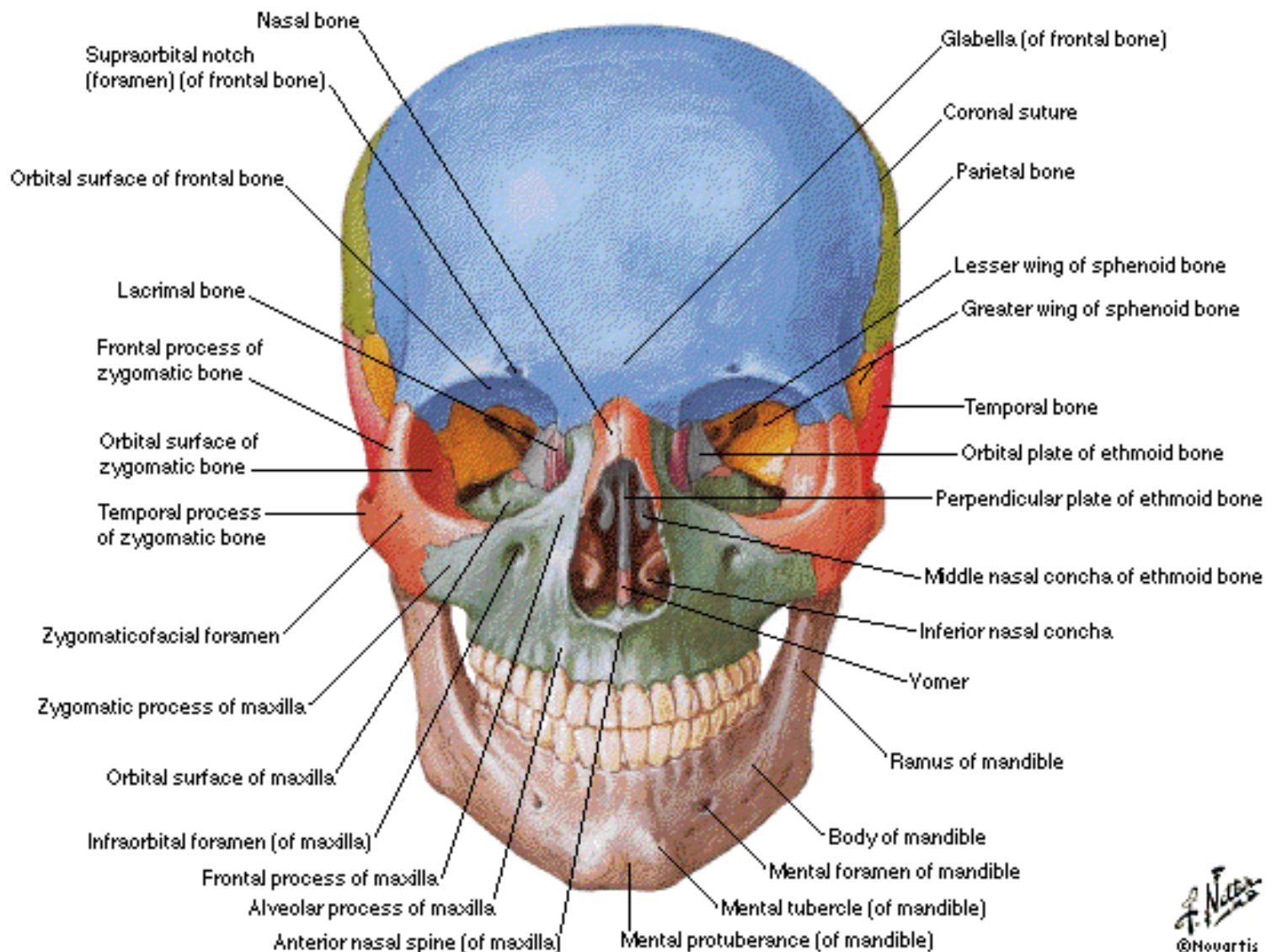


# Dental Anatomy

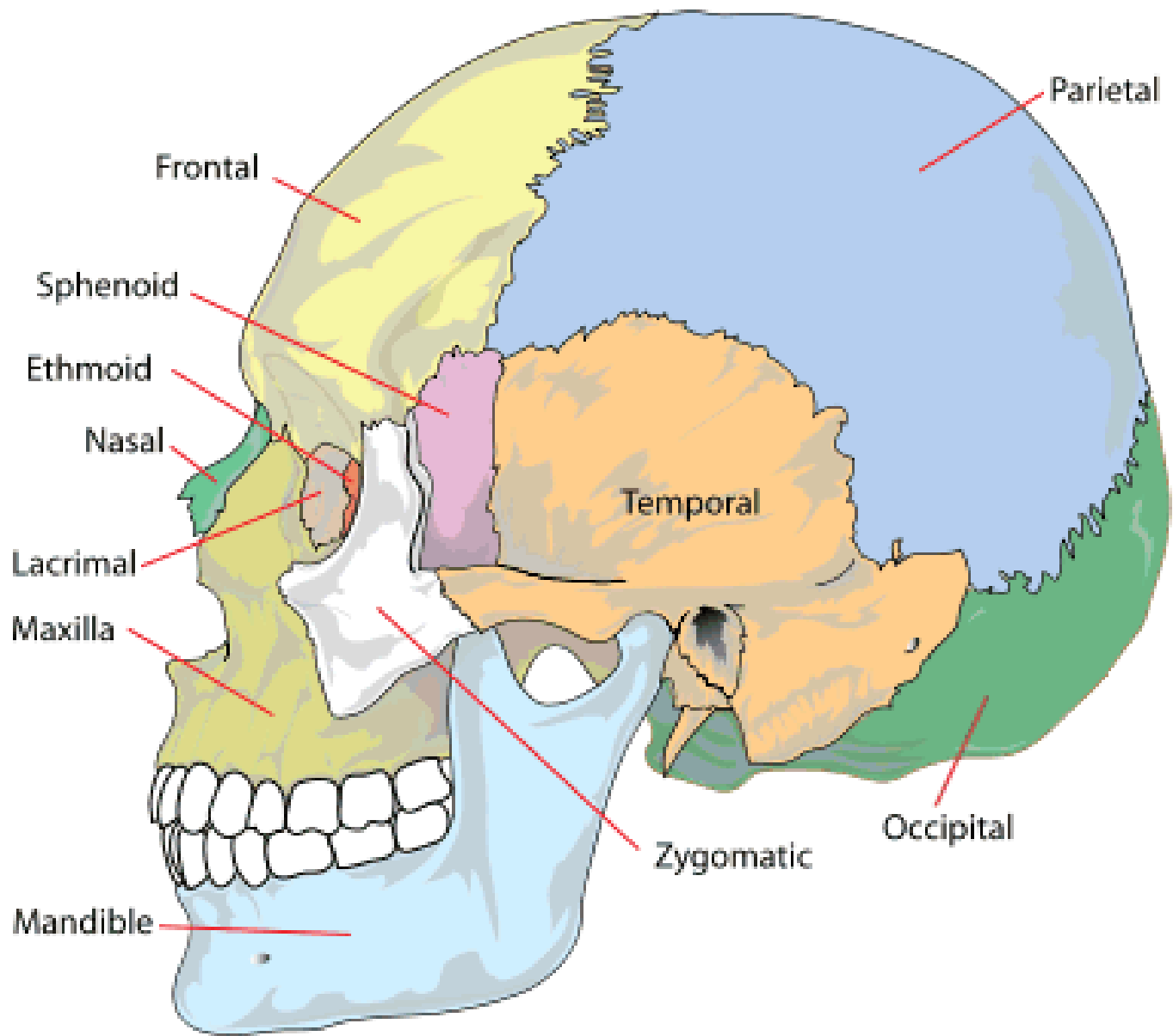
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# Skull

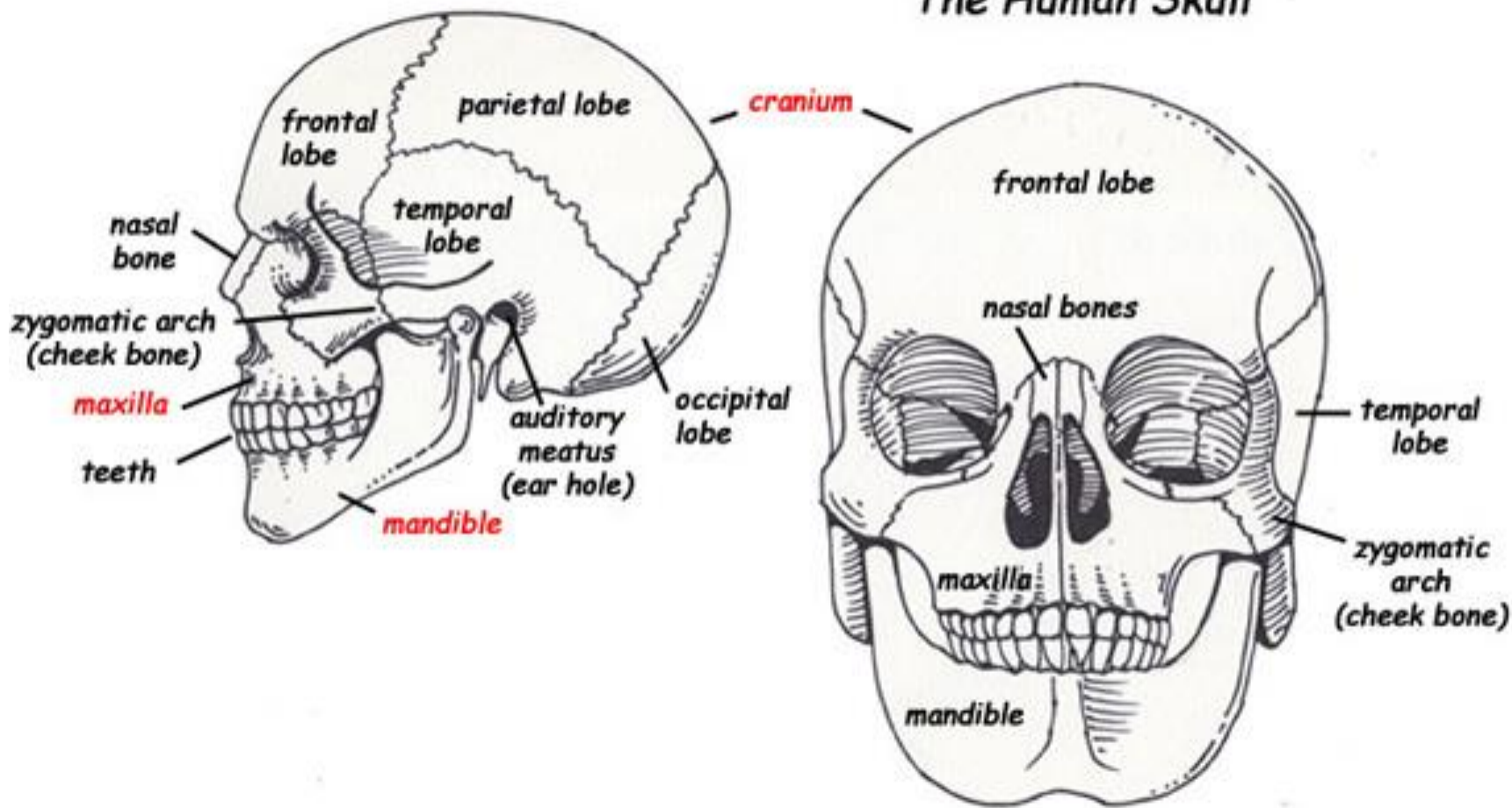
## Anterior View



*F. N. N.*  
©Novartis



# The Human Skull



# Paired Cranial Bones

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# Parietals

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- The **Parietals** are paired left and right. Externally, each possess a **Superior**, and **Inferior Temporal Line**, to which the temporal muscle is attached. The lines run from the **Frontal Crest** of the anterior frontal bone to the **Supra-Mastoid Crest** on the posterior portion of the temporal bone. The parietals articulate with each other by way of the **Mid-Sagittal Suture**, and with the frontal bone anteriorly by way of the **Coronal Suture**. These two sutures generally form a right angle with one another. Posteriorly, the parietals articulate with the **Occipital Bone** by way of the **Lambdoid Suture**. The intersection of the **Lambdoid** and **Sagittal Sutures** approximate a 120 degree angle on each of the parietals and the occipital bone. Among the sutures the Lambdoid is by far more serrated than either the Sagittal or the Coronal. Inferiorly the Parietal articulates with the temporal bone by way of the **Squamosal** and **Parieto-Mastoid Sutures**. On the external surface near the center of the bone is the **Parietal Eminence**. Slightly posterior to the eminence there may be a **Parietal Foramen**.
- Internally, the bones possess a number of **Meningeal Groves** as well as perhaps some number of **Arachnoid Foveae**. The groves generally branch from the inferior/anterior edge of the bone to superior/posterior, while the foveae are frequently found along the sagittal suture. At the area of intersection of the lambdoid and parieto-mastoid sutures there is a brief portion of the **Sigmoid** (i.e., Transverse) **Sulcus**.

# Temporal Bone

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- The **Temporal Bone** is another paired cranial bone which is difficult to describe due to its various features, and projections. It consists of two major portions, the **Squamous Portion**, which is flat or fan-like and projects superiorly from the other, very thick and rugged portion, the **Petrosal Portion**.
- The squamous portion assists in forming the **Squamous Suture** which separates the temporal bone from the adjacent and partially underlying parietal bone. The petrosal portion contains the cavity of the middle ear and all the ear ossicles; the Malleus, Incus and Stapes. This portion projects anterior and medially beneath the skull. Projecting inferiorly from the petrosal portion is the slender **Styloid Process** which is of variable length. The styloid process serves as a muscle attachment for various thin muscles to the tongue and other structures in the throat. Externally the petrosal portion possesses the **External Auditory Meatus** while internally there is an **Internal Auditory Meatus**. Anterior to the external meatus the **Zygomatic Process** has its origin. This process projects forward toward the face and its articulation with the temporal process of the zygomatic. Just anterior of the external meatus and inferior of the origin of the zygomatic process is the **Glenoid or Mandibular Fossa** which assists in forming the shallow socket of the **Temporo-Mandibular Joint**. Posterior to the external auditory meatus is the inferiorly projecting **Mastoid Process** which serves as an attachment for the sternocleidomastoid muscle. Above the mastoid process is the **Supramastoid Crest** to which the posterior portion of the temporal muscle is attached.

# Unpaired Cranial Bones

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# The Frontal Bone

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- The frontal bone may be divided into two main portions, a vertical squamous portion which articulates with the paired parietals along the **Coronal Suture** and forms the forehead, and two orbital plates, which contribute to the ceiling and lateral walls of the left and right eye orbits. On the external surface the squamous portion frequently possesses a left and right **Frontal Eminence**. Additionally, the bone possesses two **Supra-Orbital Ridges** (i.e., Superciliary or Brow Ridges) which are bumps above each of the eye orbits. In early hominids these ridges formed a **Torus** or large shelf-like process protruding from above the eyes. Associated with each **Superior Orbital Margin** of the eye orbit the frontal bone may possess a **Supra-Orbital Notch** or if completely surrounded by bone, a **Supra-Orbital Foramen**. Above the fronto-nasal suture which allows articulation between the frontal and nasal bones there is generally a trace of the vertical **Metopic Suture**. In early life the metopic suture divided the frontal bone into left and right halves. Within the bone, and above and the metopic suture, is the **Frontal Sinus**. The left and right **Frontal Crest**, begins at each **Zygomatic Process** of the frontal bone, and provides the anterior origin of the **Temporal Line** to which the left and right temporal muscle is attached.
- Internally, the frontal bone possesses the **Median Sagittal** (i.e., Sagittal-Frontal) **Crest** which separates the two frontal hemispheres of the brain.

# The Occipital Bone

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- The **Occipital Bone** consists of a large squamous, or flattened portion separated from a small thick basal portion by the **Foramen Magnum** on either side of which is a left or right **Occipital Condyle**. The occipital condyles articulate with the first cervical vertebrae (the **Atlas**). Externally, the squamous portion of the bone possesses **Superior, Middle, and Inferior Nuchal Lines** to which the muscles at the back of the neck are attached. The **External Occipital Protuberance** lies on the superior nuchal line in the mid-sagittal plane. Lateral to each occipital condyle are the **Condylar Fossae** and **Foramen** while the **Hypoglossal Canal** is medial to them.
- Internally, are the **Sagittal and Transverse Sulci**, or grooves which converge at the **Confluence of Sinuses**. A single internal **Occipital Protuberance** or **Cruciform Eminence** is also found in this area. Running inferior from the eminence to the foramen magnum is the **Internal Occipital Crest** which separates the **Cerebellar Fossae**. The transverse sulci assist in directing the developing jugular vein to the **Jugular Notch** on either side of the basilar portion of the occipital.

# The Sphenoid

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- The **Sphenoid** has a number of features and projections, which allow it to be seen from various views of the skull. It is a single bone that runs through the mid-sagittal plane and aids to connect the cranial skeleton to the facial skeleton. It consists of a hollow body, which contains the **Sphenoidal Sinus**, and three pairs of projections: the more superior **Lesser Wings**, the intermediate **Greater Wings**, and the most inferior projecting **Pterygoid Processes**. Internally upon the body is the **Sella Turcica** where the pituitary gland rests in life. The smaller lesser wings possess the **Optic Foramen** through which the optic or second cranial nerve passes before giving rise to the eye.
- The **Supra-Orbital Fissure** separates the lesser wing superiorly from the greater wing below and can best be viewed on the posterior wall of each eye orbit. The left and right greater wings assist in forming the posterior wall of each of the eye orbits where it forms an **Orbital Plate**.

# Continued

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- Just inferior to the supra-orbital fissure near the body of the sphenoid, each of the greater wings also possess a **Foramen Rotundum** which in life transmits the maxillary branch of the fifth, or trigeminal, cranial nerve. Each of these wings also possesses a much larger **Foramen Ovale** more laterally, which transmits the mandibular branch of the same nerve. More posteriorly is the smallest of the three pairs of foramina, the **Foramen Spinosum** which transmits the middle meningeal vessels and nerve to the tissues covering the brain.
- The left and right pterygoid processes project inferiorly from near the junction of each of the greater wings with the body of the sphenoid. These processes run along the posterior portion of the nasal passage toward the palate. Each process is formed from a **Medial** and **Lateral Pterygoid Plate** to which the respective medial and lateral pterygoid muscle is attached during life. In life the muscles assist in creating the grinding motion associated with chewing.

# The Ethmoid

13

- It has a number of features and projections, but unlike the sphenoid it cannot be seen from various views of the skull. It is a single bone that runs through the mid-sagittal plane and aids to connect the cranial skeleton to the facial skeleton. It consists of various plates and paired projections. The most superior projection is the **Crista Galli**, found within the cranium. It assists in dividing the left and right frontal lobes of the brain. Lateral projections from the Crista Galli are the left and right **Cribriform Plates** which in life cradle the first cranial nerves i.e., the olfactory nerves. The nerves brachiate through the porosity of these plates into the nasal cavity below. Directly inferior to the Crista Galli and running in the mid-sagittal plane is the **Perpendicular Plate** of the ethmoid which articulates with the vomer more inferiorly and assists in separating the left and right nasal passages. The Perpendicular Plate can be viewed anteriorly through the nasal cavity.
- Descending off each of the Cribriform Plates is a left or right **Orbital Plate** which aids to form the medial wall of the respective eye orbit. Each Orbital Plate is rectangular in shape and gives rise to two medial projections, the **Superior** and **Middle Nasal Concha**. These projections, like the separate Inferior Nasal Concha, assist in increasing the surface area within the nasal cavity and thereby the exposure of the brachiating olfactory nerve to inhaled odors. The Superior or **Supreme** Nasal Conche are smaller, and cannot be viewed through the anterior nasal opening because it is blocked from view by the more inferior Middle Nasal Conche.

# Paired Facial Bones

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# The Lacrimal Bone

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- The **Lacrimal** bones are the smallest and most fragile of the facial bones. They are paired left and right and assist in forming the anterior portion of the medial wall of each eye orbit. They are basically rectangular with two surfaces and four borders. Each of the borders articulate with the bones that surround the Lacrimal. The **Orbital** or **Lateral Surface** contributes to the eye orbit, while the **Medial Surface** assists in forming a small portion of the nasal passage. The orbital surface possesses a sharp superior-inferior running ridge called the **Posterior Lacrimal Crest** which divides this surface into an **Orbital Plate** and the **Lacrimal Sulcus**. The sulcus, along with a contiguous sulcus on the maxillae, assists in forming the lacrimal fossa which contains the lacrimal duct in life. The duct connects the medial corner of the eye to the nasal passage and allows tears from the eye to be shunted into the nasal passage.

# The Nasal Bones

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- Each of the nasal bones is a small rectangular bone which together form the bridge of the nose above the **Nasal Cavity** also called the **Piriform Aperture**. They articulate with each other by way of the **Internasal Suture** and with the frontal bone superiorly by way of the **Fronto-Nasal Suture** just below the glabellar region of the frontal bone. The intersection of these two sutures marks the anatomical landmark called **Nasion**. Laterally, each of the nasal bones articulates with the frontal process of the maxilla.



# The Zygomatic Bones

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- Each cheek or zygomatic bone possesses three major processes which articulate with the bones which surround it.
- The **Frontal Process** of the zygomatic forms the lateral margin and wall of the eye orbit and projects superiorly to articulate with the zygomatic process of the frontal bone. This portion of the bone separates the eye orbit from the temporal fossa and possesses a posterior projecting edge called the **Marginal Process**. The **Temporal Process** of the zygomatic runs lateral and posterior toward an articulation with the zygomatic process of the temporal bone. Together these two processes assist in forming the zygomatic arch which serves as the attachment for the masseter muscle in life, one of the primary muscles used in mastication. The temporal muscle runs beneath the arch and is also a primary mover of the mandible in chewing. The **Maxillary Process** of the zygomatic articulates with the zygomatic portion of the maxilla by way of the **Zygo-Maxillary Suture**.

# The Maxillary Bone

18

- The **Maxillae** are the paired facial bones which contain the upper dentition and thus form the upper jaw. Each is basically hollow with a large **Maxillary Sinus**. A superior projection, the **Frontal Process**, assists in forming the lateral margin of the nasal aperture and ends by articulating with the frontal bone. An **Orbital Plate** forms the floor of the eye orbit, while the **Zygomatic Process** articulates with the zygomatic bone. On the anterior surface of the bone, near the maxillo-zygomatic suture, there is an **Infra-Orbital Foramen**. The **Alveolar Process** of the Maxilla contains the upper dentition and assists in giving rise to the **Palatine Portion** which forms the anterior half of the hard palate. The left and right Maxillae articulate with one another by way of the **Inter-Maxillary Suture**. The superior end of this suture frequently terminates with the **Nasal Spine**.

# The Palatine Bones

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- The **Palatine Bones** are paired left and right and articulate with one another in the mid-sagittal plane at the **Interpalatine Suture**. Both bones assist in forming the posterior portion of the hard palate as well as a portion of the nasal cavity. Each bone possesses a **Horizontal Part**, with an inferior surface which forms the posterior portion of the hard palate and a superior surface that assists in forming the posterior portion of the floor of the nasal cavity. The **Vertical Part** of each contributes to the lateral wall of the nasal cavity. Near the posterior junction of the Vertical and Horizontal Parts on the palatal surface is a **Palatine Foramen**. Each bone possesses a number of processes and articular surfaces which touch the bones that surround it.

# The Inferior Nasal Concha

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- The **Inferior Nasal Concha** is a very thin, porous, and fragile, paired bone basically elongated and curled upon itself. It lays in the horizontal plane and is attached to the lateral wall of the nasal cavity. By way of the **Maxillary Process** on the bone's lateral surface, it is attached to the maxilla, and by way of the **Lacrimal, Ethmoid and Palatine Processes** to each of the bones which assist in forming the lateral wall of the nasal cavity. By projecting into the nasal cavity, the medial surface of the Inferior Nasal Concha assists in increasing the surface area within the cavity and thus increases the amount of mucus membrane and olfactory nerve endings exposed to inhaled odors.

# Unpaired Facial Bones

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# The Vomer Bone

22

- The **Vomer** is a single relatively flat bone located in the mid-sagittal plane. It articulates with the perpendicular plate of the ethmoid superiorly and together aid in forming the nasal septum. While it is frequently deflected slightly to the left or right, in general the septum is aligned perpendicularly and divides the nasal aperture into the left and right nasal passages. In addition to the **Perpendicular Portion**, superiorly the Vomer mushrooms out into a pair of **Alae** which terminate and articulate with the sphenoid in a heart shaped process. Inferiorly the Vomer rests on both the maxillae and the palatines.

# The Mandible

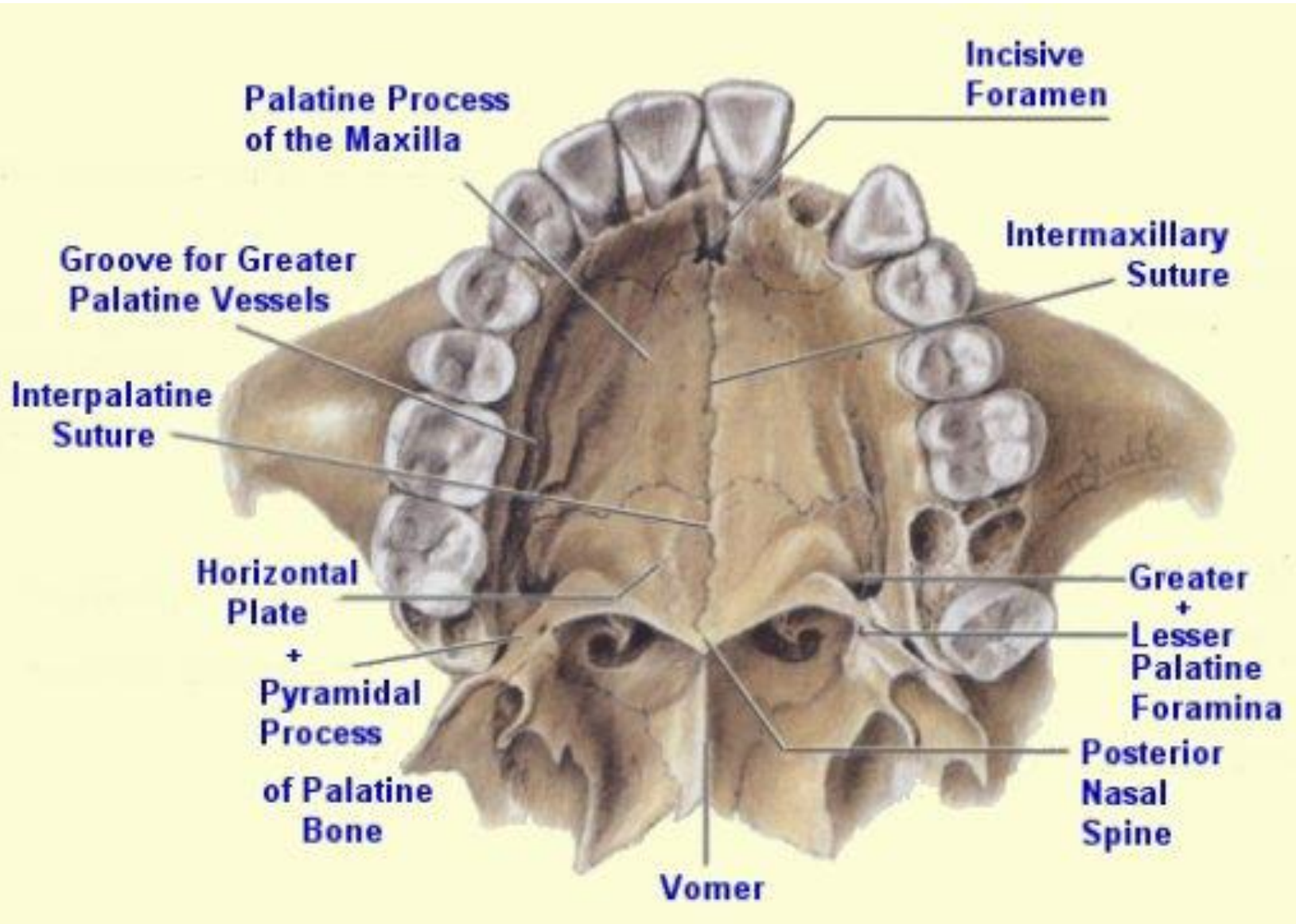
- The **Mandible** or lower jaw consists to four major portions, a left and right **Mandibular Ramus** and the left and right **Body**. The **Alveolar Process** of the body is that portion of the mandible which contains the lower dentition. The junction of the ramus and the body occurs at the **Gonial Angle** where externally one of the masseter muscles is attached. The left and right masseters make up a set of two sets of muscles used in chewing. At the gonial angle on the internal surface the **Pterygoid Attachments** are found. These attachments are for the medial and lateral pterygoid muscles which assist in the grinding motion of chewing.
- The external surface of the mandibular body possesses the **Mental Foramen** and at the midline, the **Mental Protuberance** or chin. The internal surface of the body possesses the **Lingual Foramen**, the **Mandibular Canal**, and the longitudinal running **Mylohyoid Ridge**. The **Genio Tubercle** is located in the mid-sagittal plane on the internal surface of the mandible. The superior margin of each ramus possesses both a **Mandibular Condyle** or **Head**, for articulation with the temporal bone at the tempro-mandibular joint, and the **Coronoid Process**, for the attachment of the temporalis muscle (one in the set of primary muscles used in mastication). The mandible articulates with each of the Maxillae by way of their contained respective lower and upper dentition.

# The Hyoid Bone

24

- The hyoid is a single small "U" shaped bone in the adult which does not articulate with any other bone. It is suspended from the styloid process of each temporal bone by means of the stylohyoid ligaments. It is located in the mid-sagittal plane, at the front of the throat, and beneath the mandible but above the larynx near the level of the third cervical vertebrae. It is formed from three separate parts (i.e., the **Body**, and the left and right **Greater** and **Lesser Cornu**) which fuse in early adulthood. The base of the "U" shaped bone is located anteriorly while the Cornu project posteriorly.





# The Hard Palate

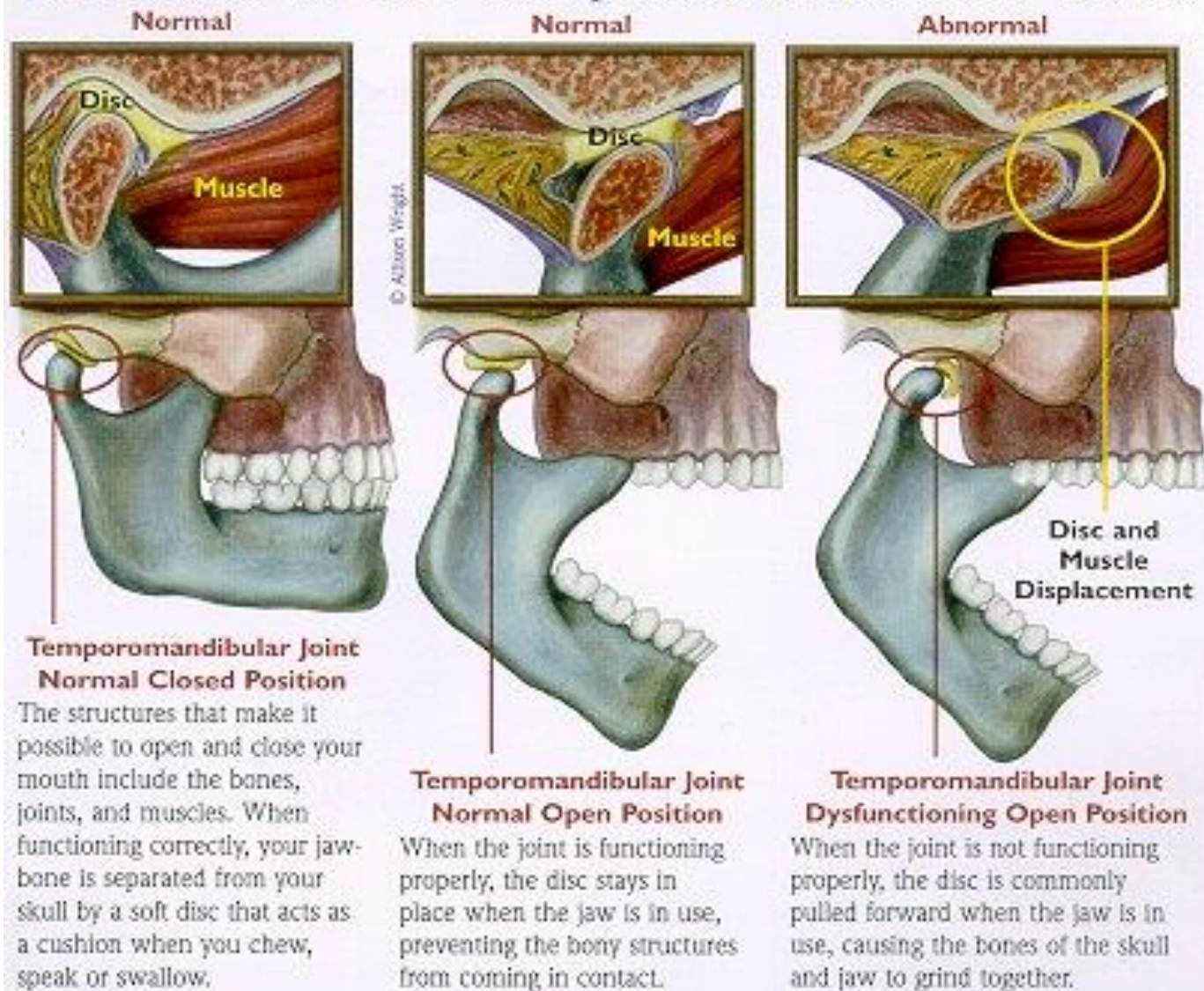
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- The hard palate is vaulted. Its bony skeleton is made up of the palatine processes of the maxillae (anterior two thirds) and the horizontal plates of the palatine bones (posterior third). The mucosa of the hard palate is tightly bound to the underlying bone.
- At the anterior end of the hard palate are transverse palatine folds which assist with the manipulation of food during chewing. In the midline is a narrow whitish streak, the palatine raphe, which marks the site of fusion of the embryonic palatal processes. The blood supply is chiefly from the greater palatine artery of each side. **The greater palatine vessels emerge from the greater palatine foramina. There is one of these on each side in the lateral border of the hard palate, medial to the upper 3rd molar** tooth. The nasopalatine nerve supplies the mucous membrane of the anterior part of the hard palate. The nasopalatine nerve passes from the nose through incisive canals that open into the incisive foramen which is posterior to the central incisor teeth. Behind each greater palatine foramen and more laterally, is the pterygoid hamulus of each side.
- The most posterior end of the hard palate is extended a little bit in the midline and this process is called the **posterior nasal spine**.

# TMJ

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# Function of the Temporomandibular Joint

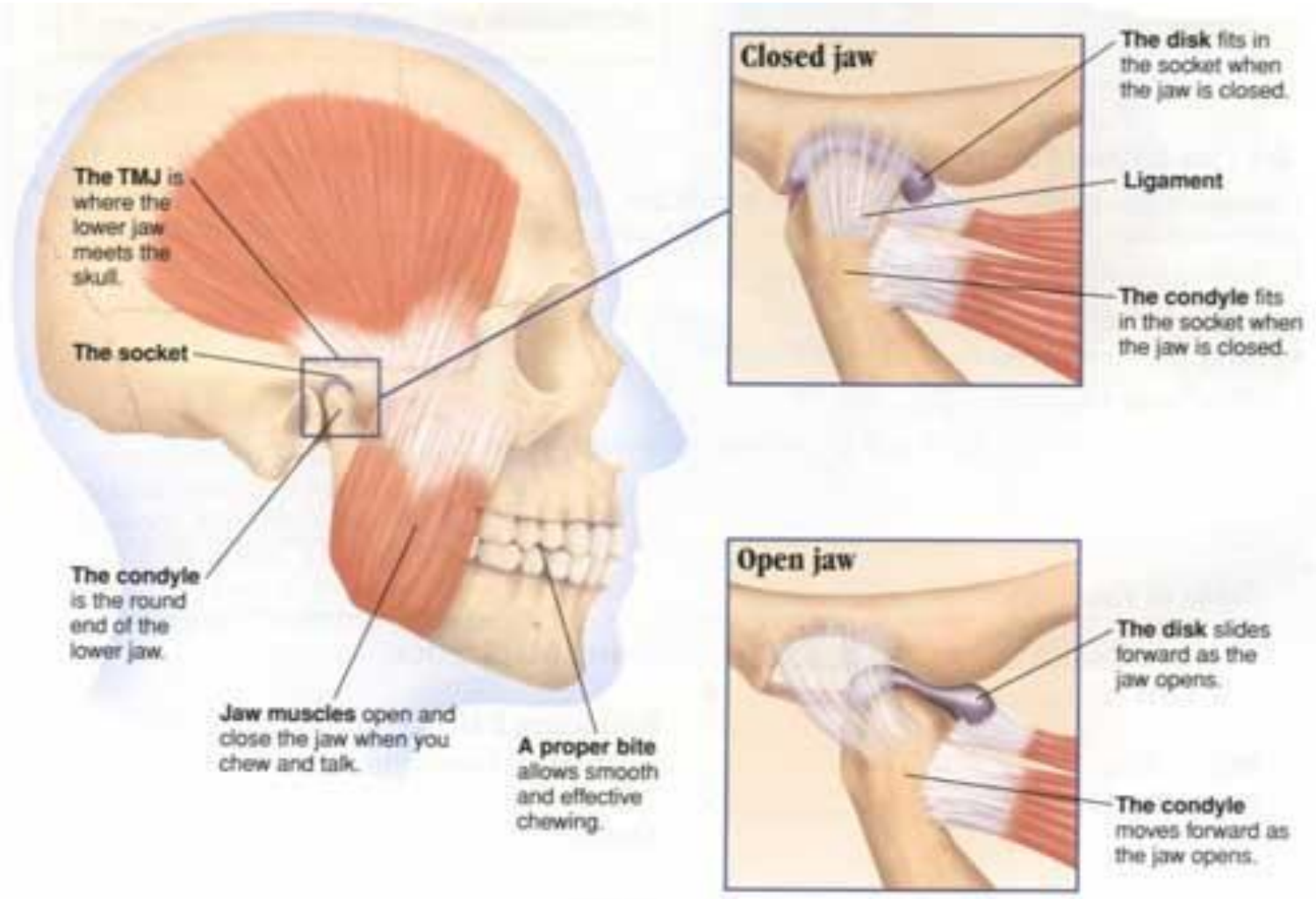


**Temporomandibular Joint Normal Closed Position**  
 The structures that make it possible to open and close your mouth include the bones, joints, and muscles. When functioning correctly, your jawbone is separated from your skull by a soft disc that acts as a cushion when you chew, speak or swallow.

**Temporomandibular Joint Normal Open Position**  
 When the joint is functioning properly, the disc stays in place when the jaw is in use, preventing the bony structures from coming in contact.

**Temporomandibular Joint Dysfunctional Open Position**  
 When the joint is not functioning properly, the disc is commonly pulled forward when the jaw is in use, causing the bones of the skull and jaw to grind together.

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# TMJ

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- There are three basic types of joints in the human body, and the TMJ incorporates characteristics of all three.
  1. **The hinge joint**, like a knee or elbow, the joint moves like a door opening and closing.
  2. **The ball and socket joint**, like the hip or shoulder, a wide range of motion is achieved by circular motion around a central point.
  3. **The glide joint**, like the wrist wherein motion is achieved when bones essentially glide together and apart.

The TMJ acts like a ball and socket joint when you chew your food, and it acts like a gliding joint when you jut your jaw forward.

To add to the complexity of the TMJ, it is the only joint in the body wherein its motion directly affects the other joint on the other side of the head.

# More about the TMJ

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- TMJ is the abbreviation used to represent the jaw joint. It stands for temporomandibular joint. TMJ is an anatomical term but is often used to refer to any problem with this joint or the associated jaw muscles. Dentists will generally use the term *temporomandibular disorders* (TMD) to refer to abnormalities that affect the TMJ or the associated jaw muscles.
- The upper part of the mandibular joint is a hollow (*mandibular fossa*) formed by the temporal bone of the skull. The lower part is formed by the **mandibular condyle** (end of the lower jaw), hence the term temporomandibular joint. The right and left lower joint bones are joined together by the body of the mandible, and are able to rotate and also move in and out of the upper part of the fossa. This makes the mechanics of jaw movement complex. When one joint is not working well the other is often affected.
- There are 3 paired and powerful muscles that close the jaw and bring the teeth together for the biting and grinding of food: the **masseter**, **temporalis**, and **medial pterygoid muscles**. The paired lateral *pterygoids* protrude the lower jaw and produces jaw opening.

- **Mandibular fossa** - the hollow formed from the temporal bone of the skull where the mandibular condyle (lower joint bone) sits when the mouth is closed.
- **Mandibular condyle** - the lower joint bone that is rounded and moves in and out of the fossa during mouth opening and closing. The right and left condyles are joined together by the mandible (lower jaw).
- **Articular disc** - a firm pad of tissue occupying the space between the upper and lower joint bones. The disc helps to maintain smooth movement and position between the 2 joint bones. Changes in disc position are often the cause of noises occurring in the joint during mouth movements. The disc itself does not have sensation but the surrounding ligaments such as the posterior attachment are sensitive and may become painful due to a disc disorder. The posterior attachment connects the disc to the mandibular fossa.



- **Temporalis muscle** - one of the large jaw-closing muscles that when strained can cause headache in and around the temples.
- **Masseter muscle** - one of the powerful jaw-closing muscles that is attached on the outside of the lower jaw.
- **Mandible (lower jaw)** - ends on both sides of the face to form the mandibular condyle, the lower joint bones.
- **Lateral pterygoid muscle** - when this muscle contracts the condyle is pulled forward and down producing mouth opening.
- A firm pad of tissue (the *articular disc*) occupies the space between the upper and lower joint bones. Ligaments attach the disc to the lower bone and the upper fossa. Changes in disc position are common and can cause jaw clicking and locking. A ligament attached to the upper and lower joint bones surrounds the joint parts. Ligaments help to provide stability to the disc and condyle during movements.