but it should be mentioned that teeth vary considerably from one person to another and that certain teeth in the dentition tend to vary more than others. Included in the illustrations of the bicuspids and the molars are drawings that show angles that can be carved in reproducing the occlusal surfaces of these teeth. The broken lines shown in the illustrations of the facial and lingual surfaces of the teeth indicate proper food deflection contours.

The drawings in this section were adapted from those appearing in the Ney Crown and Bridge Manual, J. M. Ney Co., Hartford, Conn.

■ Maxillary Central Incisor

The maxillary central incisor (Figure 2-37) is the tooth nearest the median line in the maxillary arch.

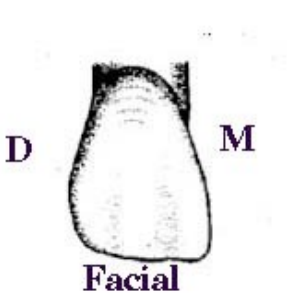
- **♦ The facial surface is broad and resembles a thumbnail in outline. The right maxillary central incisor may be distinguished from the left maxillary central incisor because the distoincisal angle is more rounded than the mesioincisal angle, and the incisal edge slopes slightly gingivally in a mesiodistal direction. The facial surface is convex both mesiodistally and incisocervically. Three distinct lobes may be seen in the incisal portion; they are separated by two developmental grooves.**

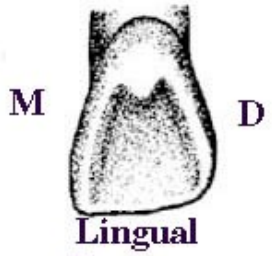
- **♦ The lingual surface appears slightly smaller than the facial surface and the cervical portion is narrower. The large lingual fossa is bounded by prominent mesial and distal marginal ridges. There is**

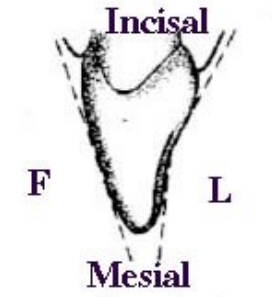
a cingulum in the cervical portion, and there may be a pit in conjunction with the cingulum.

- **Viewed on end, the incisal edge appears nearly straight. Most of the wear is on the lingual portion of the edge, so the edge becomes beveled lingually. The cingulum lies more to the distal side of the tooth than to the mesial side.**

- **The mesial surface looks like a wedge. The apex of the wedge is at the incisal edge of the tooth. The facial outline is slightly convex. The lingual outline is slightly concave from the incisal edge to the cingulum and convex from the cingulum to the cervical margin.**







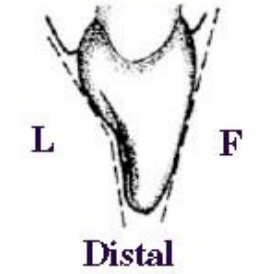
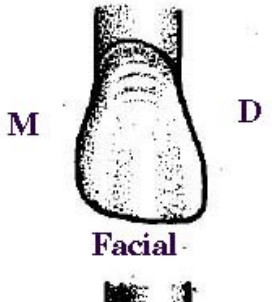
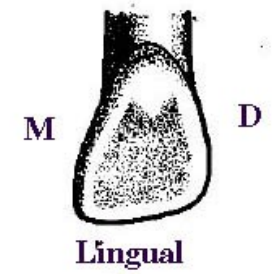
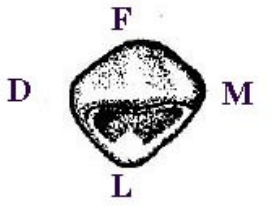
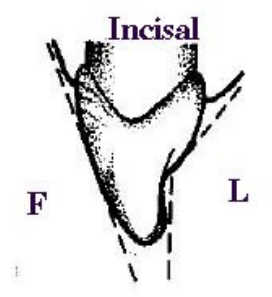


Figure 2-37. Maxillary Central Incisor









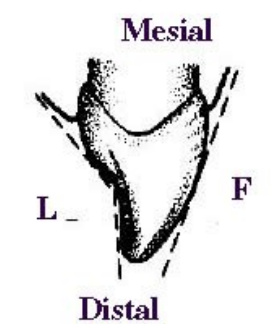


Figure 2-38. Maxillary Lateral Incisor

♦ The distal surface closely resembles the mesial surface. The lingual outline is more concave in the incisal portion than it is on the mesial surface.

■ Maxillary Lateral Incisor

The maxillary lateral incisor (Figure 2-38) is the second tooth from the median line in the maxillary arch. It resembles the central incisor but is smaller in all dimensions.

- **The facial surface is narrower and shorter than that of the central incisor. The distoincisal angle is more rounded than the mesioincisal angle. The distal portion of the incisal ridge slopes upward toward the distoincisal angle. The facial surface is convex.**

- **The lingual surface resembles the facial surface in peripheral outline except that the cervical portion is narrower. The features of this surface vary considerably from one individual to another. Proportionally, the lingual surface characteristics of a lateral incisor are more marked than similar features on a central incisor.**

- **Viewed on end, the incisal edge appears nearly straight. The cingulum lies slightly to the distal side of the tooth.**

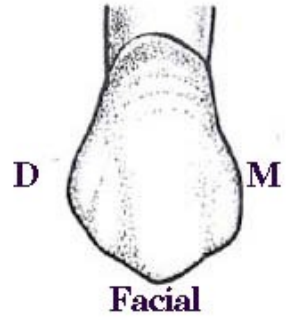
- **The mesial surface, like that of the central incisor, is wedge-shaped. The apex of the wedge is at the incisal edge. The incisal edge lies somewhat further lingually than it does in the central incisor.**

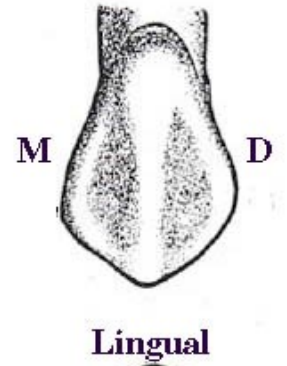
- **The distal surface resembles the mesial surface, but the facial outline is more convex and the incisal portion of the lingual outline is more concave.**

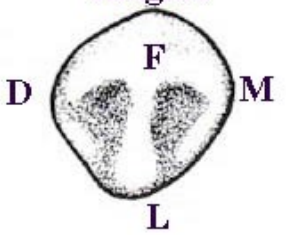
Maxillary Cuspid

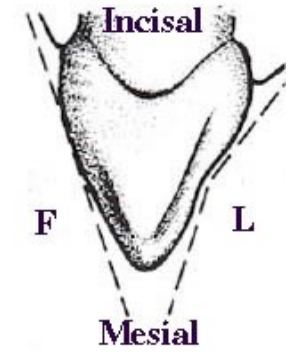
The maxillary cuspid (Figure 2-39) is the third tooth from the median line in the maxillary arch. It is located at the corner of the arch, and its long root is embedded in the canine (cuspid) eminence. The maxillary cuspid is usually the longest tooth in either jaw. Since it resembles a dog's tooth, it is sometimes called the canine.

- **The incisal portion of the facial surface is much broader than the cervical portion. The mesial and distal cusp ridges of the incisal edge slope downward toward the center to meet at the tip of the cusp. The distal slope is longer than the mesial slope. The facial surface is convex. It is divided into mesial and distal surfaces by the facial ridge. The ridge extends from the tip of the cusp to the point of greatest convexity. The mesiofacial surface of the cuspid falls on the curve of the arch formed by the anterior teeth. The distofacial surface conforms to the buccal alignment of posterior teeth.**









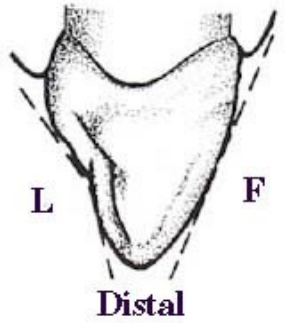


Figure 2-39. Maxillary Cuspid

♦ The *lingual surface* resembles the facial surface in outline, but the cervical portion is narrower. The mesial and distal marginal ridges prominent, and a strong lingual ridge runs from the tip of the cusp to the cingulum. The maxillary cuspid has the largest cingulum of all the anterior teeth.

♦ Viewed on end, the *incisal edge* is slightly curved. The lingual portion of the tooth appears rugged, with the ridges and grooves being very well defined.

♦ The *mesial surface* is roughly triangular. From this aspect, the cuspid appears much thicker than the incisors.

♦ The *distal surface* is shaped very much like the mesial surface but is shorter because the distal portion of the incisal edge slopes further cervically than the mesial portion.

■ **Maxillary First Bicuspid**

The *maxillary first bicuspid* (Figure 2-40) is the fourth tooth from the median line in the maxillary arch. It is the first posterior tooth. The bicuspids are sometimes called premolars because they are just in front of the molars:

♦ The *facial surface* resembles that of the cuspid in outline, but it is shorter occlusocervically and not quite as convex. The slopes of the mesial and distal cusp ridges are about equal in length. The facial ridge is prominent.

♦ The *lingual surface* is much smaller than the facial surface in all dimensions but is generally similar in outline. The lingual cusp is shorter than the facial cusp and is located

mesial to the midline of the tooth.

♦ The *occlusal surface* is broader facially than lingually. There are two cusps, the facial cusp and the lingual cusp. The mesial and distal marginal ridges correspond to the marginal ridges of the anterior teeth. The proximal surfaces converge toward the lingual; the distal surface converging the most.

The mesial fossa is distal to the mesial marginal ridge and the distal fossa is mesial to the distal marginal ridge. The facial and lingual triangular ridges extend from the tips of the cusps to the central groove. This groove ends at the mesial and distal pits. The mesial and distal marginal grooves arise from the mesial and distal pits and end on the mesial and distal surfaces,

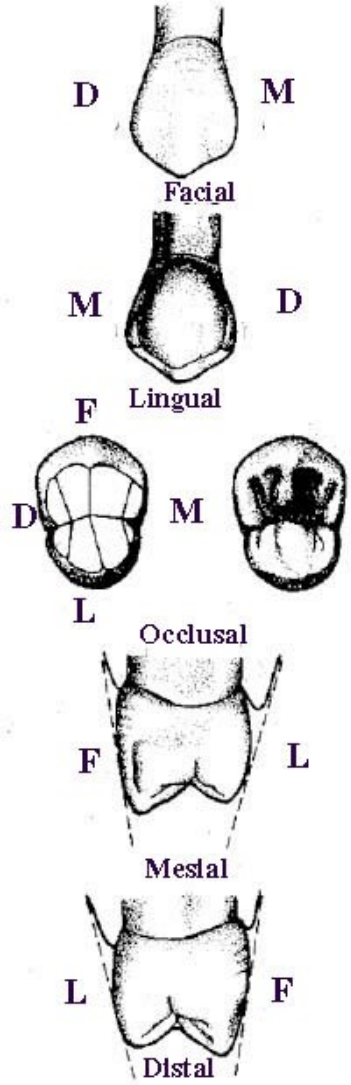


Figure 2-40. Maxillary First Bicuspid

respectively.

♦ The *mesial surface* is roughly rectangular in outline. The facial and lingual outlines are convex. The mesial surface is generally convex except for a concave area on the facial portion of the surface above the cervical margin. The mesial marginal groove extends onto the mesial surface.

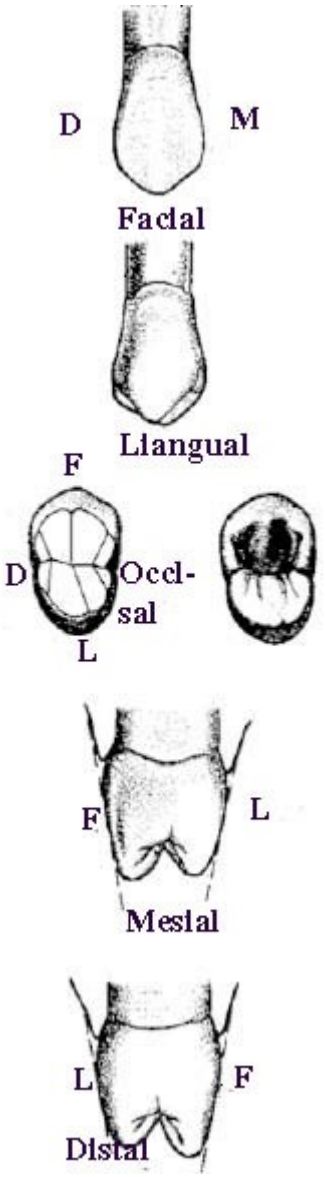


Figure 2-41. Maxillary Second Bicuspid

♦ The *distal surface* resembles the mesial surface but does not have the concave area above the cervical margin.

■ Maxillary Second Bicuspid

The *maxillary second bicuspid* is the fifth tooth from the median line in the maxillary arch. It closely resembles the first bicuspid but is more rounded in outline (Figure 2-41).

♦ The *lingual surface* is only slightly shorter than the facial surface because the facial and lingual cusps are nearly equal in length. This surface is also slightly narrower than the facial surface. The lingual surface is smoothly convex in all directions, and its

greatest convexity is in the cervical third.

♦ The *occlusal surface* has, in general, the same form and features as the occlusal surface of the first bicuspid. However, the facial and lingual portions are more nearly equal in size and the mesial and distal pits are closer together.

♦ The *mesial surface* is wider in the cervical portion than in the occlusal portion. The facial outline is slightly convex, except in the central portion. The lingual

outline is convex. Both cusps appear more rounded that the cusps of the first bicuspid.

♦ The *distal surface* is slightly shorter than the mesial surface; however, it is about the same width. The facial and lingual outlines are convex. The surface is smoothly convex except at the distal marginal groove.

■ Maxillary First Molar

The maxillary first molar (Figure 2-42) is the sixth tooth from the median line in the maxillary arch. It is the largest

tooth in either arch. The maxillary and mandibular first molars are often called 6-year molars:

♦ The *facial surface* is roughly heart shaped in outline. The mesiofacial and distofacial cusps form the occlusal border and the facial groove divides the cusps. The surface is generally convex, except at this groove. The surface has three ridges. A ridge extends perpendicularly from the tip of each cusp and a third ridge extends horizontally in the cervical

portion.

♦ The mesiolingual and distolingual cusps outline the occlusal border of the *lingual surface*. The mesiolingual cusp is the largest of the posterior teeth. Quite often this tooth has a fifth cusp, the cusp of Carabelli, which is on the lingual surface of the mesiolingual cusp. This cusp, when present, is shorter than the other cusps and does not form part of the occlusal surface. The lingual surface is generally convex, except at the distolingual groove.

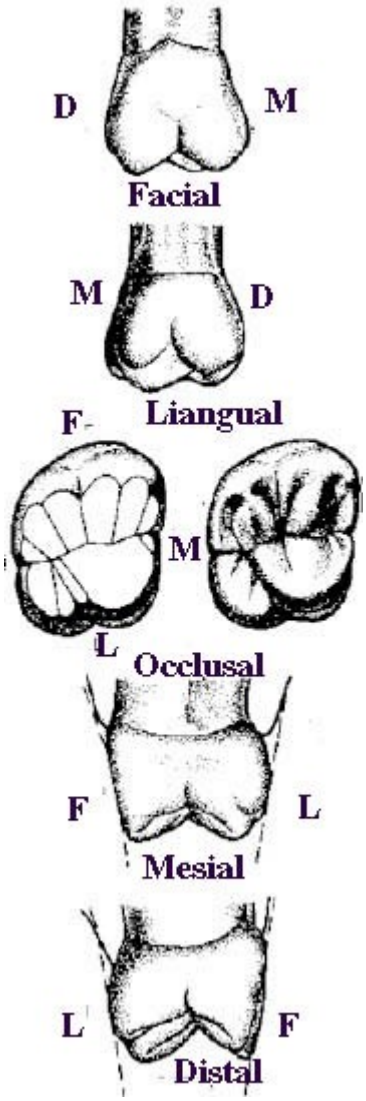


Figure 2.42. Maxillary First Molar

♦ **The *occlusal surface* is roughly rhomboidal. The cusps are large and prominent, with broad surfaces broken up into rugged ridges and well-defined grooves. The mesiolingual cusp is the largest of the cusps. The distolingual groove separates it from the distolingual cusp. An oblique ridge connects the mesiolingual and distofacial cusps. It runs parallel to the distolingual groove. The facial groove runs from the central pit onto the facial surface.**

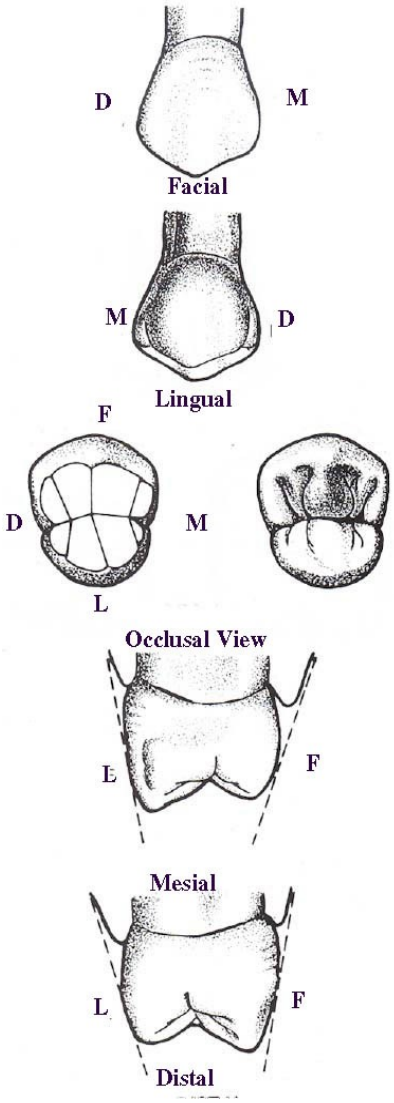


Figure 2.43. Maxillary Second Molar

The mesial and distal pits lie near the mesial and distal marginal ridges, respectively.

♦ The *mesial marginal groove* which starts at the mesial pit notches the occlusal border of the mesial surface. A double convexity marks the lingual margin if the cusp of Carabeli is present.

♦ The *distal marginal groove*, which starts at the distal pit notches the occlusal border of the distal surface.

■ Maxillary Second

Molar

The maxillary second molar (Figure 2-43) is the seventh tooth from the median line in the maxillary arch. It is quite similar to the first molar; however, it is smaller. The tooth is often called the 12-year molar:

♦ The *facial surface* of the maxillary second molar is less symmetrical than that of the first molar. The mesiofacial cusp is larger than the distofacial cusp. The facial groove lies nearer to the distal surface than it

does to the mesial surface. The same three ridges appear on the facial surface as appear on the facial surface of the first molar.

♦ The *occlusal border* of the *lingual surface* is marked by two cusps, the mesiolingual and the distolingual. The mesiolingual cusp is the largest. (The distolingual cusp is not fully reproduced in artificial teeth. For this reason, many of these artificial teeth appear triangular when viewed occlusally). The

second molar has no cusp of Carabelli. The cervical border is nearly straight. The lingual surface is generally convex.

♦ The *occlusal surface* is very similar to the occlusal surface of the first molar.

♦ The *mesial surface* is fairly symmetrical in outline. The mesiofacial cusp is slightly longer than the mesiolingual cusp. The facial outline is nearly straight, but the lingual outline is distinctly convex.

♦ **The *distal surface* is somewhat smaller than the mesial surface. The distofacial cusp is longer than the distolingual cusp. The facial outline appears less convex than it does from the mesial aspect.**

■ **Mandibular Central Incisor**

The *mandibular central incisor* (Figure 2-44) is the first tooth from the median line in the mandibular arch. It is the smallest tooth in either arch and the simplest in form:

♦ **The *facial surface* is widest at the incisal edge. The mesioincisal and distoincisal angles are close to being 90 degree angles. The mesial and distal borders are almost parallel in the incisal portion; in their middle and cervical portions the outlines converge but do not meet. The facial surface is convex. There are three lobes, separated by two developmental grooves. The grooves are more faint than they are in the maxillary central incisor and**

often disappear entirely.

♦ The *lingual surface* is quite similar in outline to the facial surface; however, the cervical portion is more narrow. The incisal portion of the lingual surface is concave. The cingulum, which begins fairly close to the cervical margin, blends more smoothly with the rest of the lingual surface than it does on the maxillary incisors.

Figure 2.44. Mandibular Central Incisor

♦ Viewed on end, the *incisal edge* appears nearly straight. In an adult, the edge is worn

smooth and sharp.

♦ The *mesial surface* is wedge-shaped. The facial outline is convex, and the lingual outline is concave in the incisal and middle portions and convex in the cervical portion. The mesial surface is almost flat, incisogingivally.

♦ The *distal surface* closely resembles the mesial surface.

Figure 2-45. Mandibular Lateral Incisor

■ Mandibular Lateral Incisor

The *mandibular lateral incisor* (Figure 2-45) is the second tooth from the median line in the mandibular arch.

Although it resembles the mandibular central incisor, it is wider and longer:

♦ 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 degrees. The distoincisal angle is rounded. The mesial border is more nearly straight than the distal border. The latter is slightly convex in the incisal portion and slightly concave in the middle and cervical

portions. The facial surface is convex.

♦ The *lingual surface* is similar in outline to the facial surface. The mesial and distal borders converge more sharply than they do on the facial surface. The incisal portion of the lingual surface is concave. The cingulum is quite large but blends smoothly with the rest of the surface.

♦ Viewed on end, the *incisal edge* forms a nearly straight line that slants lingually toward its distal end. This is because the distal portion of

the facial surface is more convex than the mesial portion.

♦ The *mesial surface* is wedge-shaped. The facial outline is convex. The lingual outline is concave in the incisal portion and convex in the middle and cervical portions.

♦ The *distal surface* is slightly shorter than the mesial surface because the incisal edge slants downward toward the distoincisal angle. The incisal portion of the distal surface is thicker than the incisal portion of the mesial surface.

■ Mandibu

lar Cuspid

The *mandibular cuspid* (Figure 2-46) is the third tooth from the median line in the mandibular arch. It is similar to the maxillary cuspid, but is narrower:

♦ The *facial surface* is asymmetrical in outline. The distal portion of the surface is shorter and broader than the mesial portion, and consequently the distal cusp ridge of the incisal edge is much longer than the mesial edge. The mesial border is slightly convex. The upper portion of the distal border is very convex, and

the lower portion is slightly concave. The three lobes are quite distinct cervically. The lingual ridge divides the surface into two planes. The ridge blends smoothly with the cingulum, which is small and confined to the cervical portion of the tooth.

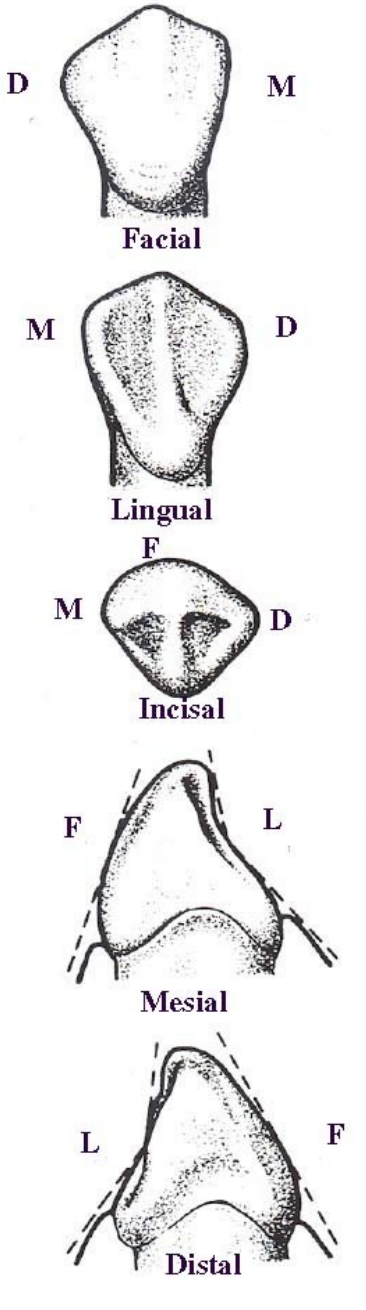


Figure 2-46. Madibular Cuspid

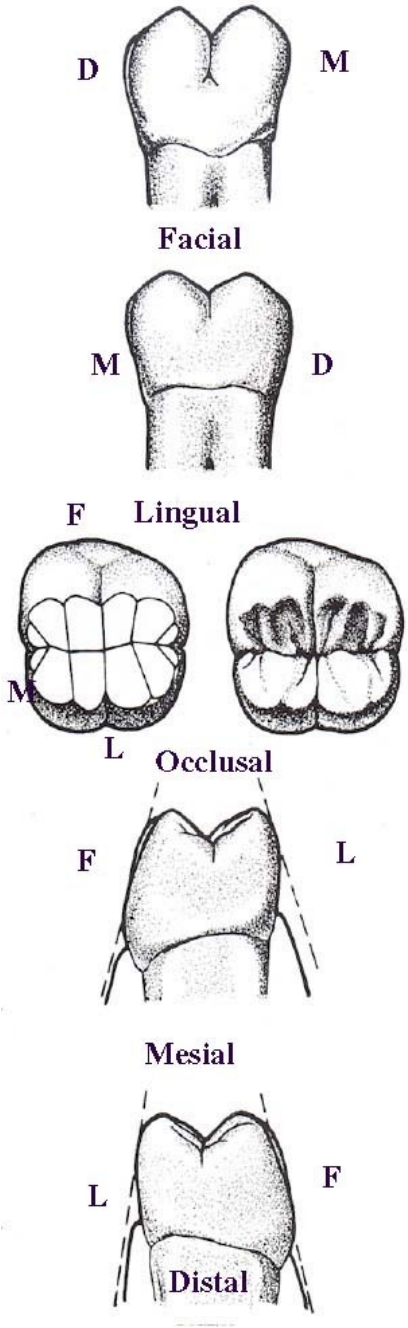


Figure 2-47. Mandibular First Bicuspid

- **Viewed on end, the incisal edge forms two curves that meet at the tip of the cusp. The mesial portion of the facial outline is convex, but the distal portion is slightly flattened. The mesial curve follows the alignment of the facial surfaces of the anterior teeth. The distal part of the facial outline conforms to the buccal surface alignment of posterior teeth. The cingulum appears uniformly curved on both sides.**

- ♦ The mesial surface more nearly resembles that of the incisors than the mesial surface of the maxillary cuspid in outline. The facial outline is convex. The lingual outline is chiefly concave except near the cervical margin. The mesial surface is generally convex.

- ♦ The distal surface is shorter than the mesial surface but is of about the same width. The incisal portion is very convex both faciolingually and incisogingivally. The cervical portion is concave incisogingivally.

■ Mandibular First Bicuspid

The mandibular first bicuspid (Figure 2-47) is the fourth tooth from the median line in the mandibular arch. It is the smallest and least typical of the bicuspids.

- ♦ The facial surface is shaped somewhat like a bell because the cervical portion is markedly constricted in comparison with the occlusal portion. The distal cusp ridge of the occlusal border is slightly longer than the mesial cusp ridge, and the distoincisal angle is more rounded than the mesioincisal angle. The distal portion of the surface is slightly shorter and broader than the mesial surface. The surface is convex.

- ♦ The lingual surface is much smaller than the facial surface because the lingual cusp is smaller than the facial cusp. The tip of the lingual cusp is closer to the mesial margin than to the distal margin. The surface is convex.

- ♦ The occlusal surface is marked by a strong facial cusp and a lingual cusp that may appear almost rudimentary. The marginal ridges are well defined. The strong lingual ridge of the facial cusp and the facial ridge of the lingual cusp may join, forming a transverse ridge. In this instance, the central groove would be very faint.

- ♦ The mesial surface is irregular in outline. From this aspect the tooth appears to be tipped lingually. The facial cusp forms most of the occlusal outline. The facial outline is very convex and the greatest convexity is in the cervical third. The lingual outline is fairly straight. Occlusocervically, the mesial surface is very convex in the occlusal portion and concave in the cervical portion.

- ♦ The distal surface is similar to the mesial surface.

■ Mandibular Second Bicuspid

The mandibular second bicuspid (Figure 2-48) is the fifth tooth from the median line in the mandibular arch.

- **The facial surface is very similar to the surface of the mandibular first bicuspid. The facial ridge is prominent, and the surface is convex.**

- **The lingual surface is similar to the surface of the mandibular first bicuspid, with the exception that there may be two cusps, the mesiolingual and the distolingual.**

- **The occlusal surface may appear in a number of forms. In the form pictured, the mesial and distal triangular fossae are quite distinct as they join the short central groove. There are three pits, the central, the mesial, and the distal.**

- **The mesial surface is similar to the surface of the mandibular first bicuspid, but it is more regular in outline. The surface is convex faciolingually. Occlusocervically, the occlusal portion is convex, and the cervical portion is concave.**

- **The distal surface is very similar to the mesial surface.**

■ Mandibular First Molar

The mandibular first molar (Figure 2-49) is the sixth tooth from the median line in the mandibular arch. It is also the largest tooth in the mandibular arch. The maxillary and mandibular first molars are often called "6-year" molars.

- **The facial surface presents three cusps: the mesiofacial, the distofacial, and the distal. The mesiofacial cusp is the largest and the distal is the smallest. The distofacial cusp, though smaller than the mesiofacial cusp, may be slightly higher. The mesiofacial (facial) groove, which may end in a pit, separates the mesiofacial and distofacial cusps. The distofacial groove separates the distofacial and distal cusps. The facial surface is convex except at the grooves.**

- **The lingual surface has a mesiolingual cusp and a distolingual cusp, which are similar in outline. They are separated by the sharply defined lingual groove. The surface is slightly convex.**

- **The occlusal surface of this tooth, unlike the surface of the maxillary first molar, is formed by all five cusps and is trapezoidal in shape. There are three pits, the mesial,**

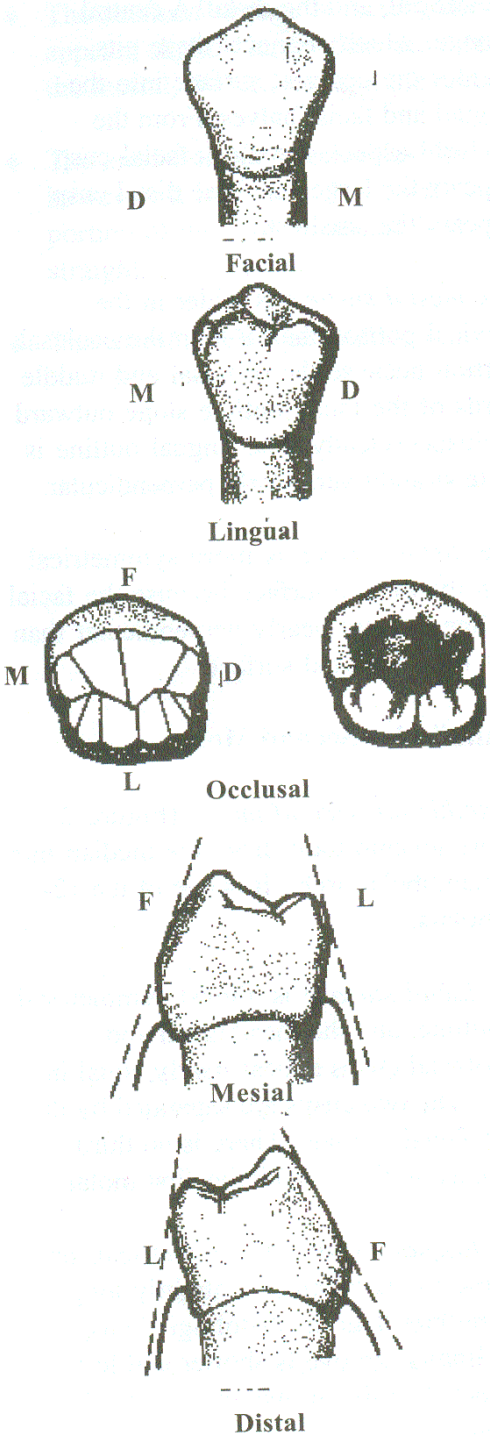
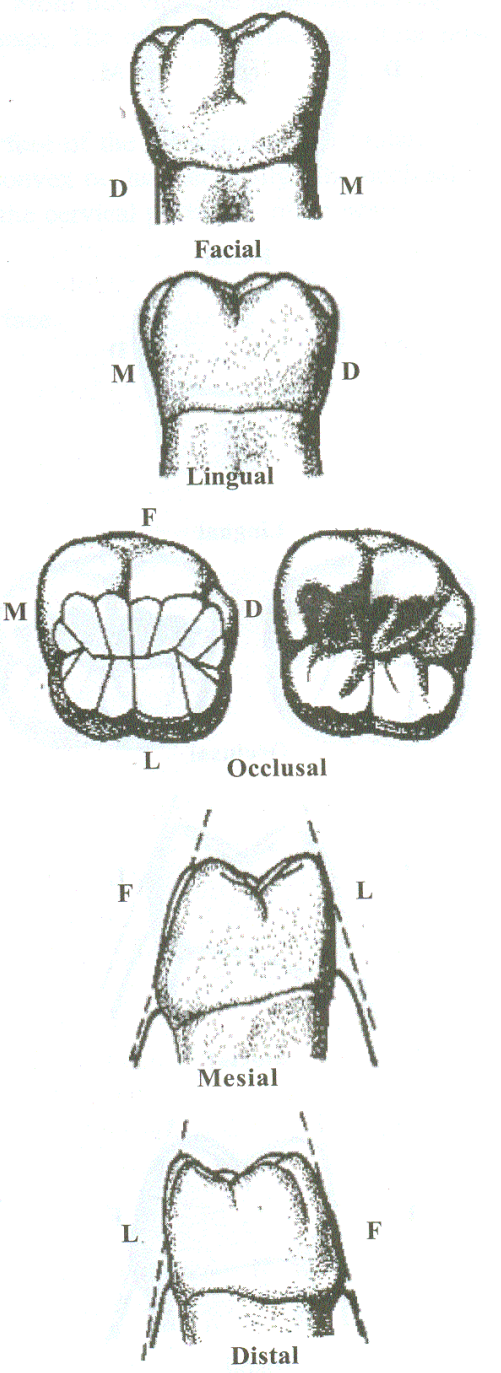


Figure 2-48. Mandibular Second Bicuspid



Figures 2-49. Mandibular First Molar

the central, and the distal. A central groove, which connects these pits, divides the occlusal surface into the lingual and facial halves. From the occlusal aspect, the mesiofacial cusp appears the largest and the distal cusp appears the smallest.

♦ The *mesial surface* is wider in the cervical portion than it is in the occlusal portion because the occlusal and middle thirds of the facial outline slope outward occlusocervically. The lingual outline is quite straight and nearly perpendicular.

♦ The *distal surface* is more symmetrical than the mesial surface because the facial outline is more nearly perpendicular than it is on the mesial surface.

■ Mandibular Second Molar

The *mandibular second molar* (Figure 2-50) is the seventh tooth from the median line in the mandibular arch. It is one of the 12-years molars.

♦ The *facial surface* is almost symmetrical in outline, and the mesiofacial and distofacial cusps appear

nearly equal in size. The two cusps are separated by the deep facial groove. There is no third cusp, as on the mandibular first molar.

♦ The *lingual surface* is symmetrical, but the mesiolingual cusp is slightly longer and bulkier than the distolingual cusp. The lingual groove is shorter and less distinct than the groove on the facial surface.

♦ The occlusal surface is rectangular in shape. From this view the mesiofacial cusp appears slightly larger than the three other cusps. The occlusal surface has three pits, the mesial, the central, and the distal.

♦ The mesial surface resembles the mesial surface of the mandibular first molar; however, it is shorter. The facial outline is convex occlusocervically. The occlusal portion of the lingual outline is convex and the cervical portion is more nearly straight.

♦ The distal surface resembles the mesial surface.