Al- Muthan`na University

College of Dentistry

Dept. of Basic Medical Science

1st. Stage - Semester: 1

Anatomy for Dentistry

Lec. : 1

Date: Tues. 29th. Nov. 2022

Introduction

Anatomy

The word anatomy comes from the Greek ana- meaning "up", and tome- meaning "a cutting". It is the study of structures or body parts and their relationships to on another. Anatomy id divided in to
Gross anatomy - macroscopic.
Histology - microscopic.

Clinical anatomy

Is the study of the macroscopic structure and function of the body as it relates to the practice of medicine and other health sciences. Anatomy: describes the structures of the body:

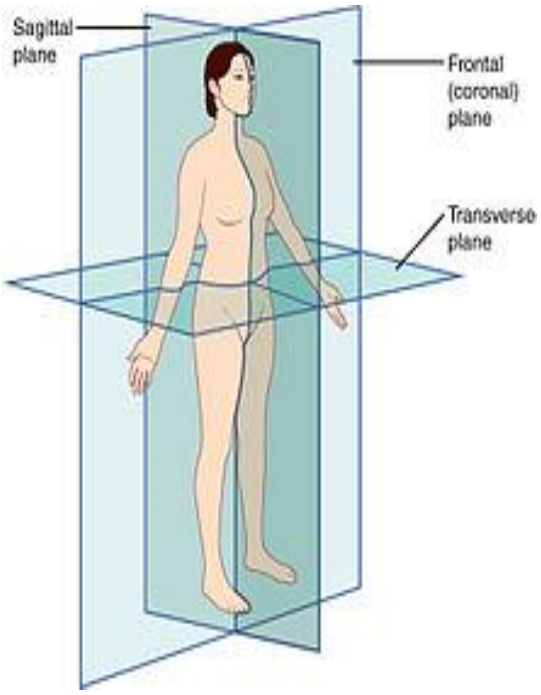
- what they are made of
- where they are located
- associated structures

Anatomical position

In this position the body is straight in standing position with eyes also looking straight. The palms are hanging by the sides close to the body and are facing forwards. The feet also point forwards and the legs are fully extended. Anatomical position is very important because the relations of all structures are described as presumed to be in anatomical position.

Planes

Three planes are commonly referred to in anatomy and medicine, they are:



- **The *sagittal plane*** is the plane that divides the body or an organ vertically into right and left imaginary equal halves. If this vertical plane runs directly down the middle of the body, it is called the *midsagittal* or *median plane*. If it divides the body into unequal right and left sides, it is called a *parasagittal plane*, or less commonly a longitudinal section.

  A structure situated nearer to the median plane of the body than another is said to be medial to the other. Similarly, a structure that lies farther away from the median plane than another is said to be lateral to the other.

- **The *coronal plane*** is the plane that divides the body or an organ into an anterior (front) portion and a posterior (rear) portion. The frontal plane is often referred to as a *frontal plane*, following Latin corona, which means "crown".

- ***The transverse plane*** is the plane that divides the body or organ horizontally into upper and lower portions. Transverse planes produce images referred to as cross sections, some times anatomists used a fourth plan called the oblique plane.

- ***The oblique plane*** is any plane other than the above described planes will be oblique plane.

Terms

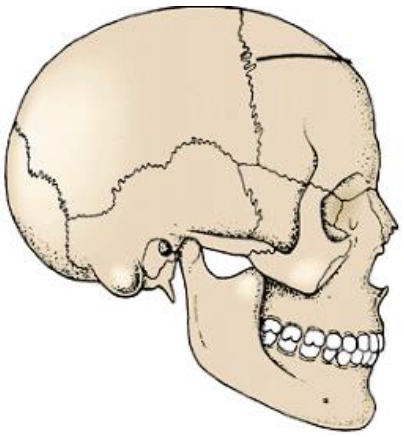
- ***Anterior* and *posterior,*** which describe structures at the front (anterior) and back (posterior) of the body. For example, the toes are anterior to the heel, and the popliteus is posterior to the patella.
  In describing the hand, the terms palmar and dorsal surfaces are used in place of anterior and posterior, and in describing the foot, the terms plantar and dorsal surfaces are used instead of lower and upper surfaces.

- ***Superior* and *inferior,*** which describe a position above (superior) or below (inferior) another part of the body. For example, the orbits are superior to the oris, and the pelvis is inferior to the abdomen.
- ***Proximal* and *distal,*** which describe a position that is closer (proximal) or further (distal) from the trunk of the body. For example, the shoulder is proximal to the arm, and the foot is distal to the knee.
- ***Superficial* and *deep,*** which describe structures that are closer to (superficial) or further from (deep) the surface of the body. For example, the skin is superficial to the bones, and the brain is deep to the skull. Sometimes *profound* is used synonymously with *deep*.
- ***Medial* and *lateral,*** which describe a position that is closer to (medial) or further from (lateral) the midline of the body. For example, the nose is medial to the eyes, and the thumb is lateral to the other fingers.
- ***Ventral* and *Dorsal,*** which describe structures derived from the front (ventral) and back (dorsal) of the embryo, before limb rotation.
- ***Cranial* and *caudal,*** which describe structures close to the top of the skull (cranial), and towards the bottom of the body (caudal).
- ***Sinister*** for left, and ***dexter*** for right are used.
- ***Paired,*** referring to a structure that is present on both sides of the body. For example, the hands are paired structures.
- ***Internal and external*** are used to describe the relative distance of a structure from the center of an organ or cavity; for example, the internal carotid artery is found inside the cranial cavity and the external carotid artery is found outside the cranial cavity.
- ***Ipsilateral*** refers to the same side of the body; for example, the left hand and left foot are ipsilateral.
- ***Contralateral*** refers to opposite sides of the body; for example, the left biceps brachii muscle and the right rectus femoris muscle are contralateral.
- ***Supine*** position of the body is lying on the back.
- ***Prone*** position is lying face downward.

Movements

Joint

Is the site where two or more bones come together. Some joints have no movement (sutures of the skull), some have only slight movement (superior tibiofibular joint), and some are freely movable (shoulder joint).



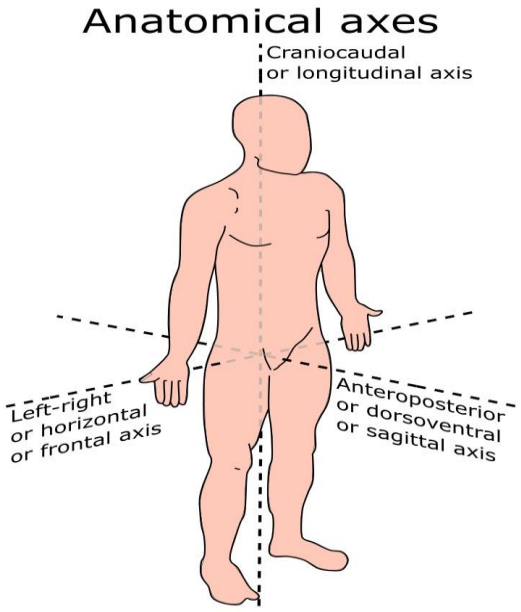
Axes

Axes are used to describe the direction of the movements at the joints.

- ***Sagittal " Antero – posterior "axes:*** extends from front to back "horizontally" from and is formed by the intersection of the sagittal and transver se planes, it rotates the body from side to side.
- ***Frontal "Horizontal" axes:*** passes horizontally from left to right and is formed by the intersection of the frontal and transverse planes, it rotates the body up to bottom.
- ***Vertical "Longitudina"l axes:*** passes vertically from inferior to superior and is formed by the intersection of the sagittal and frontal planes extends from, it rotates the body around.

Flexion is a movement that takes place in a sagittal plane. For example, flexion of the elbow joint, it is usually an anterior movement, but it is occasionally posterior, as in the case of the knee joint.

Extension means straightening the joint and usually takes place in a posterior direction.



Lateral flexion is a movement of the trunk in the coronal plane.

Abduction is a movement of a limb away from the midline of the body in the coronal plane.

Adduction is a movement of a limb toward the body in the coronal plane. In the fingers and toes, abduction is applied to the spreading of these structures and adduction is applied to the drawing together of these structures.

Rotation is the term applied to the movement of a part of the body around it`s long axis.

Medial rotation is the movement that results in the anterior surface of the part facing medially.

Lateral rotation is the movement that results in the anterior surface of the part facing laterally.

Pronation of the forearm is a medial rotation of the forearm in such a manner that the palm of the hand faces posteriorly.

Supination of the forearm is a lateral rotation of the forearm from the pronated position so that the palm of the hand comes to face anteriorly.

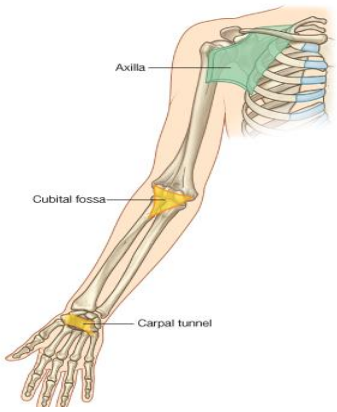
Circumduction is the combination in sequence of the movements of flexion, extension, abduction, and adduction.

Protraction is to move forward,

Retraction is to move backward, they both *(Protraction & retraction)* used to describe the forward and backward movement of the jaw at the temporomandibular joints).

Inversion is the movement of the foot so that the sole faces in a medial direction,

Eversion is the opposite movement of the foot so that the sole faces in a lateral direction.



Opposition brings the thumb and little finger together.

Reposition is a movement that moves the thumb and the little finger away from each other, effectively

Elevation means moving a part superiorly (closer to the top of the head), like shrugging the shoulders.

Depression **is** the moving a part inferiorly (closer to the feet), like moving those raised shoulders back down again, is depression.

Dorsiflexion and plantarflexion are terms used to describe movements at the ankle. They refer to the two surfaces of the foot; the dorsum (superior surface) and the plantar surface (the sole).

Dorsiflexion refers to flexion at the ankle, so that the foot points more superiorly. It is to elevating the foot, or moving it until the toes point upward.

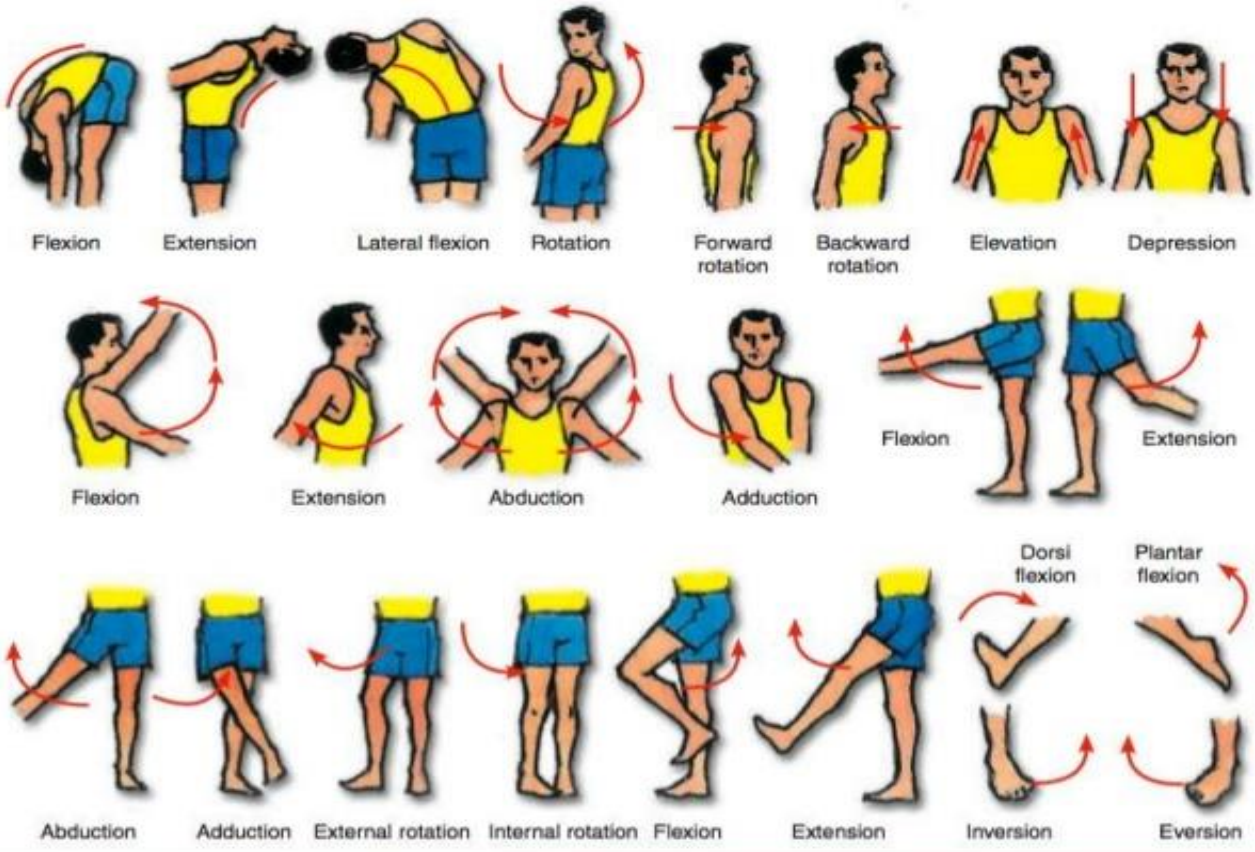
Plantarflexion refers extension at the ankle, so that the foot points inferiorly, where the foot tilt until the toes point down.

Body cavities

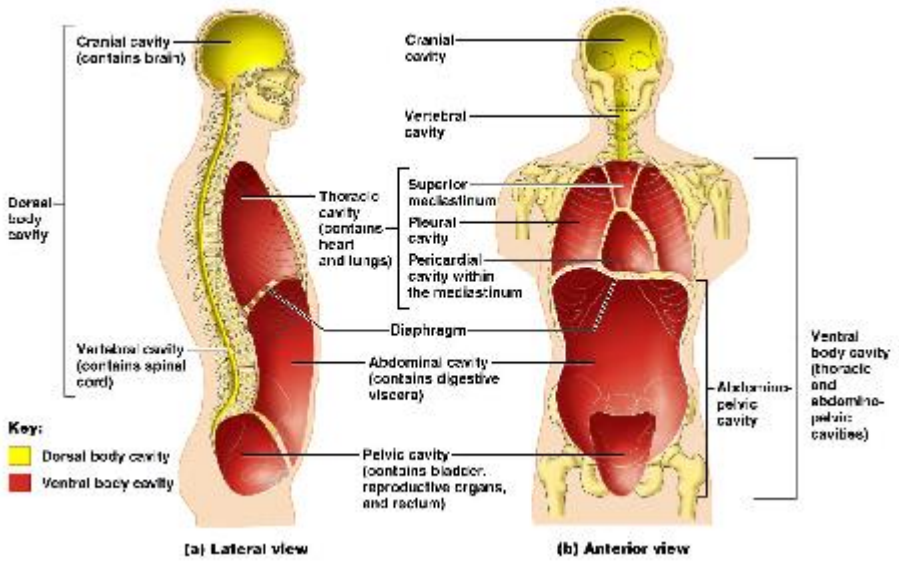
Are hollow spaces within the human body that contain internal organs.

- **The dorsal cavity:** located toward the back of the body, is divided into the cranial cavity (which holds the brain) and vertebral or spinal cavity (which holds the spinal cord).

- **The ventral cavity:** located toward the front of the body, is divided into abdominopelvic cavity and thoracic cavity by the diaphragm. The abdominopelvic cavity is subdivided into abdominal cavity



(which holds liver, gallbladder, stomach, pancreas, spleen, kidney, small, and large intestines) and the pelvic cavity (which holds the urinary bladder and reproductive organs). The thoracic cavity is subdivided into the pleural cavity (which holds the lungs) and pericardial cavity (which holds the heart).



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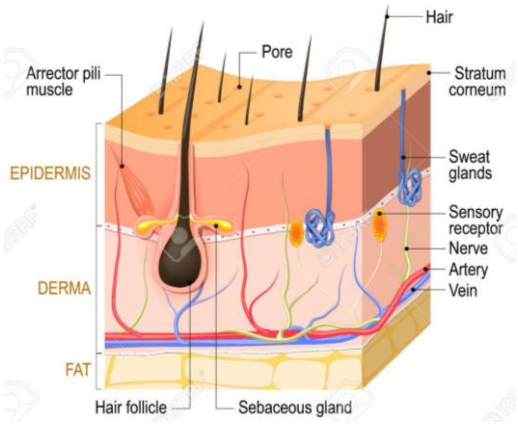
Basic structures

Skin

The skin is divided into two parts; the superficial part, the epidermis, and the deep part, the dermis , the epidermis is a stratified epithelium whose cells become flattened as they mature and rise to the surface. On the palms of the hands and the soles of the feet, the epidermis is extremely thick, to withstand the wear and tear that occurs in these regions, in other areas of the body, for example, on the anterior surface of the arm and forearm, it is thin.



The dermis is composed of dense connective tissue containing many blood vessels, lymphatic vessels, and nerves, it shows considerable variation in thickness in different parts of the body, tending to be thinner on the anterior than on the posterior surface, it is thinner in women than in men, the dermis of the skin is connected to the underlying deep fascia or bones by the superficial fascia, otherwise known as subcutaneous tissue.

The appendages of the skin are the nails, hair follicles, sebaceous glands, and sweat glands.

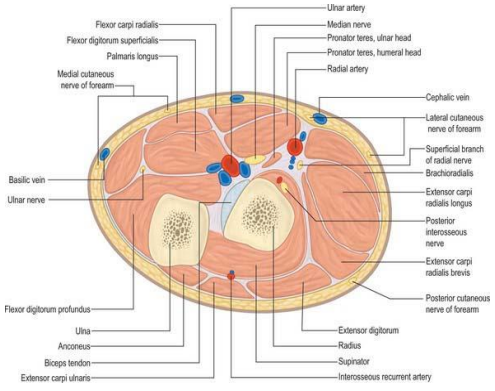
Fasciae

The fasciae of the body can be divided into two types; superficial and deep , it lies between the skin and the underlying muscles and bones.

Superficial fascia, or subcutaneous tissue, is a mixture of loose areolar and adipose tissue that unites the dermis of the skin to the underlying deep fascia .

In the scalp, the back of the neck, the palms of the hands, and the soles of the feet, it contains numerous bundles of collagen fibers that hold the skin firmly to the deeper structures, in the eyelids, auricle of the ear, penis and scrotum, and clitoris, it is devoid of adipose tissue.

Deep fascia is a membranous layer of connective tissue that invests the muscles and other deep structures. In the neck, it forms a well-defined layer that may play an important role in determining the path taken by pathogenic organisms during the spread of infection.



In the thorax and abdomen, it is merely a thin film of areolar tissue covering the muscles and aponeuroses. In the limbs, it forms a definite sheath around the muscles and other structures, holding them in place, fibrous septa extend from the deep surface of the membrane, between the groups of muscles, and in many places divide the interior of the limbs into compartments, in the region of joints, the deep fascia may be considerably thickened to form restraining bands called retinacula, their function is to hold underlying tendons in position or to serve as pulleys around which the tendons may move.

Muscles

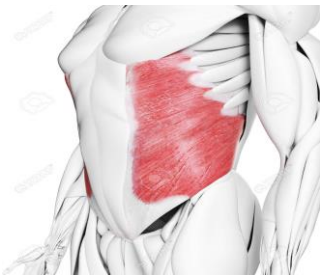
The three types of muscles are; skeletal, smooth, and cardiac.

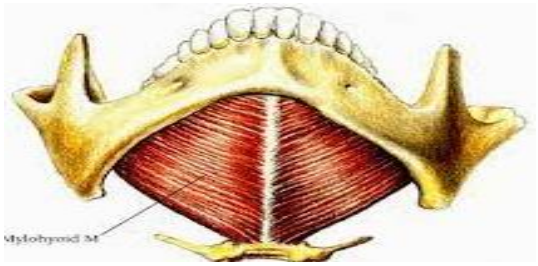
Skeletal muscles

Skeletal muscles produce the movements of the skeleton; they are sometimes called voluntary muscles and are made up of striped muscle fibers, a skeletal muscle has two or more attachments, the one that moves the least is referred to as the origin, and the one that moves the most, the insertion.

The fleshy part of the muscle is referred to as it`s belly, the ends of a muscle are attached to bones, cartilage, or ligaments by cords of fibrous tissue called tendons.

Occasionally, flattened muscles are attached by a thin but strong sheet of fibrous tissue called an aponeurosis , a raphe is an interdigitation of the tendinous ends of fibers of flat muscles.

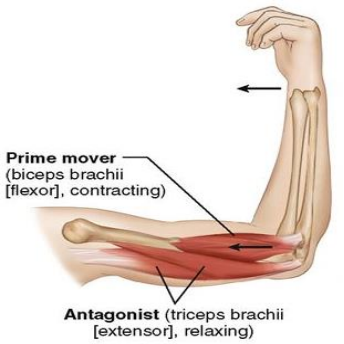




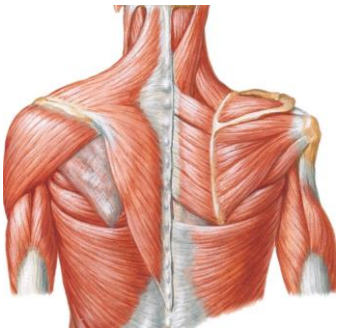
Skeletal muscle action

A muscle may work in the following four ways:

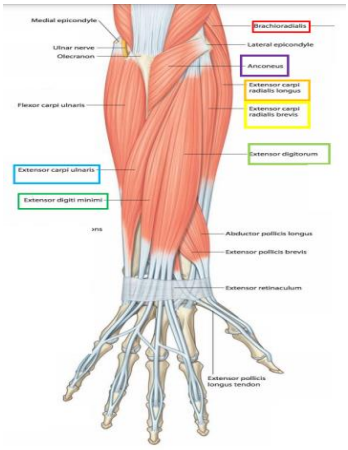
- *Prime mover:* a muscle is a prime mover when it is the chief one or a member of a chief group of muscles responsible for a particular movement, for example, the biceps brachii is a prime mover in the movement of flexion of the elbow joint .



- *antagonist:* any muscle that opposes the action of the prime mover is an antagonist, for example, the triceps opposes the action of the quadriceps femoris when the knee joint is extended , before a prime mover can contract, the antagonist muscle must be equally relaxed; this is brought about by nervous reflex inhibition.



- *fixator:* a fixator contracts isometrically (i.e. contraction inc reases the tone but does not in itself produce movement) to stabilize the origin of the prime mover so that it can act efficiently, for example, the muscles attaching the shoulder girdle to the trunk contract as fixators to allow the deltoid to act on the shoulder joint.

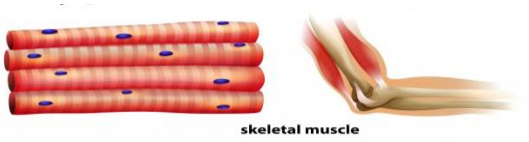


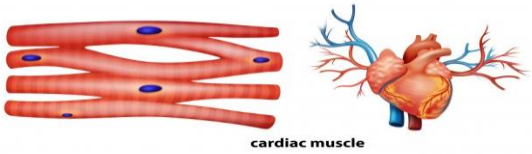
- *synergist:* in many locations in the body the prime mover muscle crosses several joints before it reaches the joint at which it`s main action takes place. To prevent unwanted movements in an intermediate joint, groups of muscles called synergists contract and stabilize the intermediate joints. for example, the flexors and extensors.

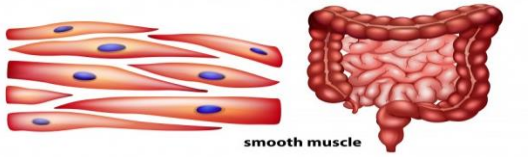
Smooth muscles

Smooth muscle consists of long, spindle-shaped cells closely arranged in bundles or sheets, in the tubes of the body it provides the motive power for propelling the contents through the lumen, in the digestive system it also causes the ingested food to be thoroughly mixed with the digestive juices.

A wave of contraction of the circularly arranged fibers passes along the tube, milking the contents onward, by their contraction, the longitudinal fibers pull the wall of the tube proximally over the contents, this method of propulsion is referred to as peristalsis.







In storage organs such as the urinary bladder and the uterus, the fibers are irregularly arranged and interlaced with one another, their contraction is slow and sustained and brings about expulsion of the

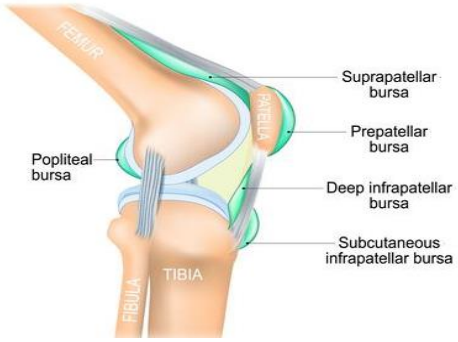
contents of the organs. In the walls of the blood vessels the smooth muscle fibers are arranged circularly and serve to modify the caliber of the lumen.

Cardiac muscles

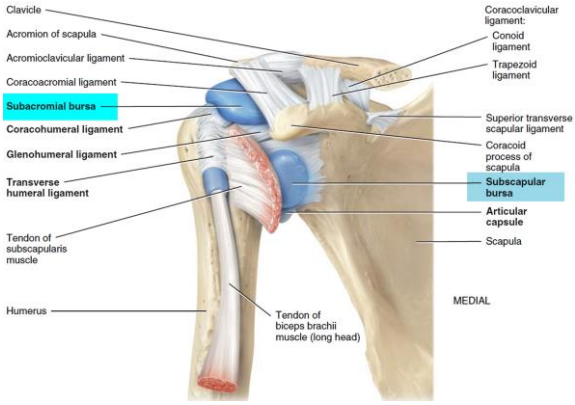
Cardiac muscles consist of striated muscle fibers that branch and unite with each other, it forms the myocardium of the heart, it`s fibers tend to be arranged in whorls and spirals, and they have the property of spontaneous and rhythmic contraction, specialized cardiac muscle fibers form the conducting system of the heart. Cardiac muscle is supplied by autonomic nerve fibers that terminate in the nodes of the conducting system and in the myocardium.

Bursae

It`s a lubricating device consisting of a closed fibrous sac lined with a delicate smooth membrane, it`s walls are separated by a film of viscous fluid, they are found wherever tendons rub against bones, ligaments, or other tendons, they are commonly found close to joints where the skin rubs against underlying bony structures, for example, the prepatellar bursa.



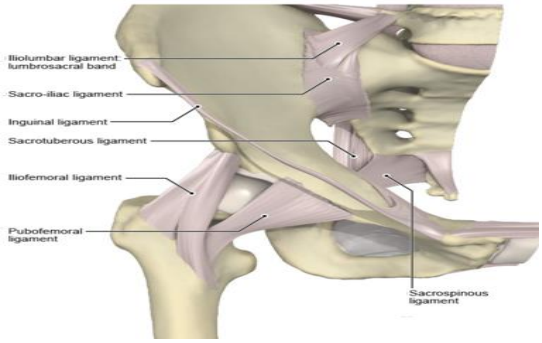
Occasionally, the cavity of a bursa communicates with the cavity of a synovial joint, for example, the suprapatellar bursa communicates with the knee joint and the subscapularis bursa communicates with the shoulder joint.

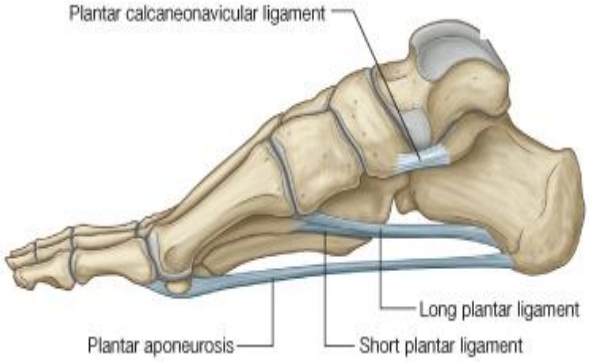


Ligaments

Is a cord or band of connective tissue uniting two structures, commonly found in association with joints, ligaments are of two types, most are composed of dense bundles of collagen fibers and are unstretchable under normal conditions (e.g., the iliofemoral ligament of the hip joint and the collateral ligaments of the elbow joint).

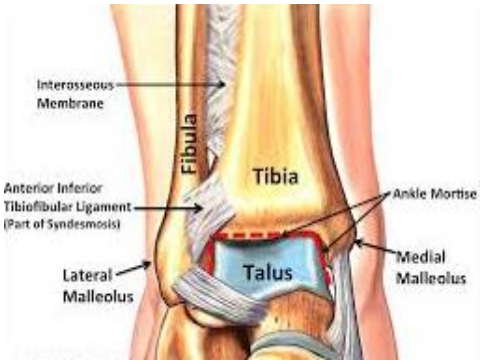
The second type is composed largely of elastic tissue and can therefore regain it`s original length after stretching (e.g., the ligamentum flavum of the vertebral column and the calcaneonavicular ligament of the foot).





Joints

A site where two or more bones come together, whether or not movement occurs between them, is called a joint. Joints are classified according to the tissues that lie between the bones: fibrous joints, cartilaginous joints, and synovial joints.

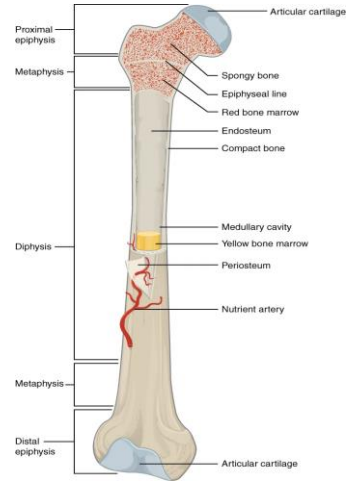


Fibrous joints

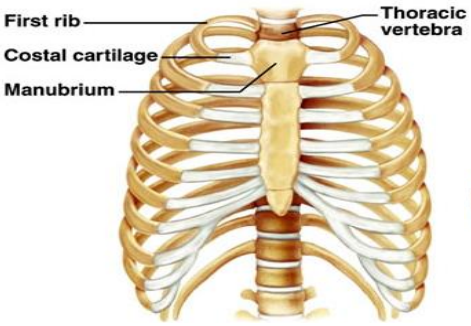
The articulating surfaces of the bones are joined by fibrous tissue, and thus very little movement is possible, the sutures of the vault of the skull and the inferior tibiofibular joints are examples of fibrous joints.

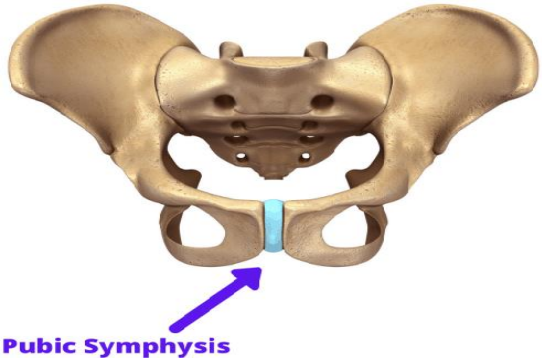
Cartilaginous joints

They can be divided into two types: primary and secondary; a primary cartilaginous joint is one in which the bones are united by a plate or bar of hyaline cartilage, so, the union between the epiphysis and the diaphysis of a growing bone and that between the first rib and the manubrium sterni are examples of such a joint. *No movement is possible.*



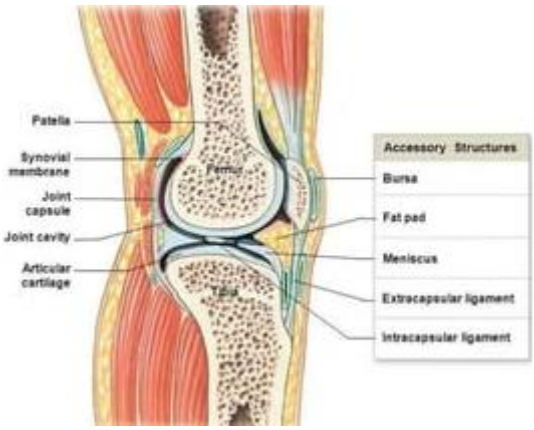
A secondary cartilaginous joint is one in which the bones are united by a plate of fibrocartilage and the articular surfaces of the bones are covered by a thin layer of hyaline cartilage, examples are the joints between the vertebral bodies and the symphysis pubis. *A small amount of movement is possible.*





Synovial joints

The articular surfaces of the bones are covered by a thin layer of hyaline cartilage separated by a joint cavity, *this arrangement permits a great degree of freedom of movement*.



- the cavity of the joint is lined by synovial membrane, which extends from the margins of one articular surface to those of the other.
- the synovial membrane is protected on the outside by a tough fibrous membrane referred to as the capsule of the joint.
- the articular surfaces are lubricated by a viscous fluid called synovial fluid, which is produced by the synovial membrane.
- in certain synovial joints, for example, in the knee joint, discs or wedges of fibrocartilage are interposed between the articular surfaces of the bones, these are referred to as articular discs.
- fatty pads are found in some synovial joints lying between the synovial membrane and the fibrous capsule or bone, examples are found in the hip and knee joints.

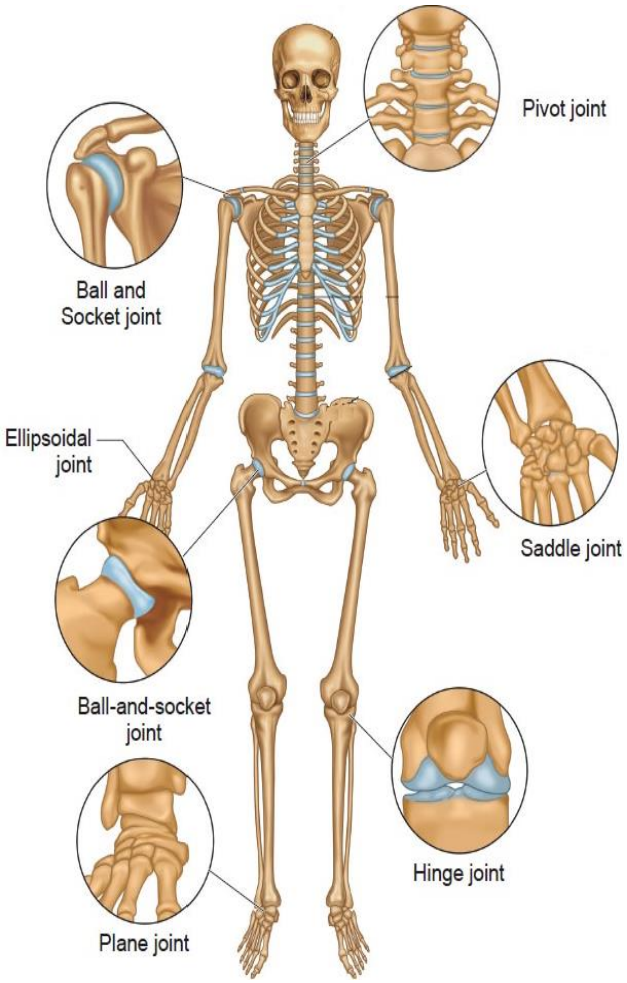
The degree of movement in a synovial joint is limited by the shape of the bones participating in the joint, the coming together of adjacent anatomic structures (e.g., the thigh against the anterior abdominal wall on flexing the hip joint), and the presence of fibrous ligaments uniting the bones.

Most ligaments lie outside the joint capsule, but in the knee some important ligaments, the cruciate ligaments, lie within the capsule

Synovial joints can be classified according to the arrangement of the articular surfaces and the types of movement that are possible.

- *plane joints:* the apposed articular surfaces are flat or almost flat, and this permits the bones to slide on one another, examples of these joints are the sternoclavicular and acromioclavicular joints.
- *hinge joints:* they resemble the hinge on a door, so that flexion and extension movements are possible, examples of these joints are the elbow, knee, and ankle joints.
- *pivot joints:* a central bony pivot is surrounded by a bony ligamentous ring and rotation is the only movement possible, atlantoaxial and superior radioulnar joints are good examples.
- *condyloid joints:* have two distinct convex surfaces that articulate with two concave surfaces, the movements of flexion, extension, abduction, and adduction are possible together with a small amount of rotation, the metacarpophalangeal joints or knuckle joints are good examples.

- *ellipsoid joints:* an elliptical convex articular surface fits into an elliptical concave articular surface. the movements of flexion, extension, abduction, and adduction can take place, but rotation is impossible, the wrist joint is a good example.
- *saddle joints:* the articular surfaces are reciprocally concavoconvex and resemble a saddle on a horse's back, They permit flexion, extension, abduction, adduction, and rotation,the best example of this type of joint is the carpometacarpal joint of the thumb.
- *ball-and-socket joints:* a ball-shaped head of one bone fits into a socketlike concavity of another, this arrangement permits free movements, including flexion, extension, abduction, adduction, medial rotation, lateral rotation, and circumduction, the shoulder and hip joints are good examples of this type of joint



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Dept. of Basic Medical Science
1st. Stage - Semester: 1

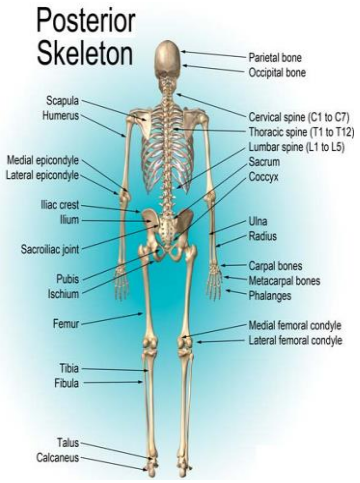
Anatomy for Dentistry
Lec. : 3
Date: Tuesday. 13th. Dec. 2022

Basic structures

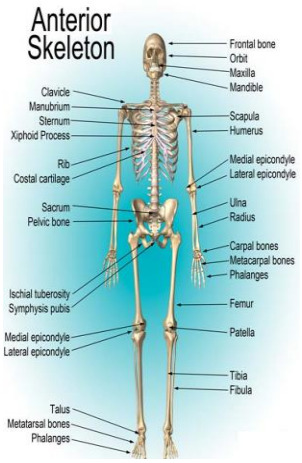
Skeletal system

The skeletal system includes all of the bones and joints in the body, each bone is a complex living organ that is made up of many cells, protein fibers, and minerals.

The skeletal system in an adult body is made up of 206 individual bones, arranged into two major divisions: the *axial skeleton* and the *appendicular skeleton*. The axial skeleton runs along the body's midline axis and is made up of 80 bones in the following regions:



- skull
- hyoid
- auditory ossicles
- ribs
- sternum
- vertebral column.



The appendicular skeleton is made up of 126 bones in the following regions:

- upper limbs
- lower limbs
- pelvic girdle
- pectoral (shoulder) girdle.

Skull

The skull is composed of 22 bones fused together except for the mandible, the 21 fused bones are separate in children to allow the skull and brain to grow, but fuse later to give added strength and protection as an adult, the mandible remains as a movable jaw bone and forms the only movable joint in the skull with the temporal bone.

Hyoid

The hyoid is a small, U-shaped bone found just inferior to the mandible, it`s the only bone in the body that does not form a joint with any other bone, it is a floating bone, the hyoid's function is to help hold the trachea open and to form a bony connection for the tongue muscles.

Auditory ossicles

The malleus, incus, and stapes known collectively as the auditory ossicles are the smallest bones in the body, found in a small cavity inside of the temporal bone, they serve to transmit and amplify sound from the eardrum to the inner ear.

Vertebrae

Twenty-six vertebrae form the vertebral column of the human body, they are named by region:

- Cervical (neck) ; 7 vertebrae
- Thoracic (chest) ; 12 vertebrae
- Lumbar (lower back) ; 5 vertebrae
- Sacrum ; 1 vertebra
- Coccyx (tailbone) ; 1 vertebra

With the exception of the singular sacrum and coccyx, each vertebra is named for the first letter of it`s region and it`s position along the superior-inferior axis, for example, the most superior thoracic vertebra is called T1 and the most inferior is called T12.

Sternum

The sternum, or breastbone, is a thin, knife-shaped bone located along the midline of the anterior

side of the thoracic region of the skeleton, it connects to the ribs by thin bands of cartilage called the costal cartilage.

Ribs

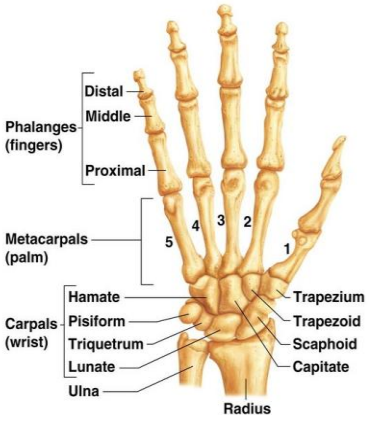
There are 12 pairs of ribs that together with the sternum form the ribcage of the thoracic region, the first seven ribs are known as "true ribs" because they connect the thoracic vertebrae directly to the sternum through their own band of costal cartilage.

Ribs 8, 9, and 10 all connect to the sternum through cartilage that is connected to the cartilage of the seventh rib, so we consider them as "false ribs," ribs 11 and 12 are also false ribs, but considered as "floating ribs" because they do not have any cartilage attachment to the sternum at all.

Pectoral girdle

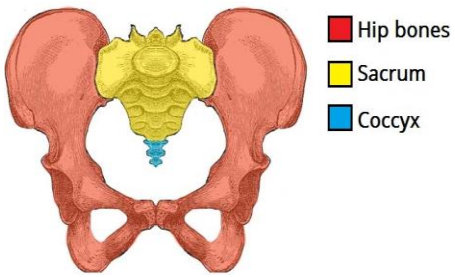
The pectoral girdle connects the upper limb bones to the axial skeleton and consists of the left and right clavicles and left and right scapulae.

The upper limb



The humerus which is the bone of the upper arm forms a joint of the shoulder with the scapula and forms the elbow joint with the lower arm bones, the radius and ulna are the two bones of the forearm, the ulna is on the medial side of the forearm and forms a joint with the humerus at the elbow, the radius allows the forearm and hand to turn over at the wrist joint.

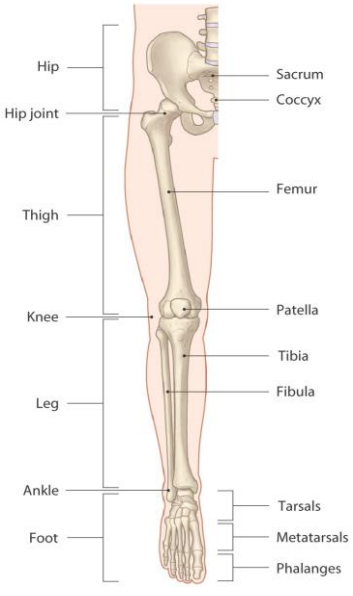
The lower arm bones form the wrist joint with the carpals, a group of eight small bones that give added flexibility to the wrist, the carpals are connected to the five metacarpals that form the bones of the hand and connect to each of the fingers, each finger has three bones known as phalanges, except for the thumb, which only has two phalanges.



Pelvic girdle

Formed by the left and right hip bones, it connects the lower limb bones to the axial skeleton.

Lower Limb



The femur is the largest bone in the body and the only bone of the thigh (femoral) region, it forms the ball and socket hip joint with the hip bone and forms the knee joint with the tibia and patella.

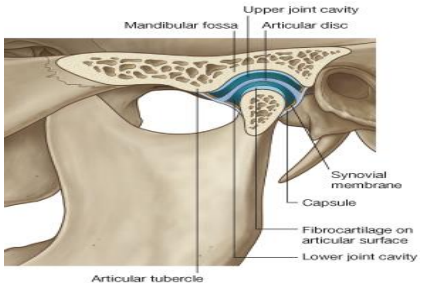
The tibia and fibula are the bones of the leg, the tibia is much larger than the fibula and bears almost all of the body's weight, the fibula is mainly a muscle attachment point and is used to help maintain balance, the tibia and fibula form the ankle joint with the talus, one of the seven tarsal bones in the foot.

The tarsals are a group of seven small bones that form the posterior end of the foot and heel, they form joints with the five long metatarsals of the foot, the metatarsals in turn form joints with one of the sets of phalanges in the toes. Each toe has three phalanges, except for the big toe, which only has two phalanges.

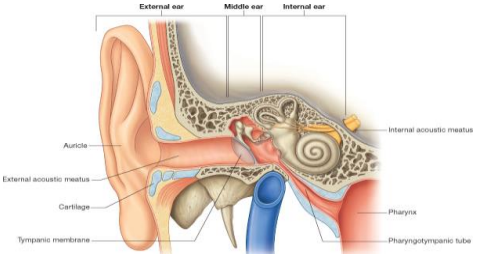
Cartilages

Cartilage is a form of connective tissue in which the cells and fibers are embedded in a gel-like matrix, the latter being responsible for its firmness and resilience, except on the exposed surfaces in joints, a fibrous membrane called the perichondrium covers the cartilage. There are three types of cartilages:

- *Hyaline cartilage* has a high proportion of amorphous matrix that has the same refractive index as the fibers embedded in it, throughout childhood and adolescence, it plays an important part in the growth in length of long bones (epiphyseal plates are composed of hyaline cartilage), it has a great resistance to wear and covers the articular surfaces of nearly all synovial joints. Hyaline cartilage is incapable of repair when fractured; the defect is filled with fibrous tissue.



- *Fibrocartilage* has many collagen fibers embedded in a small amount of matrix and is found in the discs within joints (e.g., the temporomandibular joint, sternoclavicular joint, and knee joint) and on the articular surfaces of the clavicle and mandible. Fibrocartilage, if damaged, repairs itself slowly in a manner similar to fibrous tissue elsewhere. Joint discs have a poor blood supply and therefore do not repair themselves when damaged.



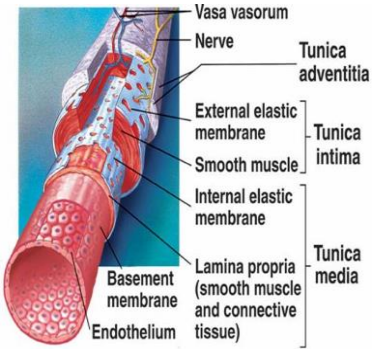
- *Elastic cartilage* possesses large numbers of elastic fibers embedded in matrix, so it is flexible and is found in the auricle of the ear, the external auditory meatus and the epiglottis. Elastic cartilage, if damaged, repairs itself with fibrous tissue.

Blood vessels

Arteries

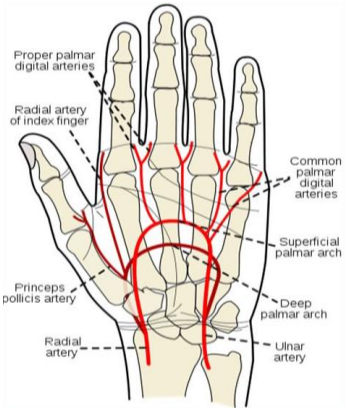
Arteries are blood vessels that carry blood away from the heart, while most arteries carry oxygenated blood, there are two exceptions to this, the pulmonary and the umbilical arteries which carry deoxygenated blood.

Each artery is a muscular tube lined by smooth tissue and has three layers:



- The intima, the inner layer lined by a smooth tissue called endothelium
- The media, a layer of muscle that lets arteries handle the high pressures from the heart.
- The adventitia, connective tissue anchoring arteries to nearby tissues.

An end artery (or terminal artery) is the only supply of oxygenated blood to a portion of tissue , examples of an end artery include the splenic artery that supplies the spleen and the renal artery that supplies the kidneys, end arteries supply the heart or brain are very important because if the arteries are occluded, the tissue is completely cut off, leading to a myocardial infarction or an ischemic stroke.



Anastomoses refer to any join between two vessels, circulatory anastomoses are named based on the vessels they join: two arteries (arterio-arterial anastomoses), two veins (veno-venous anastomoses), or between an artery and a vein (arterio-venous anastomoses), anastomoses between arteries and anastomoses between veins result in a large number of arteries and veins serving the same volume of tissue, such anastomoses occur normally in the body in the circulatory system, serving as backup routes for blood to the flow if one link is blocked or pathologically injured.

Arterio-arterial anastomoses include:

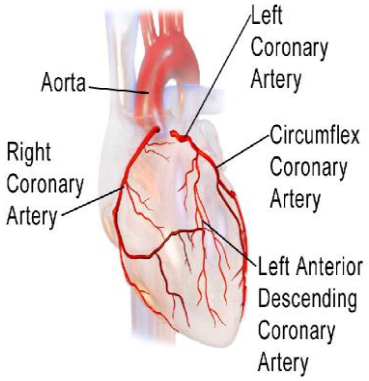
- actual joins (e.g. palmar arch, plantar arch) and
- potential ones, which may only function if the normal vessel is damaged or blocked (e.g. coronary arteries ,important examples include:

- circle of Willis in the brain.
- joint anastomoses , examples include the knee.

- coronary artery anastomoses , when two arteries or their branches join, the area of the myocardium receives dual blood supply, if one coronary artery is obstructed for any reason , the second artery is still able to supply oxygenated blood to the myocardium, this can only occur if the causative factor progresses slowly, giving the anastomoses time to form

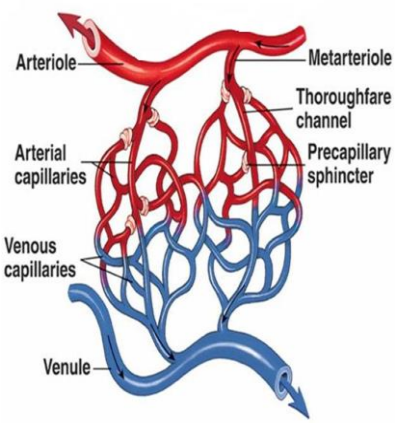
The arterial system of the human body is divided into

- systemic ; carrying blood from the heart to the whole body.
- pulmonary ; carrying deoxygenated blood from the heart to the lungs.



Systemic arteries can be subdivided into two types - muscular and elastic - according to the relative compositions of elastic and muscle tissue in their tunica media as well as their size and the makeup of the internal and external elastic lamina. The larger arteries (>10 mm diameter) are generally elastic and the smaller ones (0.1–10 mm) tend to be muscular. Systemic arteries deliver blood to the arterioles, and then to the capillaries, where nutrients and gases are exchanged.

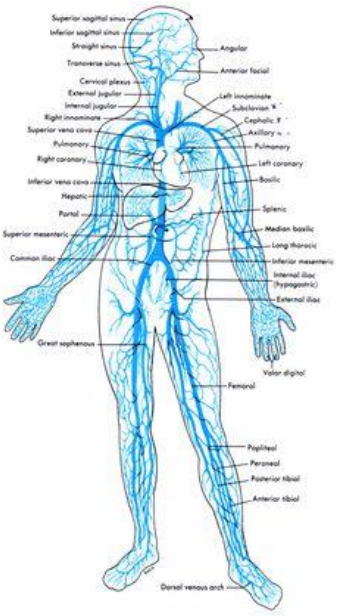
Elastic arteries , also called conducting arteries or conduit arteries; receive their own blood supply by the vasa vasorum unlike smaller blood vessels, which are supplied by diffusion , the pulmonary arteries, the aorta, and its branches together represent the body's system of elastic arteries.



The aorta is the root systemic artery, it receives blood directly from the left ventricle of the heart via the aortic valve, as the aorta branches, and these arteries branch in turn, they become successively smaller in diameter, down to the arterioles. the arterioles supply capillaries, which in turn empty into venules.

The first branches of the aorta are the coronary arteries, which supply blood to the heart muscle itself, followed by the branches of the aortic arch, namely the brachiocephalic artery, the left common carotid, and the left subclavian arteries.

Arterioles have the greatest collective influence on both local blood flow and on overall blood pressure, across which the greatest pressure drop occurs, the combination of heart output (cardiac output) and systemic vascular resistance, which refers to the collective resistance of all of the body's arterioles, are the principal determinants of arterial blood pressure at any given moment.



The capillaries are the smallest of the blood vessels and are part of the microcirculation, they have a width of a single cell in diameter to aid in the fast and easy diffusion of gases, sugars and nutrients to surrounding tissues, they have no smooth muscle surrounding them and have a diameter less than that of red blood corpuscles; a red blood corpuscles is typically 7 micrometers outside diameter, capillaries typically 5 micrometers inside diameter, so the red blood corpuscles must distort in order to pass through the capillaries. These small diameters of the capillaries provide a relatively large surface area for the exchange of gases and nutrients.

Veins

Veins are blood vessels that carry blood toward the heart, most veins carry deoxygenated blood from the tissues back to the heart; exceptions are the pulmonary and umbilical veins, both of which carry oxygenated blood to the heart.

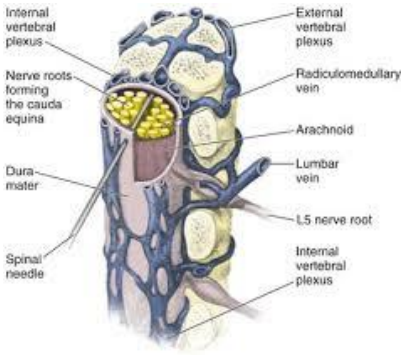
Veins are less muscular than arteries and are often closer to the skin, there are valves in most veins to prevent backflow.

The largest veins in the human body are the superior and inferior venae cavae, these are two large veins which enter the right atrium of the heart from above and below, the superior one carries blood from the arms and head, while the inferior one carries blood from the legs and abdomen to the heart.

Inferior vena cava is retroperitoneal and runs to the right and roughly parallel to the abdominal aorta

along the spine, large veins empty into these two veins, and smaller veins into these, together this forms the venous system.

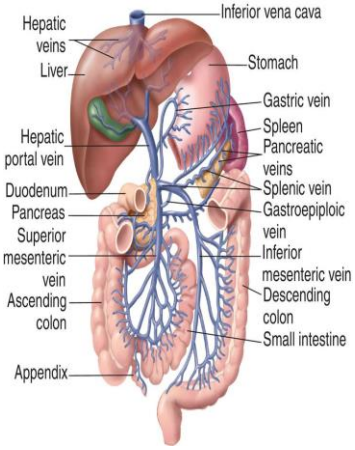
The smallest veins are called venules, the smaller veins, or tributaries, unite to form larger veins, which commonly join with one another to form venous plexuses.

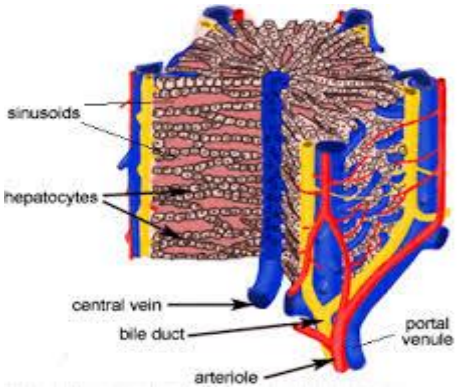


Medium-size deep arteries are often accompanied by two veins, one on each side, called venae comitantes, they are enclosed within the vascular sheath of the artery, whose pulsation help to compress and movement of the blood in the vein.

The portal venous system is a series of veins or venules that directly connect two capillary beds, examples of such systems include the hepatic portal vein , the liver has a double blood supply; the right and left hepatic arteries carry oxygenated blood to the liver, and the portal vein carries venous blood from the GI tract to the liver.

The venous blood from the GI tract drains into the superior and inferior mesenteric veins; these two vessels are then joined by the splenic vein just posterior to the neck of the pancreas to form the portal vein, which splits to form the right and left branches, each supplying about half of the liver.

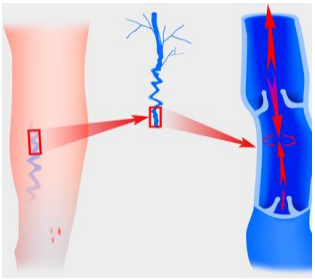




On entering the liver, the blood drains into the hepatic sinusoids, where it is screened by specialized macrophages (Kupffer cells) to remove any pathogens that manage to get past the GI defenses. The plasma is filtered through the endothelial lining of the sinusoids and bathes the hepatocytes; these cells contain vast numbers of enzymes capable of breaking down and metabolising most of what has been absorbed.

Varicose veins

Varicose veins are veins that have become enlarged and twisted, the term commonly refers to the veins on the leg, although varicose veins can occur elsewhere.



Veins have pairs of leaflet valves to prevent blood from flowing backwards (retrograde flow or venous reflux), leg muscles pump the veins to return blood to the heart (the skeletal-muscle pump), against the effects of gravity. When veins become varicose, the leaflets of the valves no longer meet properly, and the valves do not work (valvular incompetence).

This allows blood to flow backwards and they enlarge even more. Varicose veins are most common in the superficial veins of the legs, which are subject to high pressure when standing, besides being a cosmetic problem, varicose veins can be painful, especially when standing, severe long-standing varicose veins can lead to leg swelling, skin thickening and ulceration.

Life-threatening complications are uncommon, but varicose veins may be confused with deep vein thrombosis, which may be life-threatening

Al- Muthan`na University
College of Dentistry
Dept. of Basic Medical Science
1st. Stage - Semester: 1

Anatomy for Dentistry
Lec. : 4
Date: Thursday. 29th. Dec. 2022

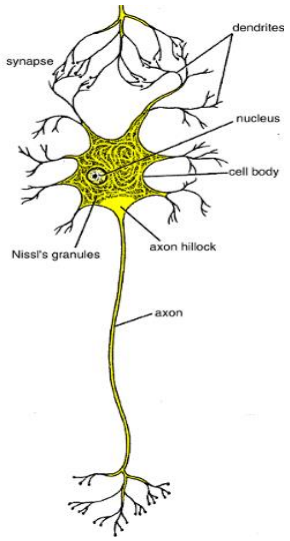
Basic structures

Nervous system

The nervous system is divided into two main parts: central and peripheral nervous system.

Central nervous system

Is the part of nervous system protected by the bones of the skull (brain) and vertebral column (spinal cord) and bathed in cerebrospinal fluid (CSF), the central nervous system is composed of large numbers of nerve cells and their processes, supported by specialized tissue called . Neuron is the term given to the nerve cell and all it`s processes, the nerve cell has two types of processes; dendrites and axons Dendrites are the short processes of the cell body carrying the impulses toward the cell body, while the axon is the longest single process which carries impulses away from the cell body.



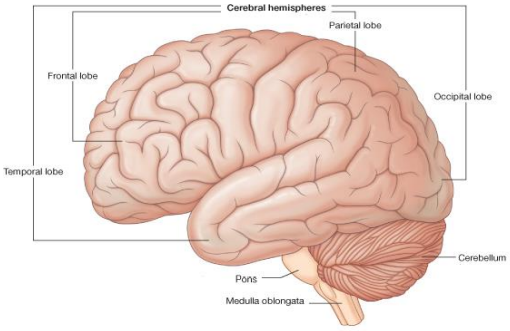
Nucleus; is the collection of cell bodies which perform the same functions.

Ganglion; is a collection of neuron cell bodies outside the central nervous system.

Synapse (relay); is the meeting of axon of a neuron with the dendrites of other neuron where the impulses pass through.

Brain

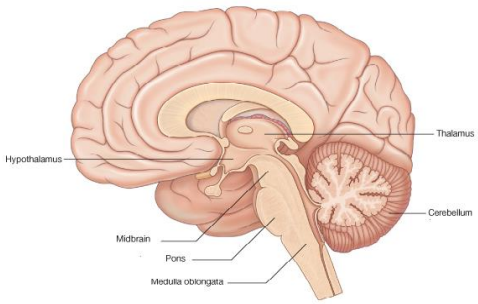
The brain can be divided into the following parts:



- the cerebrum, which divides in to two large hemispheres.
- the thalamus, hypothalamus which are together called diencephalon and other related structures, which are hidden from view in the adult brain by the cerebral hemispheres. Both the cerebrum and the diencephalon together are called the forebrain.
- the midbrain which connect the fore and hind brains.
- the hindbrain which consists of the pons, medulla oblongata and cerebellum, which gives rise to two lateral hemispheres.

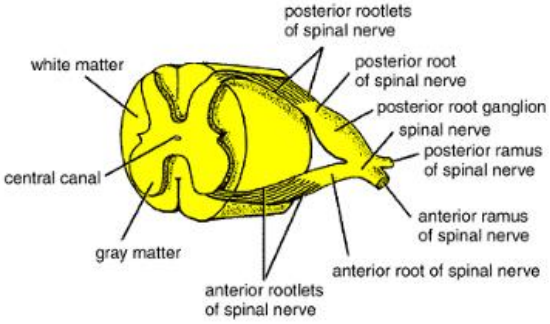
In cross section; the brain is organized into;

- Grey matter; the outer dark (grayish matter) which consists of nerve cells embedded in neuralgia, it is called cerebral cortex in the cerebrum.
- White matter; the inner light area which consists of nerve fibers (axons) embedded in neuralgia, the nerve fibers pass in the central nervous system as bundles, tracts or fascicule. The right and left hemispheres of the central nervous system are connected together by nerve fibers called commissures. The central nervous system if injured can`t regenerate.

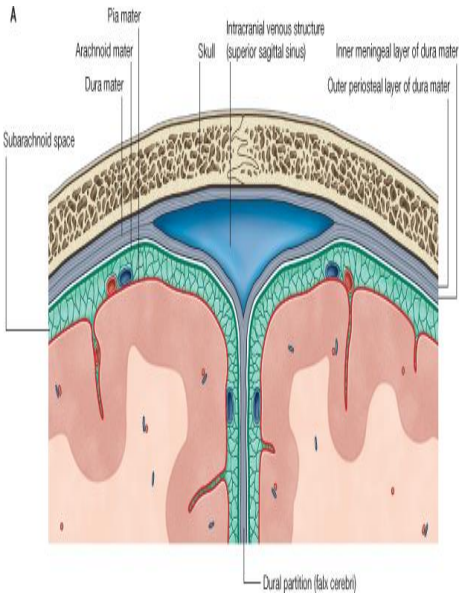


Spinal cord

The spinal cord lies within a bony canal formed by adjacent vertebrae and soft tissue elements (the vertebral canal), it has a cavity in the center called the central canal, it is formed of;

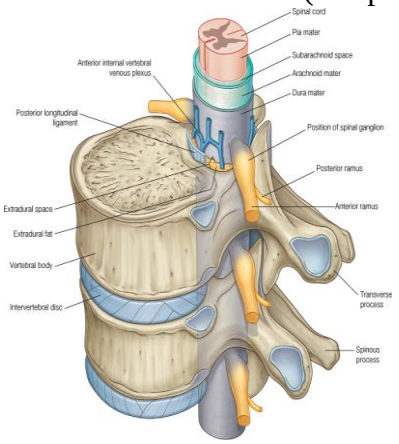


- Grey matter; the internal part which projects as two dorsal horns contain sensory neurons, two ventral horns which contain motor horns and two lateral horns in segments which give autonomic outflow.
- White matter; surround the grey matter and , consists of the axons which run as tracts. The cord is divided in to 31 segments; 8 cervicla , 12 thoracic , 5 lumbar, 5 sacral and 1 coccigeal.



The meninges

The brain, as well as the spinal cord are surrounded by three layers of membranes (the meninges,) - a tough outer layer (the dura mater), a delicate middle layer (the arachnoid mater), and an inner layer firmly attached to the surface of the brain (the pia mater), cranial meninges are continuous with, and similar to, the spinal meninges through the foramen magnum.



Peripheral nervous system

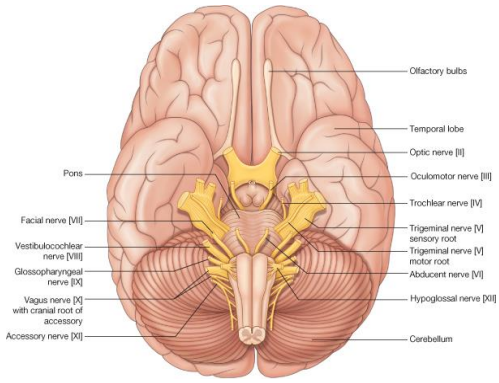
Functionally; the peripheral nervous system is divided in to two parts;

- Somatic; which control the voluntary activities which carry sensation and control skeletal muscles.
- Autonomic; which control the involuntary activities which controls smooth muscles, heart and gland secretion.

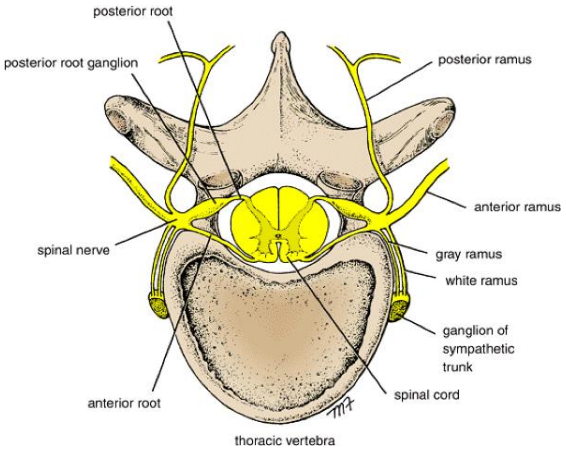
The somatic nervous system consists of the cranial and spinal nerves and their .
On dissection, the cranial and spinal nerves are seen as grayish white cords. They are made up of bundles of nerve fibers (axons) supported by delicate areolar tissue. The peripheral nerves can regenerate if they are injured.

Cranial nerves

There are 12 pairs of cranial nerves that leave the brain and pass through foramina in the skull. All the nerves are distributed in the head and neck except the Xth. (vagus), which also supplies structures in the thorax and abdomen.



- Olfactory nerve [I]
- Optic nerve [II]
- Oculomotor nerve [III]
- Trochlear nerve [IV]
- Trigeminal nerve [V]
- Abducent nerve [VI]
- Facial nerve [VII]
- Vestibulocochlear nerve [VIII]
- Glossopharyngeal nerve [IX]
- Vagus nerve [X]
- Accessory nerve [XI]
- Hypoglossal nerve [XII]



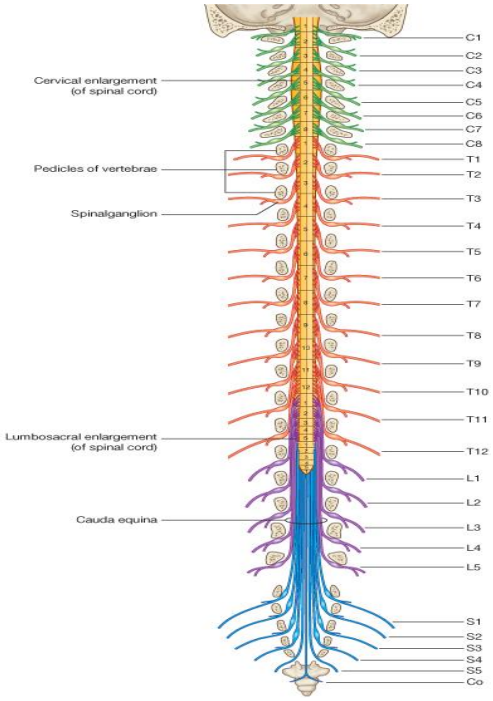
Spinal nerves

A total of 31 pairs of spinal nerves leave the spinal cord and pass through intervertebral foramina in the vertebral column. The spinal nerves are named according to the

region of the vertebral column with which they are associated: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal. Note that there are eight cervical nerves and only seven cervical vertebrae and that there is one coccygeal nerve and four coccygeal vertebrae.

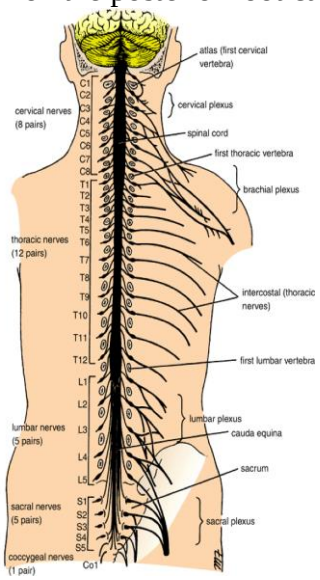
In the upper cervical region, the spinal nerve roots are short and run almost horizontally, but the roots of the lumbar and sacral nerves below the level of the termination of the cord form a vertical bundle of nerves that resembles a horse's tail and is called the cauda equina.

Each spinal nerve is connected to the spinal cord by two roots;



The anterior root consists of bundles of nerve fibers carrying nerve impulses away from the central nervous system. Such nerve fibers are called efferent fibers. Those efferent fibers that go to skeletal muscle and cause them to contract are called motor fibers. Their cells of origin lie in the anterior gray horn of the spinal cord.

The posterior root consists of bundles of nerve fibers that carry impulses to the central nervous system and are called afferent fibers. Because these fibers are concerned with conveying information about sensations of touch, pain, temperature, and vibrations, they are called sensory fibers. The cell bodies of these nerve fibers are situated in a swelling on the posterior root called the posterior root ganglion.



At each intervertebral foramen the anterior and posterior roots unite to form a spinal nerve (trunk), and thus the motor and sensory fibers mixed together , so that , the spinal nerves consists of a mixture of sensory and motor fibers , but when emerged from the foramen , the spinal nerve gives rise in to;

- Large anterior (ventral) ramus; mixed nerve passed forward supplying the muscles and skin on the anterolateral body wall and limbs.
- Small posterior (dorsal) ramus; mixed nerve passing posteriorly to supply the muscles and skin pf the back.
- In addition to the anterior and posterior rami , the spinal nerves give a small meningeal branch to innervate the vertebrae , the spinal cord and their coverings (meninges). The thoracic spinal nerves have rami communicants which associate with sympathetic part of the autonomic nervous system.

Somatic nerve plexuses

At the root of the limbs, the anterior rami of the spinal nerves tend to join one another to form complicated nerve plexuses, where the nerve fibers exchanged between neighboring rami. The cervical and brachial plexuses are found at the root of the upper limbs, and the lumbar and sacral plexuses are found at the root of the lower limbs.

- Cervical plexus; supply the skin on the angle of the mandible and skin and muscles of the neck.
- Brachial plexus; supply the skin and muscles of the upper limb.
- Lumbar & Sacral plexuses; supply the skin and muscles of the lower limb.

Serous membranes & cavities

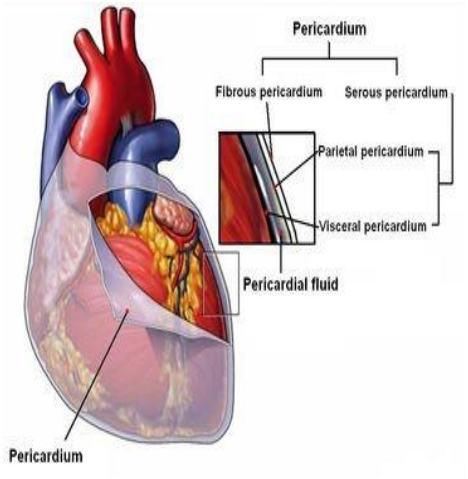
Serous membrane (or serosa) is a smooth tissue membrane consisting of two layers of mesothelium, which secrete serous fluid, the inner layer that covers organs (viscera) in body cavities is called the visceral membrane, a second layer of mesothelium of the serous membrane, called the parietal layer, lines the body wall. Between the two layers is a potential space, mostly empty except for a few milliliters of lubricating serous fluid that is secreted by the two serous membranes, they are found around organs that move a lot, such as the heart and lungs.

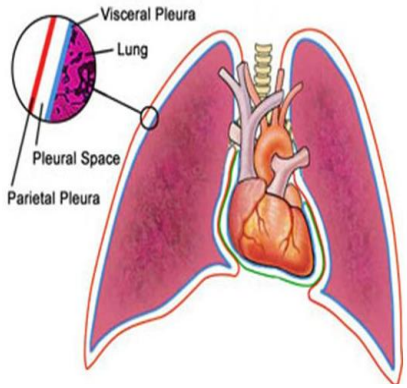
Examples of serous membranes are:

Peritoneum; the peritoneal cavity is found within the abdominal & pelvic body cavities.

Pleura; two pleural cavities (separated by mediastinum) are found within the thoracic cavity.

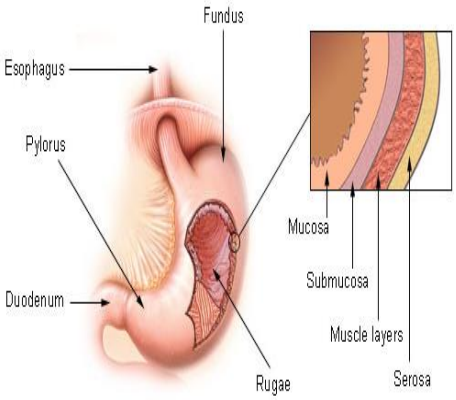
Pericardium; the pericardial cavity is found within the mediastinum of the thoracic cavity, visceral pericardium is also called *epicardium.*





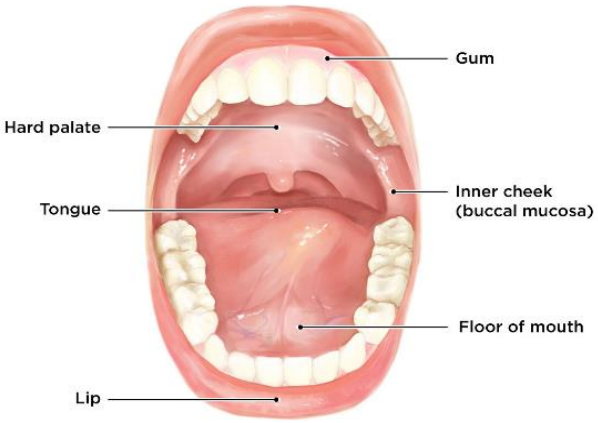
Mucous membranes

Mucous membrane is the lining of organs or passages that communicate with the surface of the body, a mucous membrane consists essentially of a layer of epithelium supported by a layer of connective tissue, the lamina propria, smooth muscle, called the muscularis mucosa, is sometimes present in the connective tissue.



It is continuous with the skin at various openings of the body such as the eyes, ears, nose, mouth, the urethral opening and the anus, frenulum of tongue and the tongue, some mucous membranes secrete mucus, a thick protective fluid secreted by some mucous membranes and/or associated glands. The function of the membrane is to stop pathogens and dirt from entering the body and to prevent bodily tissues from becoming dehydrated.

They are able to absorb a number of substances and toxins but are vulnerable regarding pain, if the lining is torn or broken, mucus is incapable of performing it`s roles of preventing infection and retaining tissue moisture levels, some mucous membranes are involved with digestion in the absorption of insoluble food molecules and secretion (releasing chemicals from glands).



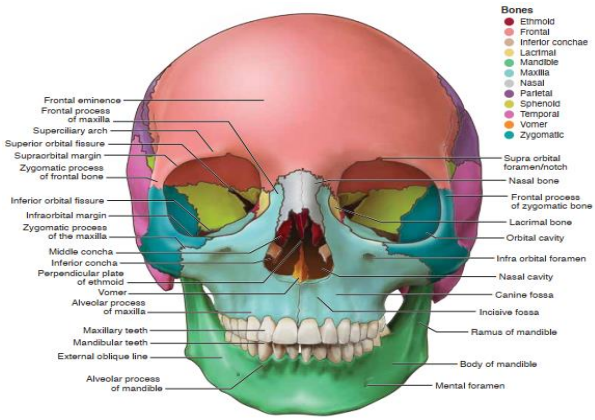
Al- Muthan`na University
College of Dentistry
Dept. of Basic Medical Science
1st. Stage - Semester: 1

Anatomy for Dentistry
Lec. : 5
Date: Thursday. 5th. Jan. 2023

The skull "neurocranium"

In human anatomy, the neurocranium, also known as the braincase is the upper and back part of the skull, which forms a protective case around the brain, in man, the neurocranium includes the calvaria or skullcap, the remainder of the skull is the facial skeleton. The neurocranium is divided into two portions:

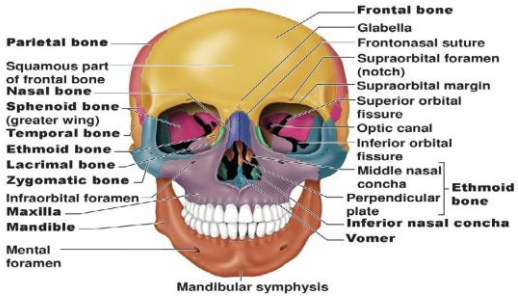
- the membranous part, consisting of flat bones, which surround the brain; and
- the cartilaginous part, or chondrocranium, which forms bones of the base of the skull , the neurocranium is usually considered to include the following eight bones:



- 1 frontal bone
- 1 ethmoid bone
- 1 occipital bone
- 1 sphenoid bone
- 2 parietal bones
- 2 temporal bones

Frontal bone

Is a shell-shaped, unpaired, flat bone of the skull located in the forehead region, the main function of the frontal bone is to create the smooth curvature of the forehead and to provide protection for the frontal lobe of the brain, in addition, it participates in the formation of several cavities of the skull such as the orbit and the anterior cranial fossa, it consists of the 6 main parts:



- one squamous part
- one nasal part
- two orbital plates
- two zygomatic processes.

The squamous part

Forms the largest portion of the frontal bone, it has two surfaces: an external and an internal, the external surface is convex and corresponds to the forehead, the piece lies above the supraorbital margin hosts a curved elevation known as the supraciliary arch, between the two arches, there is a prominence known as the glabella.

In addition, located along the frontal part of the orbital margin, at the superior border of the orbit (supraorbital margin) is the supraorbital foramen or notch where the supraorbital vessels and nerve pass through, the zygomatic processes arise caudolaterally from the squamous part and articulate with the zygomatic bone.

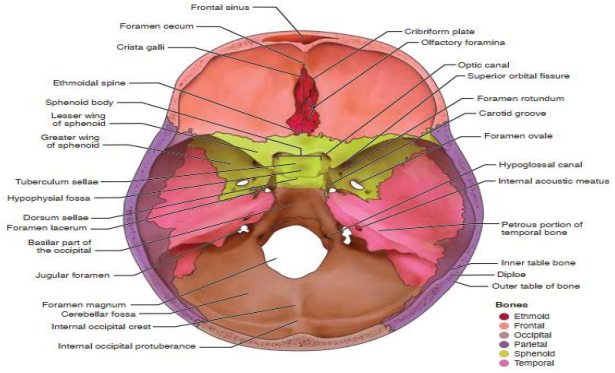
The internal surface is deeply concave and presents a ridge located in the midline known as the frontal crest, which is continuous with the sagittal sulcus, foramen cecum are two small foramina situated on each side of the posterior end of the frontal crest.

Nasal part

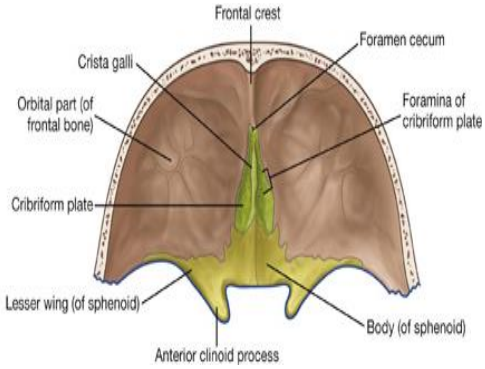
Is a small portion of the frontal bone that projects inferiorly between the right and left supraorbital margins.

Orbital part

The orbital parts contain orbital plates, each plate is a triangular-shaped flat sheet of bone that extends posteriorly from the supraorbital margin, it is named 'orbital' since it`s inferior surface comprises most of the roof of the orbit, in contrast, it`s superior surface forms the greater part of the floor of the anterior cranial fossa.



When viewed from the inferior view, the anterolateral portion of the orbital part of the frontal bone presents with the lacrimal fossa (for the lacrimal gland) while the anteromedial portion has a trochlear fossa that forms a point of attachment for the corresponding superior oblique muscle.

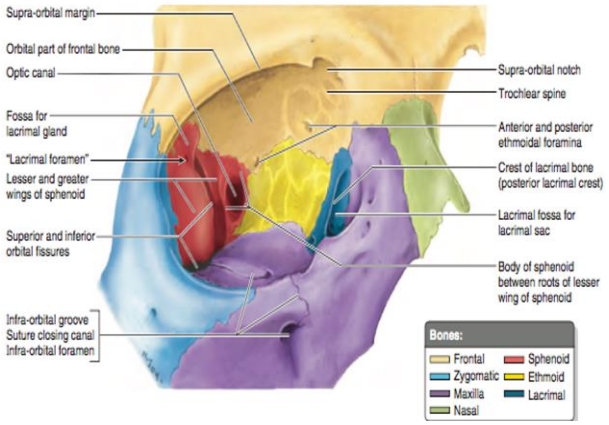


Zygomatic process

The zygomatic processes project inferolaterally on each side of the frontal bone, beginning at the lateral aspect of the supraorbital margin.

Articulations

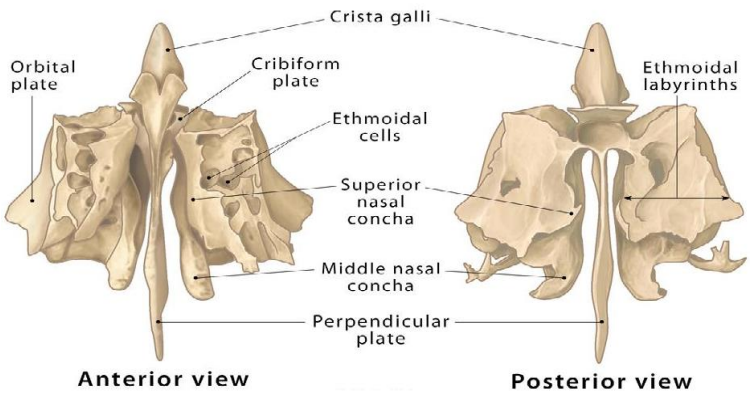
- Posteriorly:
  1. with the two parietal bones "frontoparietal or coronal suture".
  2. with the greater wing of the sphenoid bone "sphenofrontal suture".
- Laterally,
  1. With the frontal processes of zygomatic bones via the "zygomaticofrontal suture".
- The nasal plate articulates
  1. with the two nasal bones "frontonasal suture" and
  2. with the two frontal processes of each maxilla "frontomaxillary suture".
- The orbital part articulates
  1. with the sphenoid bone "sphenofrontal suture".
  2. ethmoid bone "frontoethmoidal suture".
  3. with the lacrimal bones "frontolacrimal suture".



Ethmoid bone

Is an unpaired bone in the skull that separates the nasal cavity from the brain, it is located at the roof of the nose, between the two orbits, the cubical bone is lightweight due to a spongy construction, the ethmoid bone is one of the bones that make up the orbit of the eye.

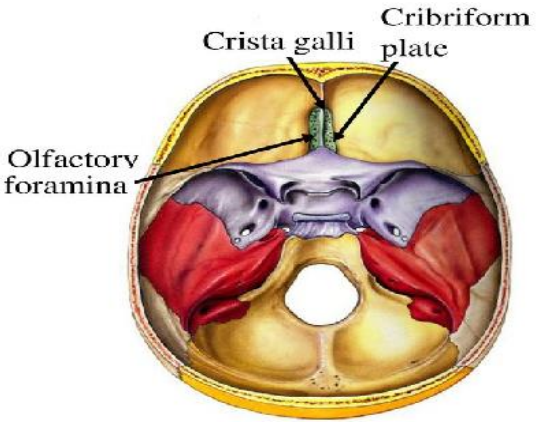
The ethmoid bone is an anterior cranial bone located between the eyes, it contributes to the medial wall of the orbit, the nasal cavity, and the nasal septum. It has three parts: cribriform plate, ethmoidal labyrinth, and perpendicular plate.



The *cribriform plate* forms the roof of the nasal cavity and also contributes to formation of the anterior cranial fossa, the *ethmoidal labyrinth* consists of a large mass on either side of the *perpendicular plate*, and the perpendicular plate forms the superior two-thirds of the nasal

septum. Between the orbital plate and the nasal conchae are the ethmoidal sinuses or ethmoidal air cells, which are a variable number of small cavities in the lateral mass of the ethmoid.

Crista galli is a thick, midline, smooth triangular process arising from the superior surface of the ethmoid bone, projecting into the anterior cranial fossa, it separates the olfactory bulbs, which lie on either side of it in the olfactory fossae of the cribriform plate.



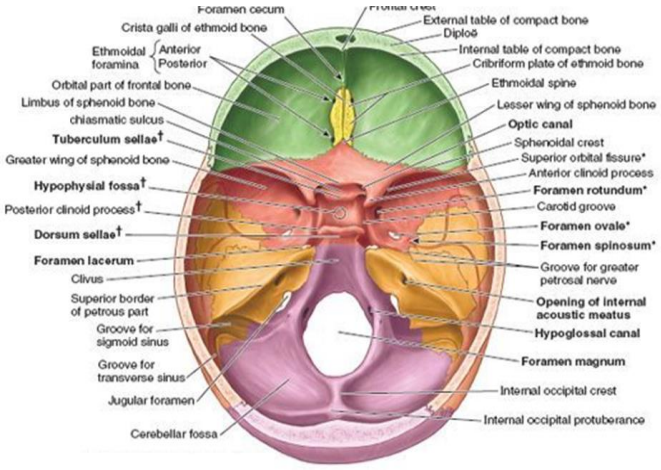
Articulations

The ethmoid bone articulates with thirteen bones:

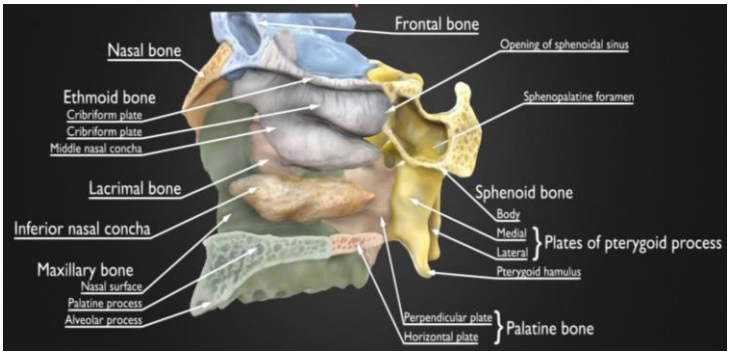
- two bones of the neurocranium: the frontal, and the sphenoid.
- eleven bones of the viscerocranium: two nasal bones, two maxillae, two lacrimals, two palatines, two inferior nasal conchae, and the vomer.

Sphenoid bone

Is an unpaired bone of the neurocranium situated in the middle of the skull towards the front, in front of the basilar part of the occipital bone, sphenoid bone is one of the seven bones that articulate to form the orbit, it`s shape somewhat resembles that of a butterfly or bat with it`s wings extended. It is divided into the following parts:

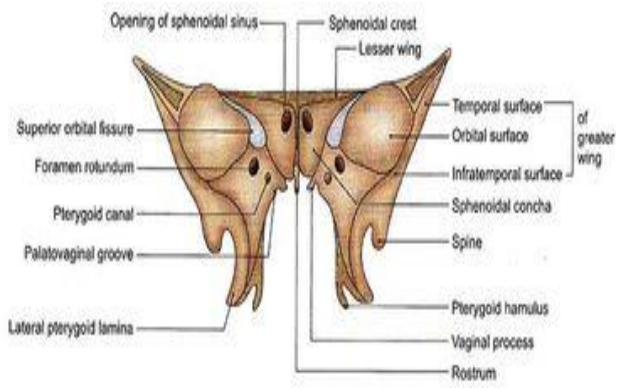


- a median portion, known as the body of sphenoid bone, containing the sella turcica, which houses the pituitary gland as well as the paired paranasal sinuses; *sphenoidal sinuses*.
- two greater wings on the lateral side of the body and two lesser wings from the anterior side.
- pterygoid processes of the sphenoides, directed downwards from the junction of the body and the greater wings.
- two sphenoidal conchae are situated at the anterior and inferior part of the body.



Articulations

The sphenoid articulates with the frontal, parietal, ethmoid, temporal, zygo matic, palatine, vomer, and occipital bones and helps to connect the neurocranium to the facial skeleton, the bone has the following surfaces:



Superior or cerebral surface

Articulates with ethmoid bone anteriorly and basilar part of occipital bone posteriorly, it shows:

1. Sulcus chiasmaticus
2. Tuberculum sellae
3. Sella turcica
4. Dorsum sellae, the posterior clinoid process is a bony prominence located at the superolateral aspect of the dorsum sellae.
5. Clivus

Inferior surface
Anterior surface
Posterior surface
Basilar part of occipital bone
Lateral surface

- Carotid sulcus lodging cavernous sinus and internal carotid artery
- Sphenoidal sinuses are asymmetrical air sinuses in the body of the sphenoid, closed by sphenoidal conchae.

Greater wing of sphenoid

1. **Superior or cerebral surface :** forms the floor of the middle cranial fossa, it presents (starting from the front):

- foramen rotundum
- foramen ovale
- foramen spinosum

2. **Lateral surface:** is divided into (by infratemporal crest):

- Upper or temporal surface
- Lower or infratemporal surface, foramen pierce it are:
- Foramen ovale
- Foramen spinosum

3. **Orbital surface :** forms the posterior wall of the orbit

Lesser wing of sphenoid

These are two triangular wings projecting laterally from anterosuperior part of the body each consists of:

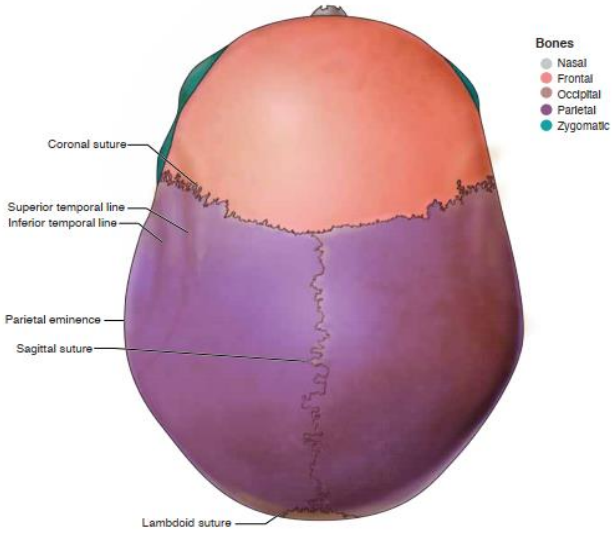
- a base forming medial end of the wing.
- tip forming the lateral end of the wing.
- superior surface forming floor of anterior cranial fossa.
- inferior surface forming upper boundary of superior orbital fissure.
- medially, terminates in the anterior clinoid process.

Parietal bone

Parietal bones are bilateral skull bones that form the superior and lateral walls of the cranium, they overlie the parietal lobes of the brain and are covered superficially by the epicranial aponeurosis, the parietal bones are part of the neurocranium, together with the frontal, ethmoid, sphenoid, temporal and occipital bones.

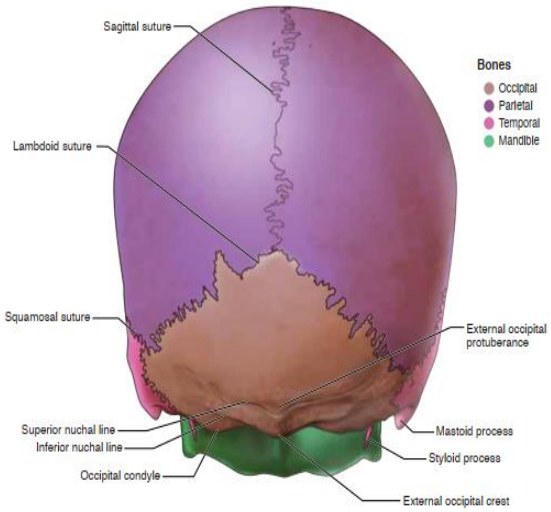
The bulk of each parietal bone forms the calvaria (skull cap), while the remaining smaller part is a component of the cranial base (basicranium).

The parietal bone is slightly curved and has a quadrilateral shape, it has two surfaces, four borders and four angles; the borders articulate with the neighbouring skull bones to form various cranial sutures, the surfaces contain numerous bony features and indentations that correspond to the anatomical structures lying against the bone, such as superficial blood vessels of the brain.

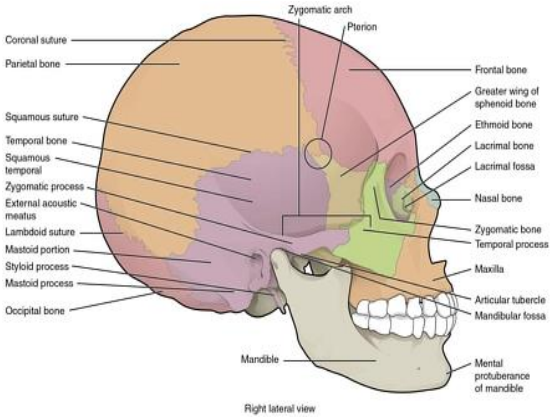


Articulations

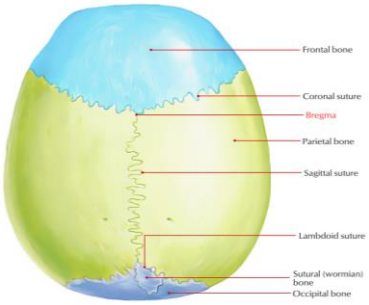
The parietal bone has four borders which articulate with the surrounding skull bones via various sutures, these borders include;

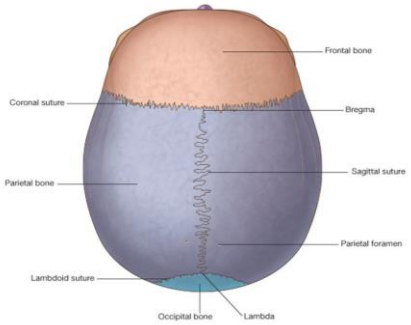


- Sagittal border, located superiorly ,the two parietal bones articulate at the sagittal borders with each other to form the *sagittal suture*.
- Squamosal border, situated inferiorly coming in contact with three bony structures, from anterior to posterior these are the greater wing of the sphenoid bone and the squamous and petrous parts of temporal bone, these articulations form the *sphenoparietal* and *parietomastoid* sutures.



- Frontal border, located anteriorly, it comes in contact with the frontal bone the *coronal suture*.
- Occipital border, located posteriorly formingthe inferolateral half of the lambdoid suture by articulating with the occipital bone.

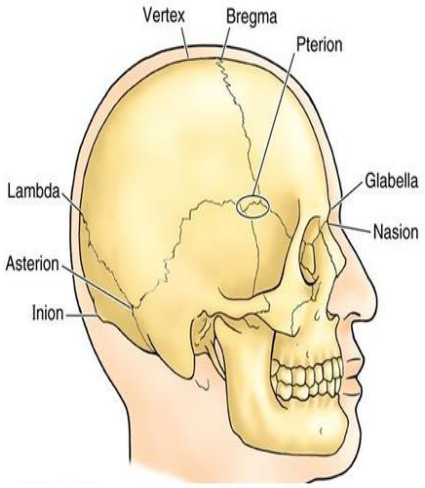




Angles

Parietal bone has four angles;

- Frontal angle pointing anterosuperiorly, it is formed by the intersection of the sagittal and frontal borders, this angle is located at the *bregma*, which represents the intersection of the sagittal and coronal sutures.
- Sphenoidal angle facing anteroinferiorly, it is created by the union of the frontal and squamosal borders, the sphenoidal angle is situated at the *pterion*, which represents the intersection of the coronal, sphenoparietal and sphenofrontal sutures.
- Occipital angle which points posterosuperiorly, being more rounded compared to the rest, it is formed by the intersection of the sagittal and occipital borders, the angle is situated at the *lambda*, which represents the union of the lambdoid and sagittal sutures.
- Mastoid angle which faces posteroinferiorly, it is created by the intersection of the occipital and squamosal borders, it is found at the *asterion* where the parietomastoid and lambdoid sutures meet.

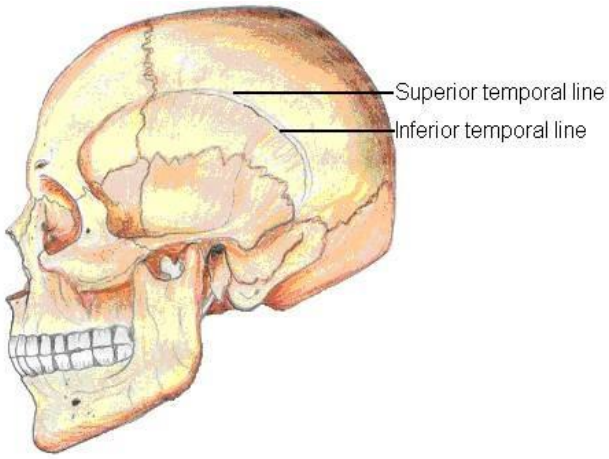


Surfaces

The parietal bone has an external and internal surface, the external surface is smooth and convex and has several important features:

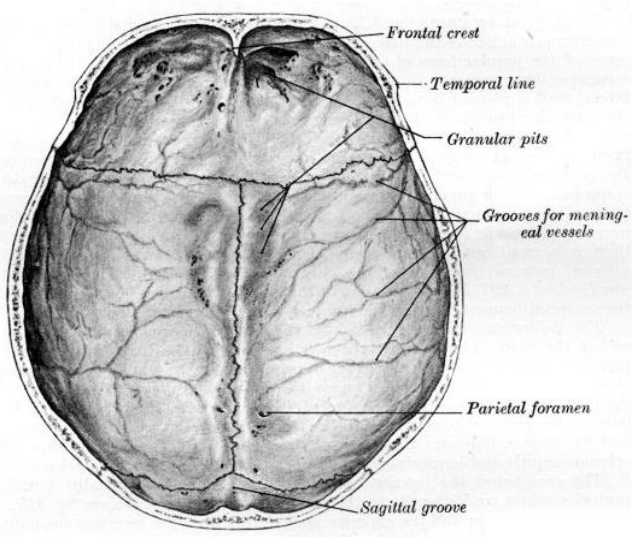
- Superior temporal line which forms an arch that travels between the frontal and occipital borders of the parietal bone.

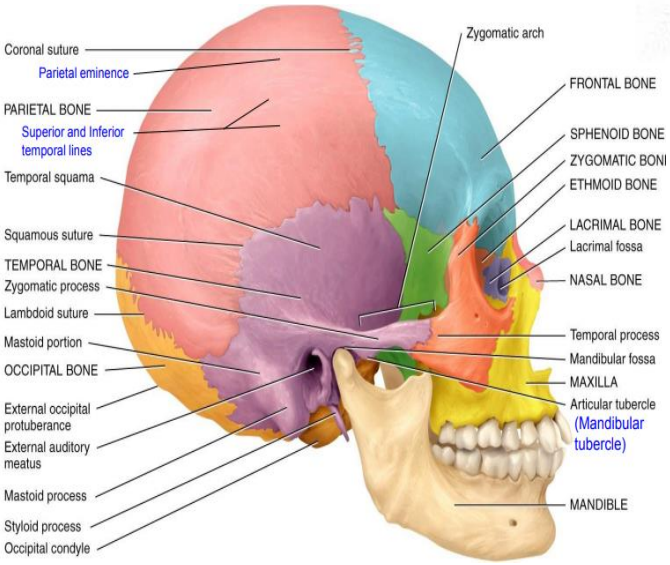
- Inferior temporal line which forms an identical arch to the previous one but located more inferiorly.
- Parietal eminence which is located centrally on the external surface of the parietal bone, it marks the origin of ossification of the parietal bone.



The internal surface is concave and highly irregular compared to it`s external counterpart, it contains several grooves that house various blood vessels;

- A thin and highly branched groove for middle meningeal artery.
- A broader groove for superior sagittal sinus which travels anterosuperiorly along the sagittal border.
- A small portion of the groove for sigmoid sinus overlies the occipital angle.





Temporal bones

are situated at the sides and base of the skull, and lateral to the temporal lobes of the cerebral cortex, the temporal bones are overlaid by the sides of the head known as the temples, and house the structures of the ears, the lower seven cranial nerves and the major vessels to and from the brain traverse the temporal bone. The temporal bone consists of four parts:

- the squamous
- mastoid
- petrous and
- tympanic parts.

The *squamous part* is the largest and most superiorly positioned relative to the rest of the bone, the zygomatic process is a long, arched process projecting from the lower region of the squamous part and it articulates with the zygomatic bone.

The *mastoid part* lies posteroinferior to the squamous . The *petrous part*, fused with the squamous and mastoid parts and lies between the sphenoid and occipital bones , which is shaped like a pyramid. The *tympanic part* is relatively small and lies inferior to the squamous part, anterior to the mastoid part, and superior to the styloid process.

The *styloid*, is pillar shaped directed inferiorly and anteromedially between the parotid gland and internal jugular vein.

Articulations

- *Occipitomastoid suture*, separates occipital bone and mastoid portion of temporal bone.

- *Squamosal suture* , separates parietal bone and squama portion of temporal bone.
- *Sphenosquamosal suture*, separates sphenoid bone and squama portion of temporal bone.
- *Zygomaticotemporal suture* , separates zygomatic bone and zygomatic process of temporal bone.

Occipital bone

Is a cranial bone and the main bone of the **occiput** "back and lower part of the skull", it is trapezoidal in shape and curved on itself like a shallow dish, the occipital bone overlies the occipital lobes of the cerebrum. At the base of skull in the occipital bone, there is a large oval opening called the foramen magnum, which allows the passage of the spinal cord.

Like the other cranial bones, it is classed as a flat bone . From it`s front to the back is the:

- basilar part, also called the basioccipital,
- lateral parts on the sides of the foramen magnum, also called the exoccipitals, and
- the back is named as the squamous part.

The basilar part is a thick, somewhat quadrilateral piece in front of the foramen magnum and directed towards the pharynx. The squamous part is the curved, expanded plate behind the foramen magnum and is the largest part of the occipital bone.

The occipital bone, like the other seven cranial bones, has outer and inner layers " also called *plates* or *tables*" of cortical bone tissue between which is the cancellous bone tissue known in the cranial bones as *diploë*. The bone is especially thick at the ridges, protuberances, condyles, and anterior part of the basilar part; in the inferior cerebellar fossae it is thin, semitransparent, and without diploë.

Outer surface

Near the middle of the outer surface of the squamous part of the occipital (the largest part) there is a prominence, the external occipital protuberance, the highest point of this is called the inion.

From the inion, along the midline of the squamous part until the foramen magnum, runs a ridge the external occipital crest "also called the medial nuchal line" and this gives attachment to the nuchal ligament.

Running across the outside of the occipital bone are three curved lines and one line "the medial line" that runs down to the foramen magnum, these are known as the nuchal lines which give attachment to various ligaments and muscles. They are named as the *highest, superior* and *inferior nuchal lines*. The inferior nuchal line runs across the midpoint of the *median* nuchal line.

Inner surface

The inner surface of the occipital bone forms the base of the posterior cranial fossa, the foramen magnum is a large hole situated in the middle, with the clivus, a smooth part of the occipital bone travelling upwards in front of it, the median internal occipital crest travels behind it to the internal occipital protuberance, and serves as a point of attachment to the falx cerebri.

To the sides of the foramen sitting at the junction between the lateral and base of the occipital bone are the hypoglossal canals, further out, at each junction between the occipital and petrous portion of the temporal bone lies a jugular foramen.

At the midpoint above the foramen a raised part is formed called the internal occipital protuberance, from each side of this eminence runs a groove for the transverse sinuses.

There are two midline skull landmarks at the foramen magnum: the *basion* is the most anterior point of the opening and the *opisthion* is the point on the opposite posterior part, the basion lines up with the dens.

Foramen magnum

The foramen magnum is a large oval foramen longest front to back; it is wider behind than in front where it is encroached upon by the occipital condyles, the clivus, a smooth bony section, travels upwards on the front surface of the foramen, and the median internal occipital crest travels behind it.

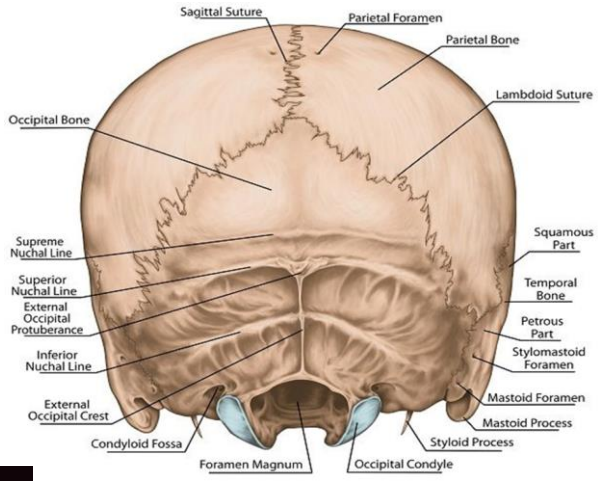
Angles

- The superior angle of the occipital bone articulates with the occipital angles of the parietal bones and, in the fetal skull, corresponds in position with the posterior fontanelle.

- The lateral angles are situated at the extremities of the groove for the transverse sinuses, each is received into the interval between the mastoid angle of the parietal bone, and the mastoid portion of the temporal bone.
- The inferior angle is fused with the body of the sphenoid bone.

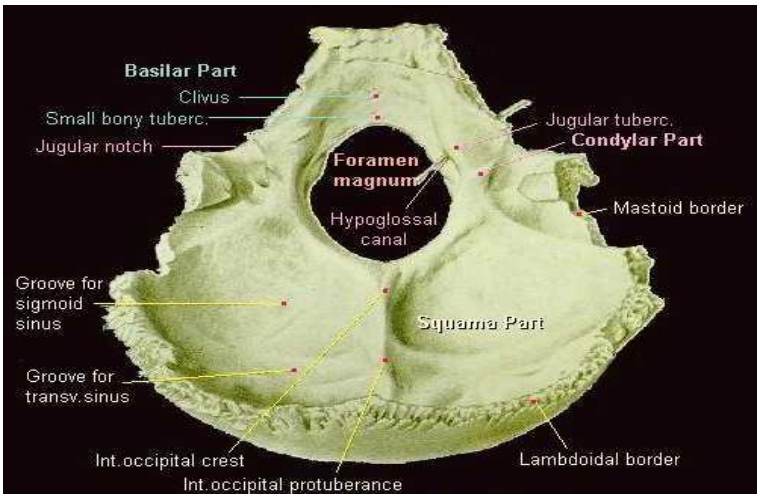
Borders

- The superior borders extend from the superior to the lateral angles, they are deeply serrated for articulation with the occipital borders of the parietals, and form by this union the *lambdoidal suture.*
- The inferior borders extend from the lateral angles to the inferior angle,the upper half of each articulates with the mastoid portion of the corresponding temporal, the lower half with the petrous part of the same bone.



Sutures

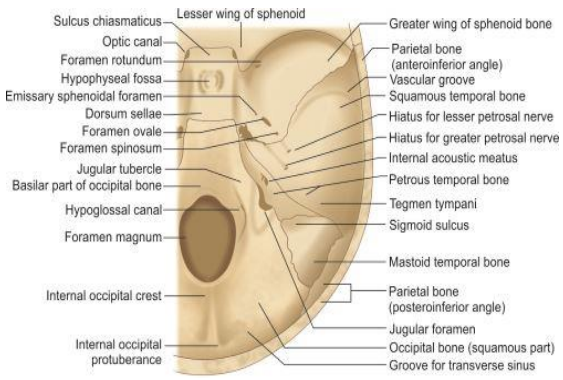
- lambdoid suture joins the occipital bone to the parietal bones.
- occipitomastoid suture joins the occipital bone and mastoid portion of the temporal bone.

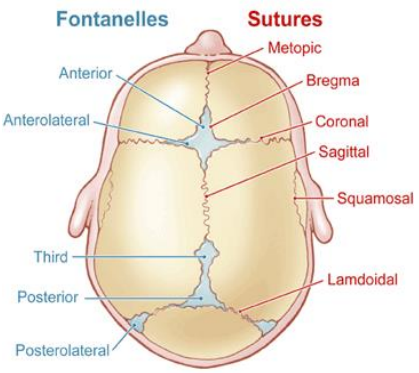


- sphenobasilar suture joins the basilar part of the occipital bone and the back of the sphenoid bone body .
- petrous-basilar suture joins the side edge of the basilar part of the occipital bone to the petrous-part of the temporal bone .

Neonatal Skull

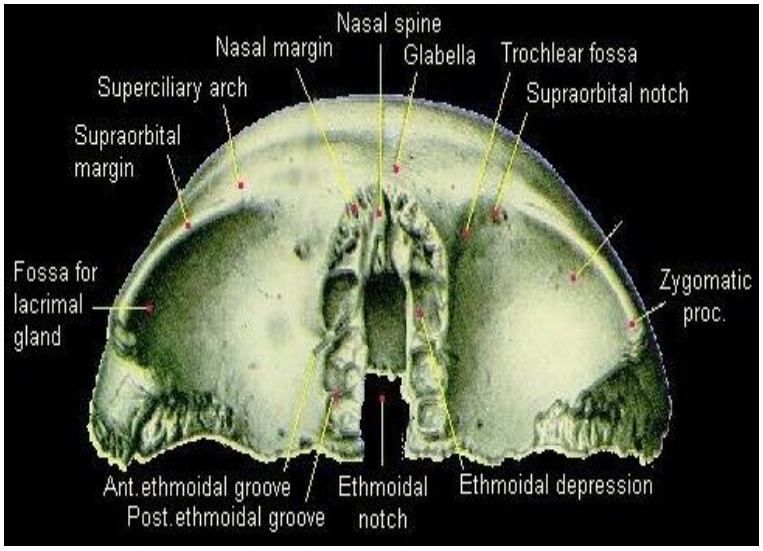
The bones of the skull are smooth and unilaminar, there being no diploe present, most of the skull bones are ossified at birth, but the process is incomplete, and the bones are mobile on each other, being connected by fibrous tissue or cartilage, the bones of the vault are ossified in membrane; the bones of the base are ossified in cartilage, the bones of the vault are not closely knit at sutures, as in the adult, but are separated by unossified membranous intervals called *fontanelles*.

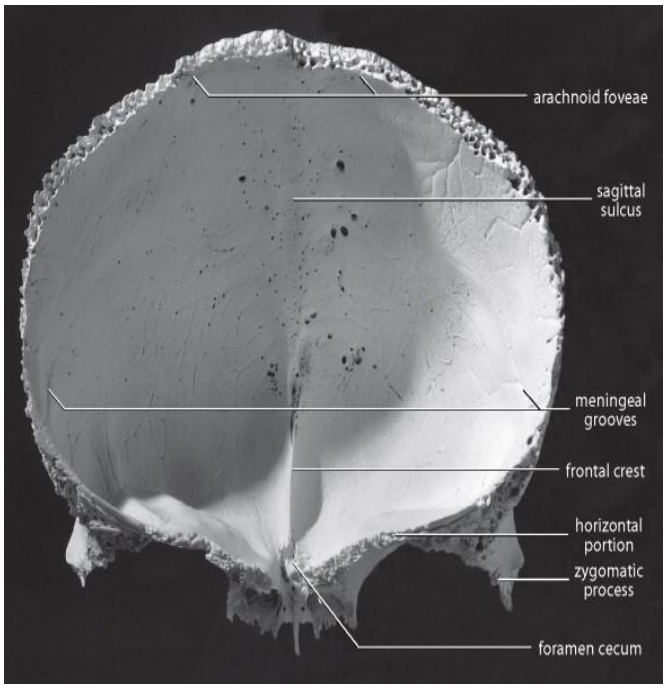




Clinically, the anterior and posterior fontanelles are most important and are easily examined in the midline of the vault, the anterior fontanelle is diamond shaped and lies between the two halves of the frontal bone in front and the two parietal bones behind , the fibrous membrane forming the floor of the anterior fontanelle is replaced by bone and is closed by 18 months of age.

The posterior fontanelle is triangular and lies between the two parietal bones in front and the occipital bone behind, by the end of the first year, the fontanelle is usually closed and can no longer be palpated.



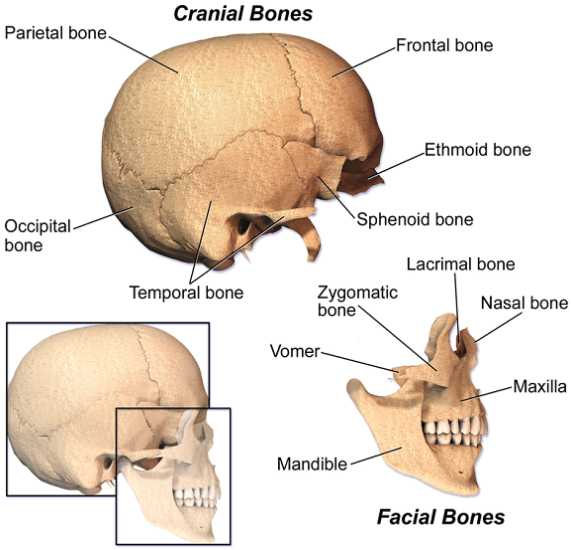


Al- Muthan`na University
College of Dentistry
Dept. of Basic Medical Science
1st. Stage - Semester: 1

Anatomy for Dentistry
Lec. : 6
Date: Thursday. 26th. Jan. 2023

The skull "viscerocranium"

A collection of 14 bones that make up the human face:
Paired bones: inferior nasal concha, nasal bone, maxilla, palatine bone, lacrimal bone, zygomatic bone
Unpaired bones: mandible and vomer.

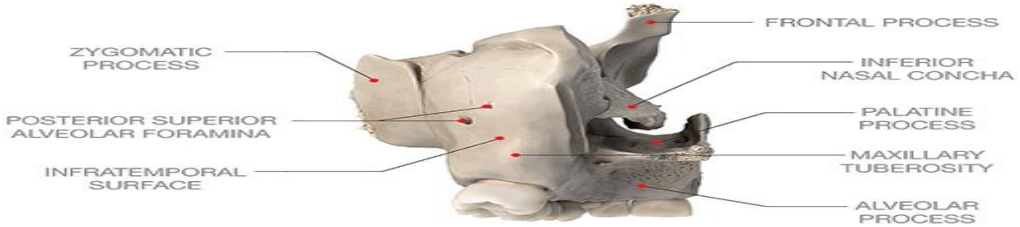


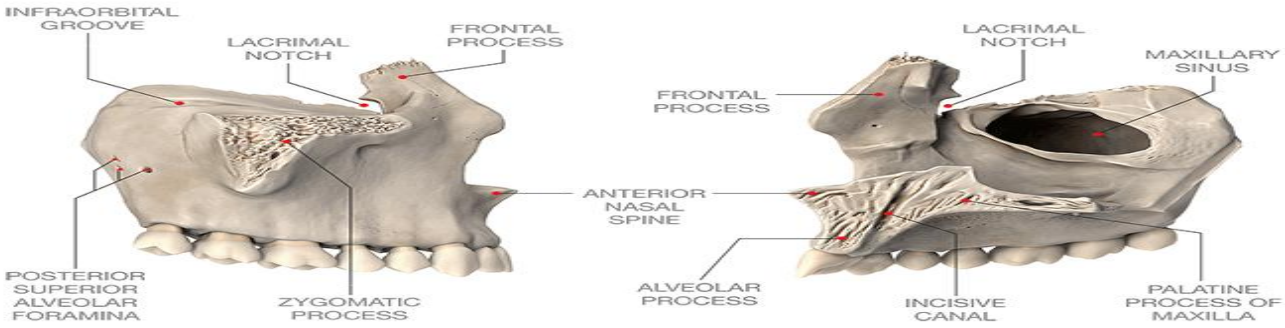
Maxilla

It is the central, paired bone of the viscerocranium, the left and right maxilla fuse in the midline to form the upper jaw, between the two maxillae lies a cranial suture called the intermaxillary suture. The maxilla is made of several parts:

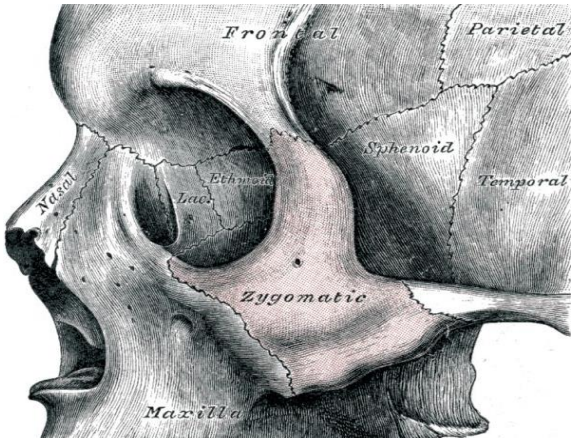
- the body
- the zygomatic process (zygomatic arch)
- the frontal process
- the alveolar process (teeth socket)
- the palatine process (hard palate)

Important features of the maxilla include the infraorbital foramen, maxillary sinus, and incisive foramen. The main function of the maxilla is to hold the upper teeth in place.



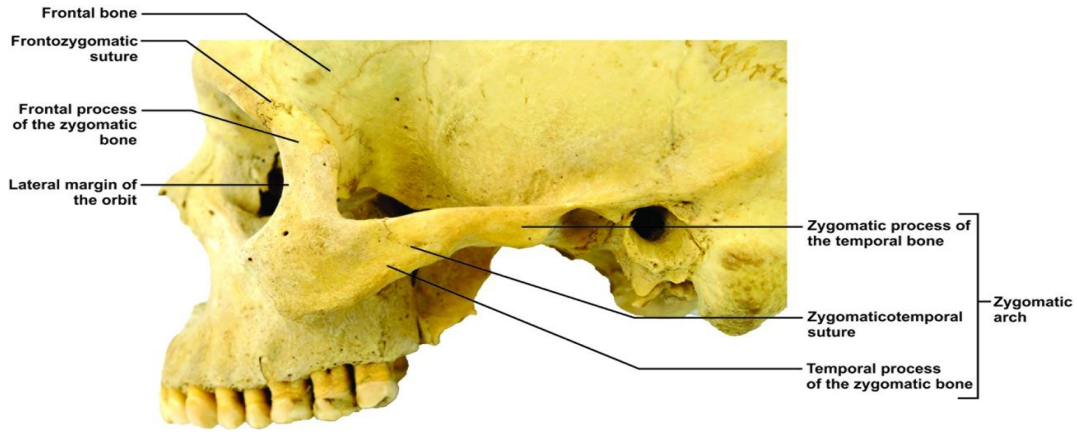


Zygomatic bone



Is an irregular paired bone of the face located at the upper lateral part of the face, also known as the 'cheek bone' because it forms the lateral prominences of the face, it has three processes that include the frontal, maxillary and temporal processes, through these processes, the zygomatic bone articulates with the frontal bone, temporal bone, sphenoid bone, and maxilla. The most important feature of the zygomatic bone is the zygomatic arch, which is formed by the zygomatic process of the temporal bone and the temporal process of the zygomatic bone.

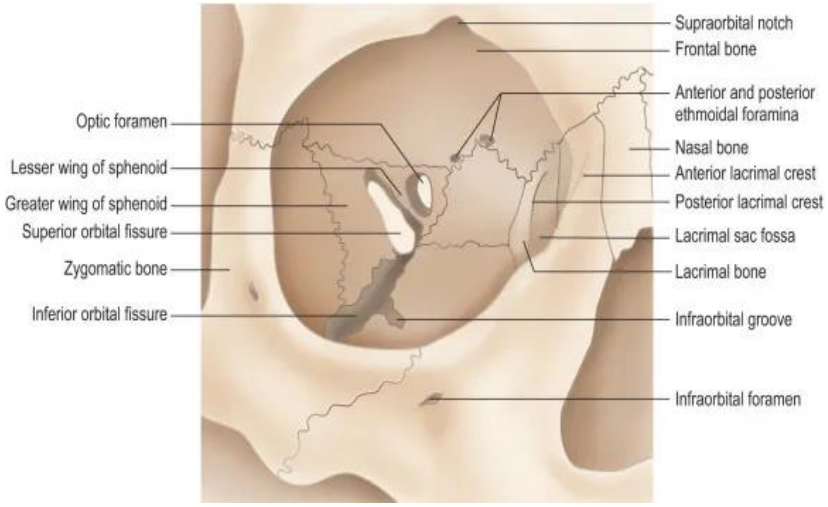
The main function of the arch is to protect the eyes



from a direct blow and to provide attachment for the masticatory muscles (temporalis and masseter).

Lacrimal bone

It`s the smallest and the most fragile bone of the viscerocranium, it is a paired oblong مستطيل bone situated in the anterior part of the medial wall of the orbit, the word *'Lacrima'* is latin for 'tear', so the name of the bone corresponds with it`s relation to the nearby lacrimal structures.



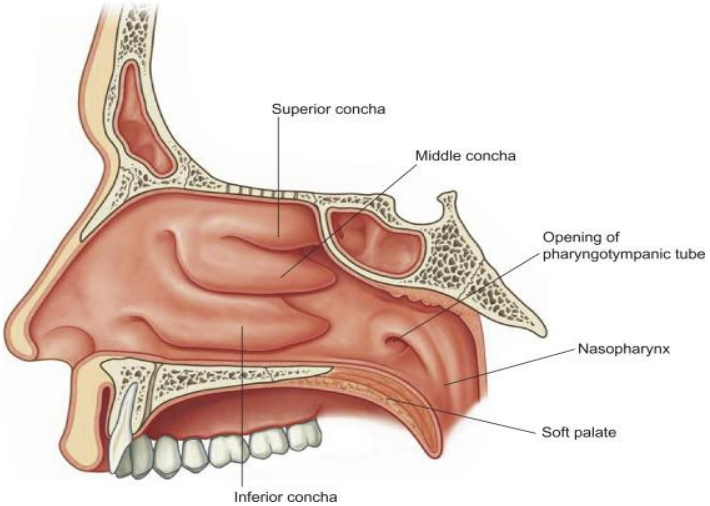
The bone has two surfaces "lateral and medial' and four borders "anterior, posterior, superior and inferior".

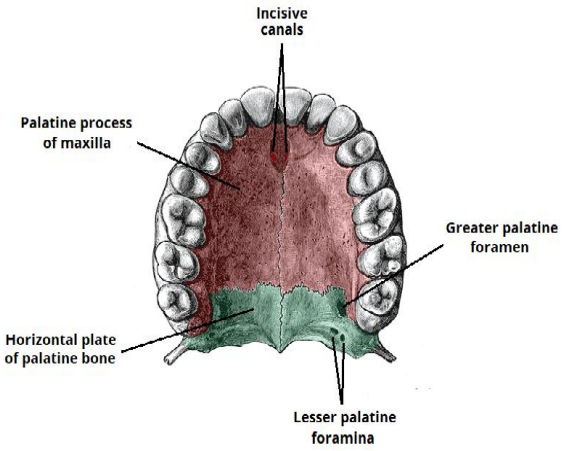
The main function of the lacrimal bone is to provide support for the structures of the lacrimal apparatus, which secretes and drains tears, in addition, the lacrimal bone as an attachment site for the orbicularis oculi muscle.

Inferior nasal concha

It is the longest and broadest of the three conchae, in contrast to the superior and middle nasal conchae, the inferior nasal concha is a separate bone, the inferior nasal concha is a bony plate located on the lateral wall of the nasal cavity.

The main function of the inferior nasal concha is to participate in the formation of both the middle and inferior nasal meatus, the inferior nasal meatus lies directly beneath the inferior nasal concha and is the largest space of the nasal cavity. It is responsible for the majority of airflow direction, humidification, heating and filtering of air inhaled through the nose.





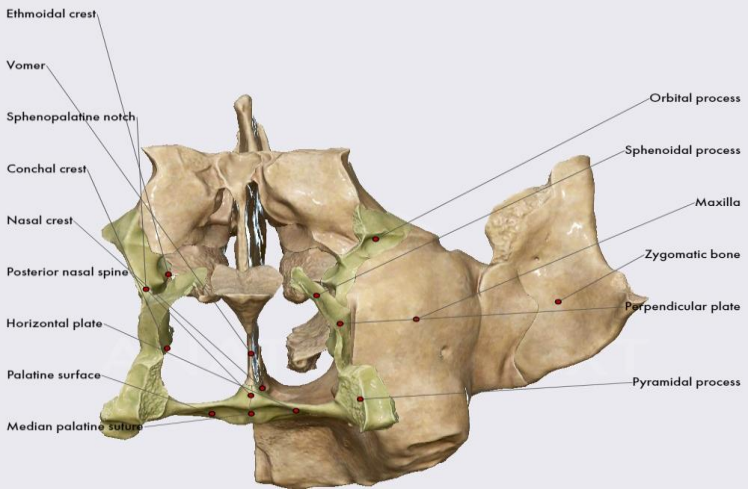
Palatine bone

The palatine bone is a paired, L-shaped bone located posterior to the nasal cavity, more specifically, the bone is interposed between the maxilla and sphenoid bones, the palatine bone is primarily defined by it`s horizontal and perpendicular plates, due to it`s many connections with the surrounding bones, the palatine

bone participates in the formation of several important structures:

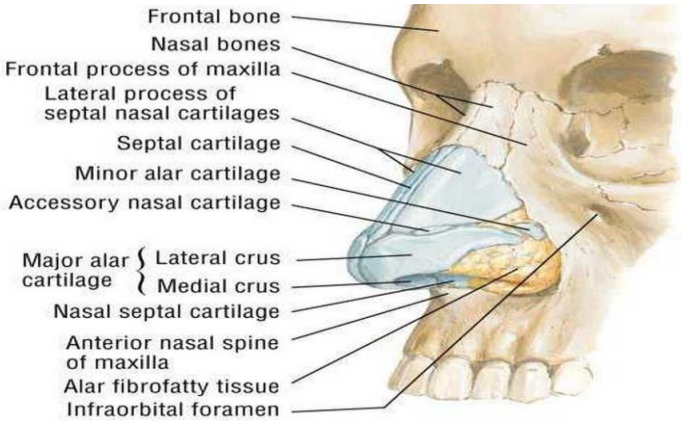
- a horizontal plate forms the posterior portion of the hard palate of the oral cavity.
- a perpendicular plate contributes to the lateral wall of the nasal cavity where it borders the pterygoid process of the sphenoid bone.

The palatine bone also contributes to a small portion of the orbital floor, via the orbital process found at the superior end of the perpendicular plate.



Nasal bone

The nasal bone is a paired, rectangle-shaped bone located medial to the frontal processes of the maxillae, the left and right nasal bones connect in the midline via the internasal suture.

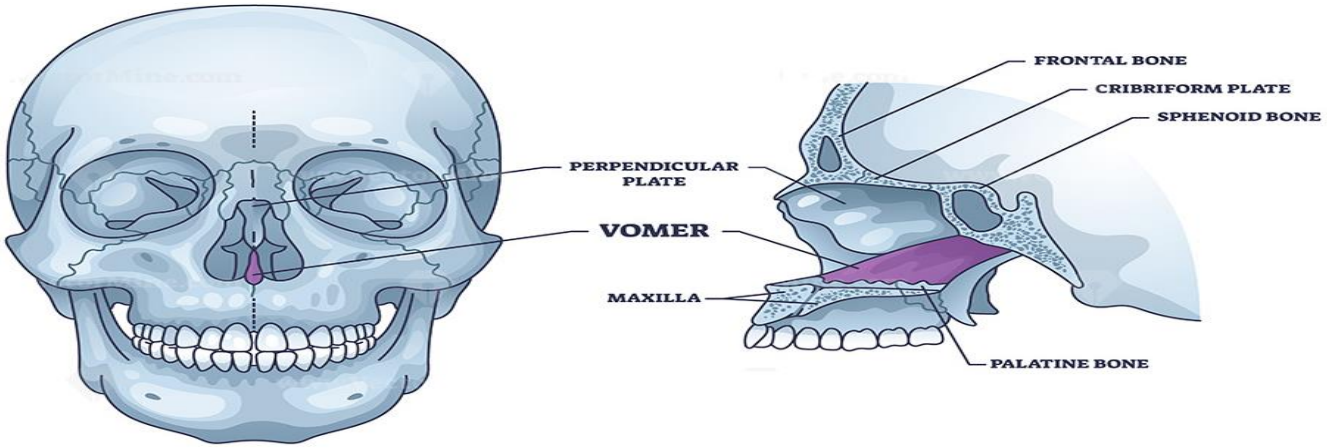


The bone has 4 borders and 2 surfaces which form a number of connections with the surrounding bones. The main function of the nasal bone is to form the bridge of the nose, the nasal aperture, and to protect the nasal cavity from external factors.

Vomer

The vomer is the second unpaired bone of the viscerocranium situated in the midsagittal line. It is a flat plate of bone situated vertically in the nasal cavity, along with the ethmoid bone, the vomer forms the bony portion of the nasal septum which separates the left and right sides of the nose.

More specifically, the superior two-thirds of the bony nasal septum is formed by the perpendicular plate of the ethmoid bone, while the inferior third is formed by the vomer, the anterior part of the nasal cavity is formed by the nasal cartilage.

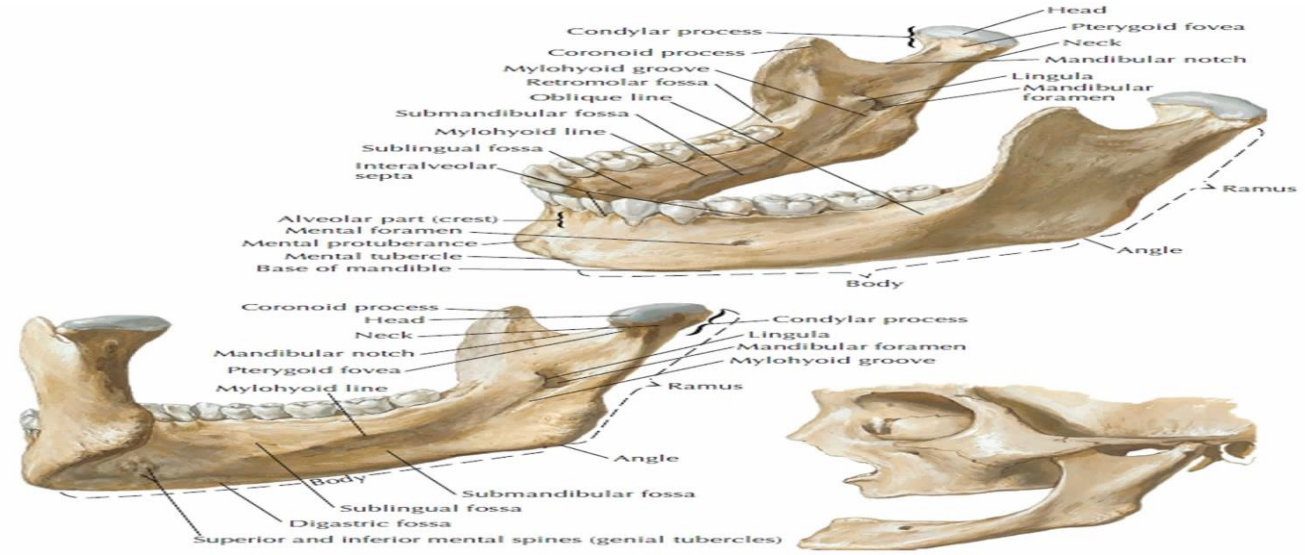


Mandible

It is the largest bone of the viscerocranium located in the inferior portion of the face, forming the lower jaw, it is important to note that the mandible is not part of the skull, but it is attached to it via the temporomandibular joint (TMJ). Besides the bones of the middle ear " auditory ossicles", the mandible is the only mobile bone of the head.

The mandible is composed of two main parts; a horizontal body "anteriorly" and two vertical rami "posteriorly)", on each side, the body and the ramus are connected at the angle of the mandible, these parts harbor various anatomical landmarks that participate in important functions of the mandible.

The main function of this bone is to form the contours of the face (chin and jawline) and to hold the lower teeth in place. The TMJ allows the mandible to move in various directions and allows a person to speak and chew.



Functions

The prime function of the viscerocranium is to shape the human face and cavities of the anterior skull including the orbit, oral and nasal cavities, it protects the delicate contents of these cavities, as well as the neurovascular structures of the face.

The bony surface of the viscerocranium provides attachment points for the facial muscles which are important for expressing emotions and mood, the viscerocranial bones also contain sinuses (e.g. maxillary sinuses) that reduce the weight of the skull and enhance the resonance of the voice while speaking.

Al- Muthan`na University
College of Dentistry
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1st. Stage - Semester: 1

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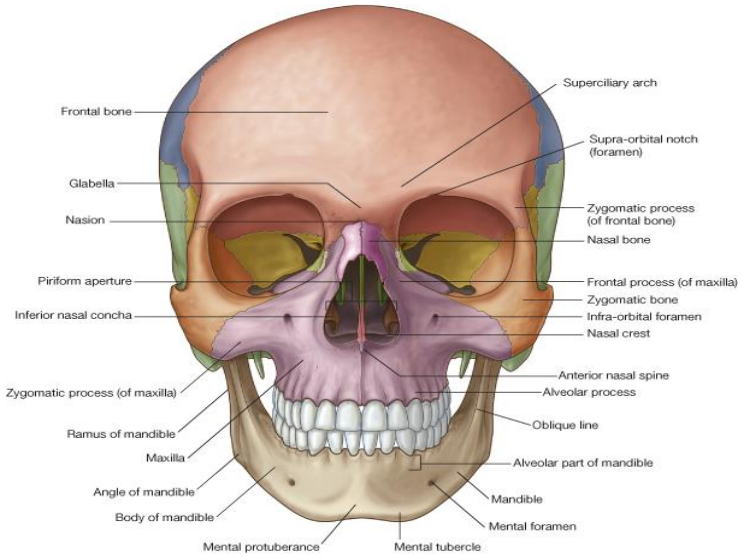
External view of the skull

The skull bones are made up of external and internal tables of compact bone separated by a layer of spongy bone called the diploe, the internal table is thinner and more brittle than the external table. The bones are covered on the outer and inner surfaces with periosteum.

1. Anterior view of the skull

The anterior view of the skull includes the forehead superiorly and the orbits, the nasal region, the part of the face between the orbit and the upper jaw, the upper jaw, and the lower jaw inferiorly.



Frontal bone forms the forehead and the superior part of the rim of each orbit , just superior to the rim of the orbit on each side are the raised superciliary arches, which are more pronounced in men than in women. Between these arches is a small depression (the glabella).

In the medial part of the superior rim of each orbit is the supra-orbital foramen (supra-orbital notch).

Medially, the frontal bone forms a part of the medial rim of the orbit. Laterally, the zygomatic process of the frontal bone forms the upper lateral rim of the orbit, this process articulates with the frontal process of the zygomatic bone.

Zygomatic and nasal bones

The zygomatic bone (the cheekbone) forms the lower lateral rim of the orbit, as well as the lateral part of the inferior rim of the orbit .

Superiorly, in the nasal region the paired nasal bones articulate with each other in the midline, and with the frontal bone superiorly, the center of the frontonasal suture formed by the articulation of the nasal bones and the frontal bone is the Nasion.

Laterally, each nasal bone articulates with the frontal process of each maxilla. Inferiorly, the piriform aperture is the large opening in the nasal region and the anterior opening of the nasal cavity. It is bounded superiorly by the nasal bones and laterally and inferiorly by each maxilla.

Through the piriform aperture ; the fused nasal crests, seen forming the lower part of the bony nasal septum ending anteriorly as the anterior nasal spine, and the paired inferior nasal conchae.

Maxillae

The part of the face between the orbit and the upper teeth and each upper jaw is formed by the paired maxillae. Superiorly, each maxilla contributes to the inferior and medial rims of the orbit.

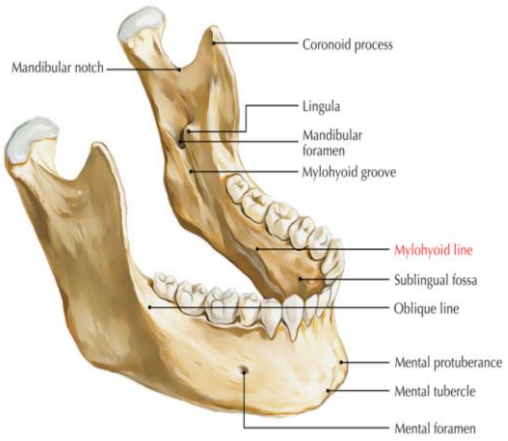
Laterally, the zygomatic process of each maxilla articulates with the zygomatic bone and medially, the frontal process of each maxilla articulates with the frontal bone.

Inferiorly, the body of maxilla lies lateral to the opening of the nasal cavity , just below the inferior rim of the orbit, is the infra-orbital foramen.

Inferiorly, each maxilla ends as the alveolar process, which contains the teeth and forms the upper jaw.

Mandible

The lower jaw (mandible) is the most inferior structure in the anterior view of the skull, it consists of the body of mandible anteriorly and the ramus of mandible posteriorly, they both meet posteriorly at the angle of mandible, all these parts of the mandible are visible, to some extent, in the anterior view. The body of mandible is divided into two parts:



- the lower part is the base of mandible.
- the upper part is the alveolar part of mandible.

The alveolar part of mandible contains the teeth, the base of the mandible has a midline swelling (the mental protuberance) on it`s anterior surface where the two sides of the mandible come together, just lateral to the mental protuberance, on either side, are slightly more pronounced areas (mental tubercles).

Laterally, a mental foramen is visible halfway between the upper border of the alveolar part of mandible and the lower border of the base of mandible, the oblique line passing from the front of the ramus onto the body of the mandible reaching to the mental foramen, it is a point of attachment for muscles that depress the lower lip.

2. Lateral view of the skull

This view consists of the lateral wall of the cranium, which includes lateral portions of the calvaria and the facial skeleton, and half of the lower jaw.

- bones forming the lateral portion of the calvaria include the frontal, parietal, occipital, sphenoid, and temporal bones.
- bones forming the visible part of the facial skeleton include the nasal, maxilla, and zygomatic bones.
- the mandible forms the visible part of the lower jaw.

Lateral portion of the calvaria begins anteriorly with the frontal bone, in upper regions, the frontal bone articulates with the parietal bone at the coronal suture, the parietal bone then articulates with the occipital bone at the lambdoid suture.

In lower parts of the lateral portion of the calvaria, the frontal bone articulates with the greater wing of the sphenoid bone which then articulates with the parietal bone at the sphenoparietal suture, and with the anterior edge of the temporal bone at the sphenosquamous suture.

The junction where the frontal, parietal, sphenoid, and temporal bones are in close proximity is the Pterion.

The final articulation across the lower part of the lateral portion of the calvaria is between the temporal bone and the occipital bone at the occipitomastoid suture.

Temporal bone is a major contributor to the lower portion of the lateral wall of the cranium consisting of several parts:

- the squamous part has the appearance of a large flat plate, forms the anterior and superior parts of the temporal bone.
- the zygomatic process is an anterior bony projection from the squamous part of the temporal bone that initially projects laterally to articulate with the temporal process of the zygomatic bone to form the zygomatic arch.
- Identify the superior and inferior temporal lines, which begin as a single line from the posterior margin of the zygomatic process of the frontal bone and diverge as they arch backward. The temporal fossa lies below the inferior temporal line.
- The infratemporal fossa lies below the infratemporal crest on the greater wing of the sphenoid, the pterygomaxillary fissure is a vertical fissure that lies within the fossa between the pterygoid process of the sphenoid bone and back of the maxilla, it leads medially into the pterygopalatine fossa.

- The pterygopalatine fossa is a small space behind and below the orbital cavity, it communicates laterally with the infratemporal fossa through the pterygomaxillary fissure, medially with the nasal cavity through the sphenopalatine foramen, superiorly with the skull through the foramen rotundum, and anteriorly with the orbit through the inferior orbital fissure.
- The inferior orbital fissure is a horizontal fissure between the greater wing of the sphenoid bone and the maxilla. It leads forward into the orbit.
- immediately below the origin of the zygomatic process from the squamous part of the temporal bone is the tympanic part of the temporal bone, and clearly visible on the surface of this part is the external acoustic opening leading to the external acoustic meatus "ear canal".
- the petromastoid part, which is usually separated into a petrous part and a mastoid part for descriptive purposes.

The mastoid part articulates with the parietal bone superiorly at the parietomastoid suture, and with the occipital bone posteriorly at the occipitomastoid suture, these two sutures are continuous with each other, and the parietomastoid suture is continuous with the squamous suture.

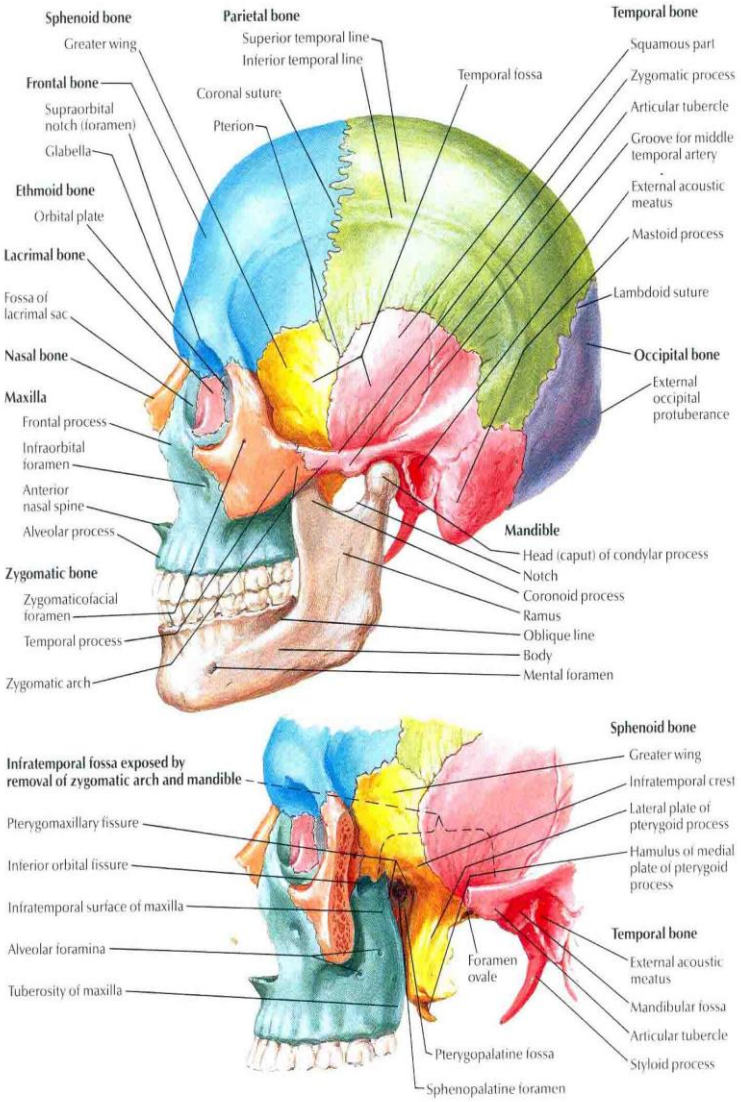
Inferiorly, a large bony prominence "the mastoid process" projects from the inferior border of the mastoid part of the temporal bone, it is a point of attachment for several muscles.

Medial to the mastoid process, the styloid process projects from the lower border of the temporal bone.

Visible part of the facial skeleton in a lateral view of the skull include the nasal, maxilla, and zygomatic bones as follows:

- one of the small, paired nasal bones.
- the maxilla.
- the zygomatic bone.

Usually a small foramen (the zygomaticofacial foramen, is visible on the lateral surface of the zygomatic bone.



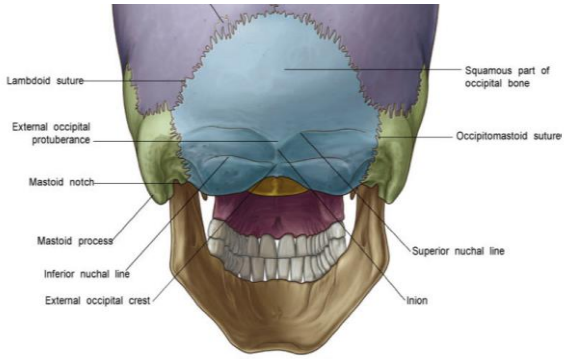
Mandible

The final bony structure visible in a lateral view of the skull is the mandible. it consists of the body, the ramus and the angle of mandible. The teeth are in the alveolar part of mandible of the body and the mental protuberance is visible in this view.

The mental foramen is on the lateral surface of the body and on the superior part of the ramus a condylar process which involved in articulation of the mandible and coronoid process which is the point of attachment for the temporalis muscle.

3. Posterior view

The occipital, parietal, and temporal bones are seen in the posterior view of the skull



Occipital bone

Centrally the flat or squamous part of occipital bone is the main structure in this view of the skull, it

articulates superiorly with the paired parietal bones at the lambdoid suture and laterally with each temporal bone at the occipitomastoid sutures, along the lambdoid suture small islands of bone (sutural bones or wormian bones) may be observed.

Several bony landmarks are visible on the occipital bone. There is a midline projection, "the external occipital protuberance" with curved lines extending laterally from it "superior nuchal lines". The most prominent point of the external occipital protuberance is the Inion. About 1 inch "2.5 cm" below the superior nuchal lines two additional lines "the inferior nuchal lines" curve laterally. Extending downward from the external occipital protuberance is the external occipital crest.

Temporal bones

Laterally, the temporal bones are visible in the posterior view of the skull, with the mastoid processes being the prominent feature . On the inferomedial border of each mastoid process is a notch (the mastoid notch), which is a point of attachment for the posterior belly of the digastric muscle.

4. Superior view

The frontal bone, parietal bones, and occipital bone are seen in a superior view of the skull, these bones make up the superior part of the calvaria or the calva "skullcap".
In an anterior to posterior direction:

- the unpaired frontal bone articulates with the paired parietal bones at the coronal suture.
- the two parietal bones articulate with each other in the midline at the sagittal suture.
- the parietal bones articulate with the unpaired occipital bone at the lambdoid suture.

The junction of the sagittal and coronal sutures is the bregma, and the junction of the sagittal and lambdoid sutures is the lambda.

The only foramen visible in this view of the skull may be the paired parietal foramina, posteriorly, one on each parietal bone just lateral to the sagittal suture.

5. Inferior view

The base of the skull is seen in the inferior view and extends anteriorly from the middle incisor teeth posteriorly to the superior nuchal lines and laterally to the mastoid processes and zygomatic arches.

For descriptive purposes the base of the skull is often divided into:

- an anterior part, which includes the teeth and the hard palate.
- a middle part, which extends from behind the hard palate to the anterior margin of the foramen magnum.
- a posterior part, which extends from the anterior edge of the foramen magnum to the superior nuchal lines.

a. anterior part : the main features of the anterior part of the base of the skull are the teeth and the hard palate.

The teeth project from the alveolar arches of the two maxillae, these arches are arranged in a U-shaped configuration that borders the hard palate on three sides.

The hard palate is composed of the palatine processes of each maxilla anteriorly and the horizontal plates of each palatine bone posteriorly.

The paired palatine processes of each maxilla meet in the midline at the intermaxillary suture, the paired maxilla and the paired palatine bones meet at the palatomaxillary suture, and the paired horizontal plates of each palatine bone meet in the midline at the interpalatine suture.

Several additional features are also visible when the hard palate is examined:

- the incisive fossa in the anterior midline immediately posterior to the teeth, the walls of which contain incisive foramina "the openings of the incisive canals, which are passageways between the hard palate and nasal cavity".
- the greater palatine foramina near the posterolateral border of the hard palate on each side, which lead to greater palatine canals.

- just posterior to the greater palatine foramina, the lesser palatine foramina which lead to lesser palatine canals.
- a midline pointed projection "the posterior nasal spine" in the free posterior border of the hard palate.

b. middle part , the middle part of the base of the skull is complex:

- forming the anterior half are the vomer and sphenoid bones.
- forming the posterior half are the occipital and paired temporal bones.

- *the anterior half*

Vomer

Anteriorly, the small vomer is in the midline, resting on the sphenoid bone, it contributes to the formation of the bony nasal septum separating the two choanae.

Sphenoid

Most of the anterior part of the middle part of the base of the skull consists of the sphenoid bone, which is made up of a centrally placed body, paired greater and lesser wings projecting laterally from the body, and two downward projecting pterygoid processes immediately lateral to each choana. Three parts of the sphenoid bone, the body, greater wings, and pterygoid processes are seen in the inferior view of the skull

- *the posterior half*

In the posterior half of the middle part of the base of the skull are the occipital bone and the paired temporal bones

Occipital bone

This bone, or more specifically it`s basilar part, is in the midline immediately posterior to the body of the sphenoid, extending posteriorly to the foramen magnum and is bounded laterally by the temporal bones.

Prominent on the basilar part of the occipital bone is the pharyngeal tubercle, a bony protuberance for the attachment of parts of the pharynx to the base of the skull

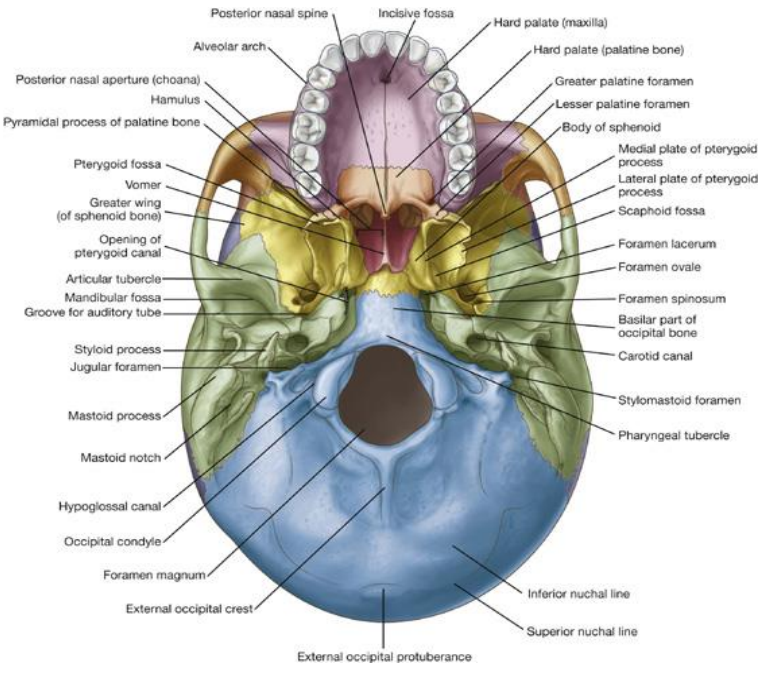
Temporal bone

Immediately lateral to the basilar part of the occipital bone is the petrous part of the petromastoid part of each temporal bone. Wedge-shaped in it`s appearance, with it`s apex anteromedial, the petrous part of the temporal bone is between the greater wing of the sphenoid anteriorly and the basilar part of the occipital bone posteriorly, the apex forms one of the boundaries of the foramen lacerum, an irregular opening filled in life with cartilage.

Posterolateral from the foramen lacerum is the large circular opening for the carotid canal.

Between the petrous part of the temporal bone and the greater wing of the sphenoid is a groove for the cartilaginous part of the pharyngotympanic tube "auditory tube" this groove continues posterolaterally into a bony canal in the petrous part of the temporal bone for the pharyngotympanic tube.

Just lateral to the greater wing of the sphenoid is the squamous part of the temporal bone, which participates in the temporomandibular joint. It contains the mandibular fossa, which is a concavity where the head of the mandible articulates with the base of the skull. An important feature of this articulation is the



prominent articular tubercle, which is the downward projection of the anterior border of the mandibular fossa.

c. posterior part extends from the anterior edge of the foramen magnum posteriorly to the superior nuchal lines, it consists of parts of the occipital bone centrally and the temporal bones laterally.

Occipital bone

The occipital bone is the major bony element of this part of the base of the skull, it has four parts ; the squamous part, which is posterior to the foramen magnum, the lateral parts, which are lateral to the foramen magnum, and the basilar part, which is anterior to the foramen magnum.

On each anterolateral border of the foramen magnum are the rounded occipital condyles, these paired structures articulate with the atlas "vertebra CI" , posterior to each condyle is a depression "the condylar fossa" containing a condylar canal, and anterior and superior to each condyle is the large hypoglossal canal. Lateral to each hypoglossal canal is a large, irregular jugular foramen.

Temporal bone

Laterally in the posterior part of the base of the skull is the temporal bone, the parts of the temporal bone seen in this location are the mastoid part of the petromastoid part and the styloid process.

The lateral edge of the mastoid part is identified by mastoid process and the mastoid notch, Anteromedial to the mastoid process is the needle-shaped styloid process projecting from the lower border of the temporal bone , between the styloid process and the mastoid process is the stylomastoid foramen.

Al- Muthan`na University
College of Dentistry
Dept. of Anatomy
Semester: 1

Gross Anatomy
Head & Neck
Lec. : 8
Date: Thursday. 9th. Feb. 2023

Cranial cavity

The cranial cavity is the space within the calvaria that contains the brain, meninges, proximal parts of the cranial nerves, blood vessels, and cranial venous sinuses.

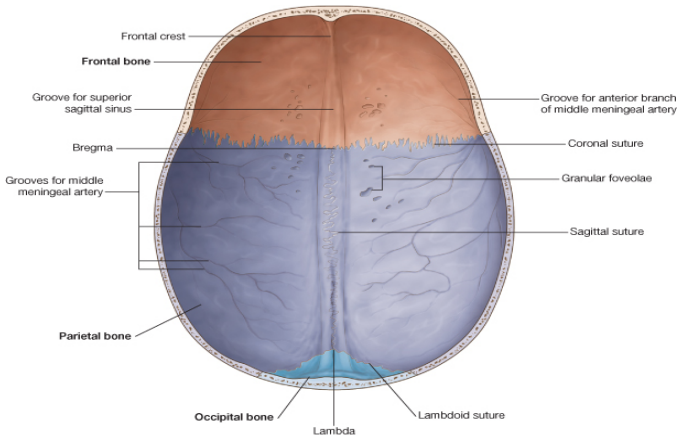
Roof

The calva (vault) is the dome - shaped roof that protects the superior aspect of the brain, it consists of the frontal bone anteriorly, the paired parietal bones in the middle, and the occipital bone posteriorly.

Sutures visible internally include:

- the coronal suture, between the frontal and parietal bones;
- the sagittal suture, between the paired parietal bones;
- the lambdoid suture, between the parietal and occipital bones.

Visible junctions of these sutures are the bregma, where the coronal and sagittal sutures meet, and the lambda, where the lambdoid and sagittal sutures meet, other markings on the internal surface of the calva include; bony ridges, and numerous grooves and pits. From anterior to posterior, features seen are;



* a midline ridge of bone extending from the surface of the frontal bone (the frontal crest), which is a point of attachment for the falx cerebri "a specialization of the dura mater that partially separates the two cerebral hemispheres"
* at the superior point of the termination of the frontal crest the beginning of the groove for the superior sagittal sinus, which widens and deepens posteriorly and marks the position of the superior sagittal sinus "an intra - dural venous structure"
* on either side of the groove for the superior sagittal sinus throughout its course, a small number of depressions and pits "the granular foveolae", which mark the location of arachnoid granulations
* on the lateral aspects of the roof of the cranial cavity, smaller grooves created by various meningeal vessels.

Floor

The floor of the cranial cavity is divided into anterior, middle, and posterior cranial fossae.

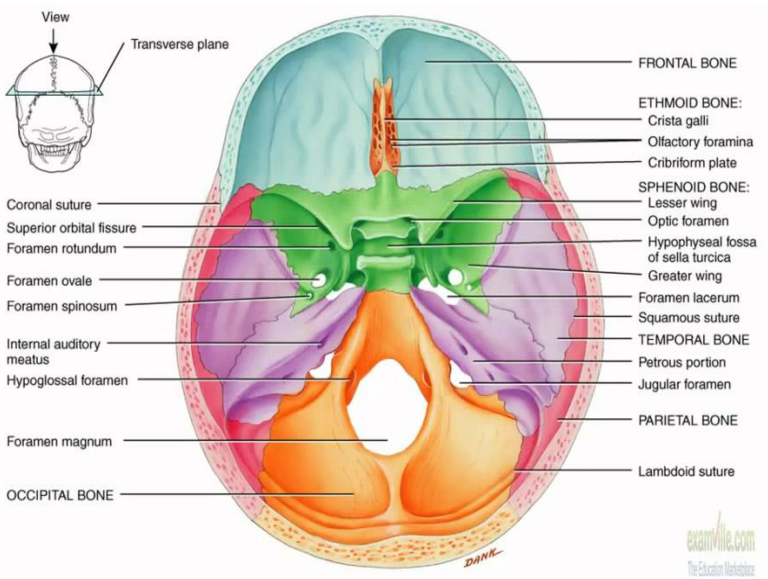
Anterior cranial fossa

Parts of the frontal, ethmoid, and sphenoid bones form the anterior cranial fossa, it`s floor is composed of:

- frontal bone in the anterior and lateral direction
- ethmoid bone in the midline
- two parts of the sphenoid bone, the body, and lesser wing, posteriorly.

The anterior cranial fossa is above the nasal cavity and the orbits, and it is filled by the frontal lobes of the cerebral hemispheres, anteriorly, a small wedge-shaped midline crest of bone "the frontal crest" projects from the frontal bone, it is a point of attachment for the falx cerebri , which is the vertical extension of dura mater partially separating the two cerebral hemispheres.

Immediately posterior to the frontal crest is the foramen caecum, lying between the frontal and ethmoid bones , it may transmit emissary veins connecting the nasal cavity with the superior sagittal sinus.

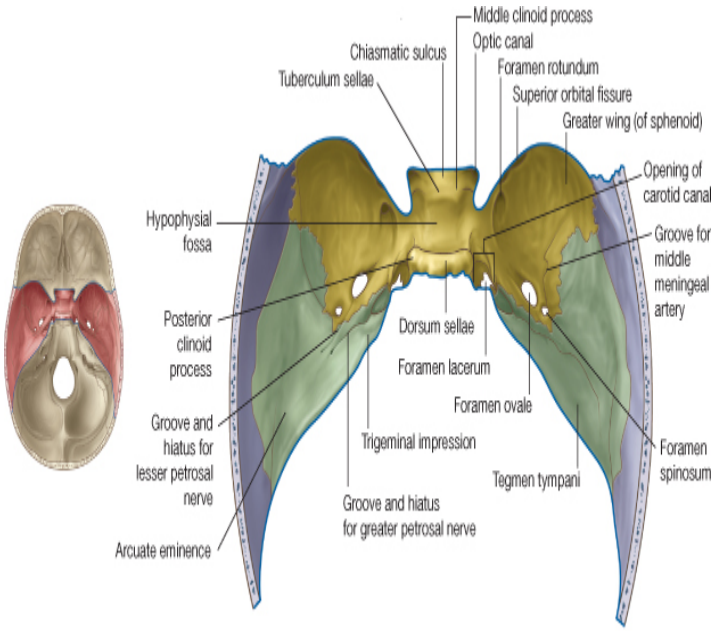


Posterior to the frontal crest is a wedge bone projecting superiorly from the ethmoid "the crista galli" , it`s another point of attachment of the falx cerebri.

Lateral to the crista galli is the cribriform plate of the ethmoid bone , it`s a sieve-like structure, allows small olfactory nerve [I] fibers to pass through it`s foramina from the nasal mucosa to the olfactory bulb.

On each side of the ethmoid, the floor of the anterior cranial fossa is formed by thin plates of frontal bone "the orbital part of the frontal bone", which also forms the roof of the orbit below.

Posterior to both the frontal and ethmoid bones, the rest of the floor of the anterior cranial fossa is formed by the body and lesser wings of the sphenoid. In the midline, the body extends anteriorly between the orbital parts of the frontal bone to reach the ethmoid bone and posteriorly it extends into the middle cranial fossa.



The boundary between the anterior and middle cranial fossae in the midline is the anterior edge of the chiasmatic sulcus, a smooth groove stretching between the optic canals across the body of the sphenoid.

Lesser wings of the sphenoid

The two lesser wings of the sphenoid project laterally from the body of the sphenoid and forming the boundary between the lateral parts of the anterior and middle cranial fossae.

Each lesser wing ends laterally as a sharp point at the junction of the frontal bone and the greater wing of the sphenoid near the upper lateral edge of the superior orbital fissure.

Medially each lesser wing widens and ends as a rounded anterior clinoid process, just anterior to each anterior clinoid process is a circular opening in the lesser wing of the sphenoid (the optic canal), through which the ophthalmic artery and optic nerve [II] pass as they exit the cranial cavity to enter the orbit, the optic canals are usually included in the middle cranial fossa.

Middle cranial fossa

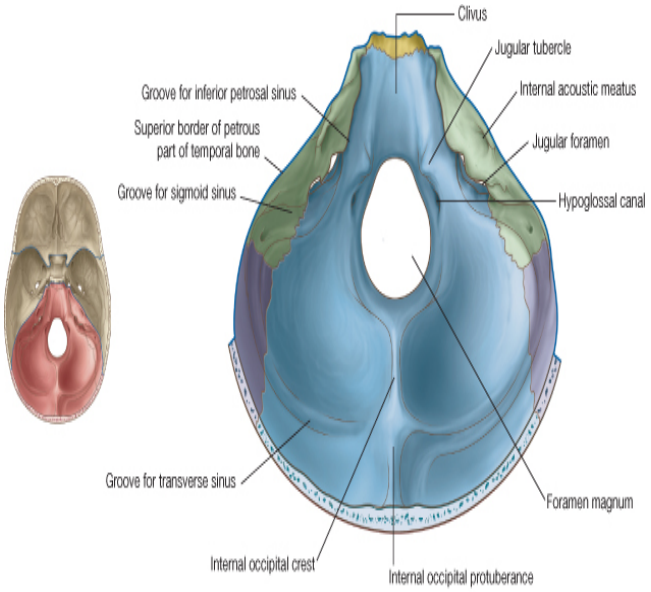
The middle cranial fossa consists of parts of the sphenoid and temporal bones, the boundary between the anterior and middle cranial fossae in the midline is the anterior edge of the chiasmatic

sulcus, which is a smooth groove stretching between the optic canals across the body of the sphenoid.

The posterior boundaries of the middle cranial fossa are formed by the anterior surface of the superior border of the petrous part of the petromastoid part of the temporal bone.

Sphenoid

The floor in the midline of the middle cranial fossa is elevated and formed by the body of the sphenoid, lateral to this are large depressions formed on either side by the greater wing of the sphenoid and the squamous part of the temporal bone. These depressions contain the temporal lobes of the brain.



Sella turcica

Just posterior to the chiasmatic sulcus is the modified remaining of the body of the sphenoid "the sella turcica", which consists of a deep central area "the hypophysial fossa" containing the pituitary gland with anterior and posterior vertical walls of bone.

The anterior wall of the sella is the "tuberculum sellae" a vertical wall of bone, lateral projections from the corners of the tuberculum sellae "the middle clinoid processes" are sometimes present.

The posterior wall of the sella turcica is the "dorsum sellae", a large ridge of bone , at the top of this bony ridge the lateral edges contain rounded projections "the posterior clinoid processes", which are points of attachment, like the anterior clinoid processes, for the tentorium cerebelli.

Fissures and foramina

Lateral to each side of the body of the sphenoid, the floor of the middle cranial fossa is formed on either side by the greater wing of the sphenoid.

Superior orbital fissure is a gup separates the greater wing of the sphenoid from the lesser wing and is a major passageway between the middle cranial fossa and the orbit.

Posterior to the medial end of the superior orbital fissure on the floor of the middle cranial fossa is a rounded foramen projecting in an anterior direction "the foramen rotundum".

Posterolateral to the foramen rotundum is a large oval opening "the foramen ovale", which allows structures to pass between the infratemporal fossa and the middle cranial fossa. Posterolateral from the foramen ovale is the small foramen spinosum , this opening also connects the infratemporal fossa with the middle cranial fossa.

Posteromedial to the foramen ovale is the rounded opening of the carotid canal, directly inferior to this opening is an irregular foramen "the foramen lacerum", clearly observed in the inferior view of the skull, the foramen lacerum is closed in life by a cartilaginous plug and no structures pass through it completely.

Temporal bone

The posterior boundary of the middle cranial fossa is formed by the anterior surface of the petrous part of the petromastoid part of the temporal bone. Medially, there is a slight depression (trigeminal impression) in the anterior surface of the petrous part of the temporal bone , which marks the location of the sensory ganglion for the trigeminal nerve [V].

Lateral to the trigeminal impression and on the anterior surface of the petrous part of the temporal bone is a small linear groove that passes in a superolateral direction, and ends in a

foramen (the groove and hiatus for the greater petrosal nerve), the greater petrosal nerve is a branch of the facial nerve [VII].

Anterolateral to the groove for the greater petrosal nerve is a second, smaller groove and hiatus for the lesser petrosal nerve, a branch from the tympanic plexus , above and lateral to the small openings for the greater and lesser petrosal nerves, near the superior ridge of the petrous part of the temporal bone, is a rounded protrusion of bone (the arcuate eminence) produced by the underlying anterior semicircular canal of the inner ear.

Just anterior and lateral to the arcuate eminence the anterior surface of the petrous part of the temporal bone is slightly depressed, this region is the tegmen tympani, and marks the thin bony roof of the middle ear cavity.

Posterior cranial fossa

The posterior cranial fossa consists mostly of parts of the temporal and occipital bones with small contributions from the sphenoid and parietal bones . It is the largest and deepest of the three cranial fossae and contains the brainstem (midbrain, pons, and medulla) and the cerebellum.

Boundaries

The anterior boundaries of the posterior cranial fossa in the midline are the dorsum sellae and the clivus, the clivus is a slope of bone that extends upwards from the foramen magnum. It is formed by contributions from the body of the sphenoid and from the basilar part of the occipital bone.

Laterally the anterior boundaries of the posterior cranial fossa are the superior border of the petrous part of the petromastoid part of the temporal bone, posteriorly the squamous part of the occipital bone to the level of the transverse groove is the major boundary, while laterally the petromastoid part of the temporal bone and small parts of the occipital and parietal bones border the fossa.

Foramen magnum

Centrally, in the deepest part of the posterior cranial fossa, is the largest foramen in the skull, the foramen magnum. It is surrounded by the basilar part of the occipital bone anteriorly, the lateral parts of the occipital bone on either side, and the squamous part of the occipital bone posteriorly.

The spinal cord passes superiorly through the foramen magnum to continue as the brainstem, also passing through the foramen magnum are the vertebral arteries, the meninges, and the spinal roots of the accessory nerve [XI].

Grooves and foramina

The clivus slopes upwards from the foramen magnum, lateral to the clivus is a groove for the inferior petrosal sinus between the basilar part of the occipital bone and the petrous part of the petromastoid part of the temporal bone.

Laterally, across the upper half of the posterior surface of the petrous part of the temporal bone, is an oval foramen "the internal acoustic meatus", the facial [VII] and vestibulocochlear [VIII] nerves, and the labyrinthine artery pass through it.

Inferior to the internal acoustic meatus the temporal bone is separated from the occipital bone by the large jugular foramen, leading to this foramen from the medial side is the groove for the inferior petrosal sinus, and from the lateral side the groove for the sigmoid sinus.

The sigmoid sinus passes into the jugular foramen, and is continuous with the internal jugular vein, while the inferior petrosal sinus empties into the internal jugular vein in the area of the jugular foramen. Just Inferior to the jugular foramen and superior to the foramen magnum, is the hypoglossal canal, posterolateral to the hypoglossal canal is the small condylar canal that, when present, transmits an emissary vein.

Squamous part of the occipital bone

The squamous part of the occipital bone has several prominent features;

- running upwards in the midline from the foramen magnum is the internal occipital crest.
- on either side of the internal occipital crest the floor of the posterior cranial fossa is concave to accommodate the cerebellar hemispheres.
- the internal occipital crest ends superiorly in a bony prominence "the internal occipital protuberance".
- extending laterally from the internal occipital protuberance are grooves produced by the transverse sinuses, which continue laterally, eventually joining a groove for each sigmoid sinus-each of these grooves then turns inferiorly towards the jugular foramina, the transverse and sigmoid sinuses are intra-dural venous sinuses.

Internal foramina of the skull

Foramen	**Structures passing through foramen**
Anterior cranial fossa	
Foramen caecum	Emissary veins to nasal cavity
Olfactory foramina in cribriform plate	Olfactory nerves [I]
Optic canal	Optic nerve [II]; ophthalmic artery
Middle cranial fossa	
Superior orbital fissure	Oculomotor nerve [III]; trochlear nerve [IV]; ophthalmic division of the trigeminal nerve [V_1]; abducent nerve [VI]; ophthalmic veins
Foramen rotundum	Maxillary division of the trigeminal nerve [V_2]
Foramen ovale	Mandibular division of the trigeminal nerve [V_3]; lesser petrosal nerve
Foramen spinosum	Middle meningeal artery
Hiatus for the greater petrosal nerve	Greater petrosal nerve
Hiatus for the lesser petrosal nerve	Lesser petrosal nerve
Posterior cranial fossa	
Foramen magnum	End of brainstem/beginning of spinal cord; vertebral arteries; spinal roots of the accessory nerve; meninges
Internal acoustic meatus	Facial nerve [VII]; vestibulocochlear nerve [VIII]; labyrinthine artery
Jugular foramen	Glossopharyngeal nerve [IX]; vagus nerve [X]; accessory nerve [XI]; inferior petrosal sinus, sigmoid sinus (forming internal jugular vein)
Hypoglossal canal	Hypoglossal nerve [XII]; meningeal branch of the ascending pharyngeal artery
Condylar canal	Emissary vein

Al- Muthan`na University
College of Dentistry
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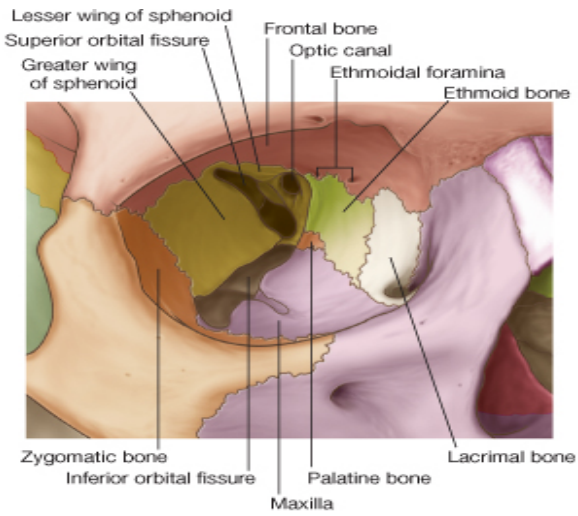
Skeleton of the orbital region

The orbit is a pyramidal cavity (هرمي) with its base in front and its apex behind, the orbital margin is formed above by the frontal bone, the lateral margin is formed by the processes of the frontal and zygomatic bones, the inferior margin is formed by the zygomatic bone and the maxilla, and the medial margin is formed by the processes of the maxilla and the frontal bone.

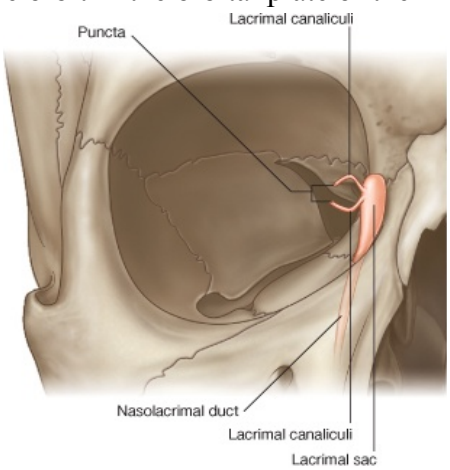


- *the roof* is formed by the orbital plate of the frontal bone, which separates the orbital cavity from the anterior cranial fossa and the frontal lobe of the cerebral hemisphere.
- *the lateral wall* is formed by the zygomatic bone and the greater wing of the sphenoid.
- *the floor* is formed by the orbital plate of the maxilla, which separates the orbital cavity from the maxillary sinus
- *the medial wall* is formed from before backward by the frontal process of the maxilla, the lacrimal bone, the orbital plate of the ethmoid (which separates the orbital cavity from the ethmoid sinuses), and the body of the sphenoid.

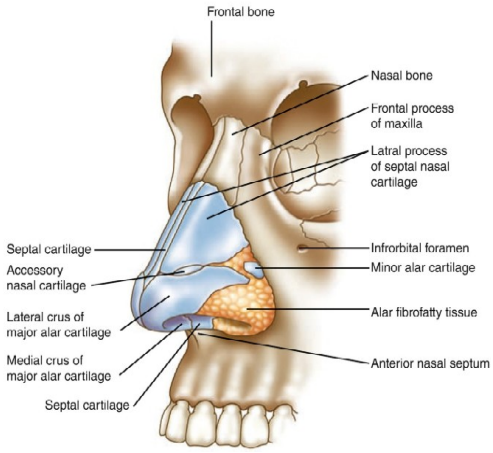
Openings in to the orbital cavity

The openings into the orbital cavity are:

- ***Orbital opening**:* lies anteriorly, about one-sixth of the eye is exposed; the remainder is protected by the walls of the orbit.
- ***Supraorbital notch (foramen):*** the supraorbital notch is situated on the superior orbital margin, it transmits the supraorbital nerve and blood vessels.
- ***Infraorbital groove and canal**:* situated on the floor of the orbit in the orbital plate of the maxilla, they transmit the infraorbital nerve (a continuation of the maxillary nerve) and blood vessels.



- ***Nasolacrimal canal**:* located anteriorly on the medial wall; it communicates with the inferior meatus of the nose, it transmits the nasolacrimal duct.
- ***Inferior orbital fissure**:* located posteriorly between the maxilla and the greater wing of the sphenoid, it communicates with the pterygopalatine fossa, it transmits the maxillary nerve and it`s zygomatic branch, the inferior ophthalmic vein, and sympathetic nerves.
- ***Superior orbital fissure**:* located posteriorly between the greater and lesser wings of the sphenoid, it communicates with the middle cranial fossa, it transmits the lacrimal nerve, the frontal nerve, the trochlear nerve, the oculomotor nerve (upper and lower divisions), the abducent nerve, the nasociliary nerve, and the superior ophthalmic vein.



- ***Optic canal***: located posteriorly in the lesser wing of the sphenoid, it communicates with the middle cranial fossa, it transmits the optic nerve and the ophthalmic artery.

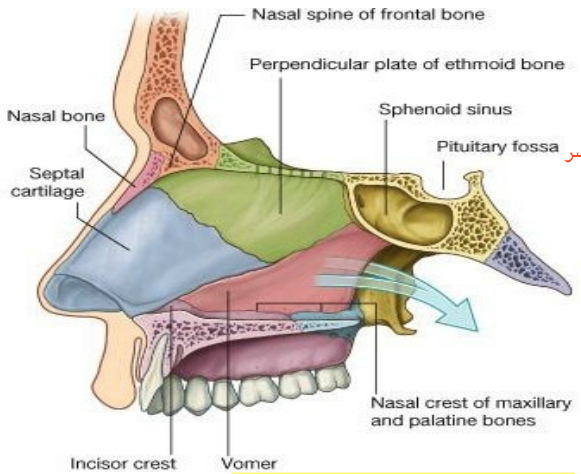
Skeleton of the external nose

The external nose has two elliptical orifices called the nostrils, which are separated from each other by the nasal septum, the lateral margin, the ala nasi, is rounded and mobile.

The framework of the external nose is made up above by the nasal bones, the frontal processes of the maxillae, and the nasal part of the frontal bone, below, the framework is formed of plates of hyaline cartilage.

Skeleton of the nasal cavity

The nasal cavity extends from the nostrils in front to the posterior nasal apertures or choanae behind, where the nose opens into the nasopharynx, the nasal vestibule is the area of the nasal cavity lying just inside the nostril , the nasal cavity is divided into right and left halves by the nasal septum, the septum is made up of the septal cartilage, the vertical plate of the ethmoid, and the vomer. Each half of the nasal cavity has a floor, a roof, a lateral wall, and a medial or septal wall.

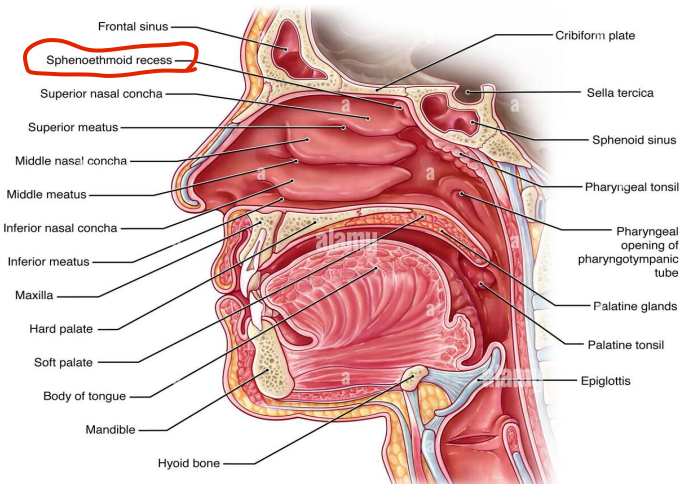


Floor is formed of the palatine process of the maxilla and the horizontal plate of the palatine bone.

Roof is narrow and is formed anteriorly beneath the bridge of the nose by the nasal and frontal bones, in the middle by the cribriform plate of the ethmoid, located beneath the anterior cranial fossa, and posteriorly by the downward sloping body of the sphenoid.

Lateral wall has three projections of bone called the superior, middle, and inferior nasal conchae, the space below each concha is called a meatus.

Sphenoethmoidal recess is a small area above the superior concha, it receives the opening of the sphenoid air sinus.

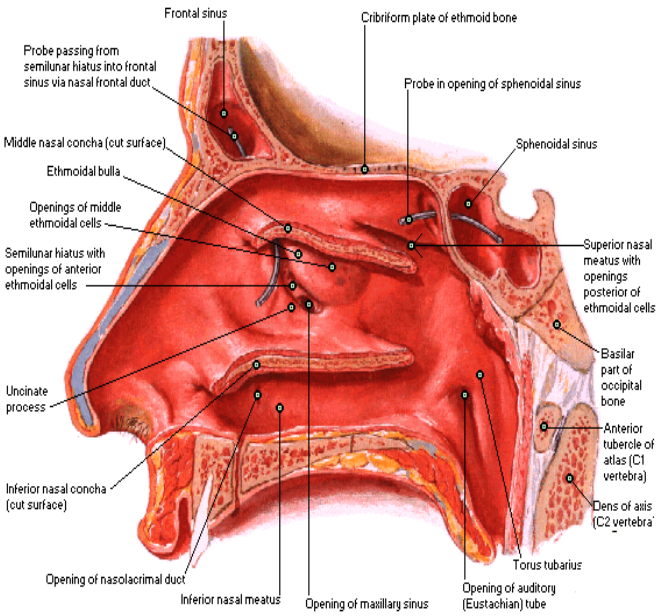


Superior meatus lies below the superior concha, it receives the openings of the posterior ethmoid sinuses.

Middle meatus lies below the middle concha, it has a rounded swelling called the bulla ethmoidalis that is formed by the middle ethmoidal air sinuses, which open on its upper border. A curved opening, the hiatus semilunaris, lies just below the bulla, the anterior end of the hiatus leads into a funnel-shaped channel called the infundibulum, which is continuous with the frontal sinus. The maxillary sinus opens into the middle meatus through the hiatus semilunaris.

Inferior meatus lies below the inferior concha and receives the opening of the lower end of the nasolacrimal duct, which is guarded by a fold of mucous membrane.

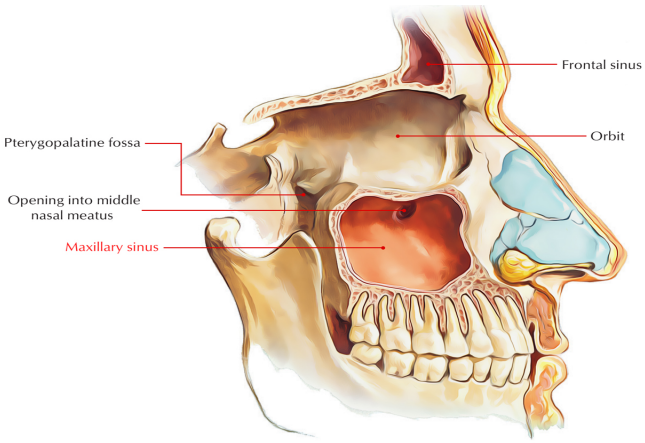
Medial wall is formed by the nasal septum, the upper part is formed by the vertical plate of the ethmoid and the vomer, the anterior part is formed by the septal cartilage. The septum rarely lies in the midline, thus increasing the size of one half of the nasal cavity and decreasing the size of the other.



Para nasal sinuses

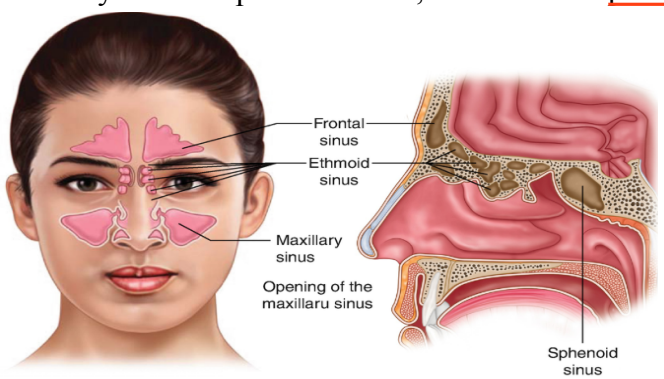
Are cavities found in the interior of the maxilla, frontal, sphenoid, and ethmoid bones, they are lined with mucoperiosteum and filled with air; they communicate with the nasal cavity through relatively small apertures. ثقب

The maxillary sinus is pyramidal in shape and located within the body of the maxilla behind the skin of the cheek, it`s roof is formed by the floor of the orbit, and the floor is related to the roots of the premolars and molar teeth, the maxillary sinus opens into the middle meatus of the nose through the hiatus semilunaris.



The frontal sinuses are two and contained within the frontal bone, they are separated from each other by a bony septum, each sinus is roughly triangular, extending upward above the medial end of the eyebrow حاجب and backward into the medial part of the roof of the orbit, each frontal sinus opens into the middle meatus of the nose through the infundibulum.

The sphenoidal sinuses also two and lie within the body of the sphenoid bone, each sinus opens into the Sphenoethmoidal recess above the superior concha.



The ethmoid sinuses are three: anterior, middle, and posterior and they are contained within the ethmoid bone, between the nose and the orbit, they are separated from the latter by a thin plate of bone so that infection can readily spread from the sinuses into the orbit. كبل

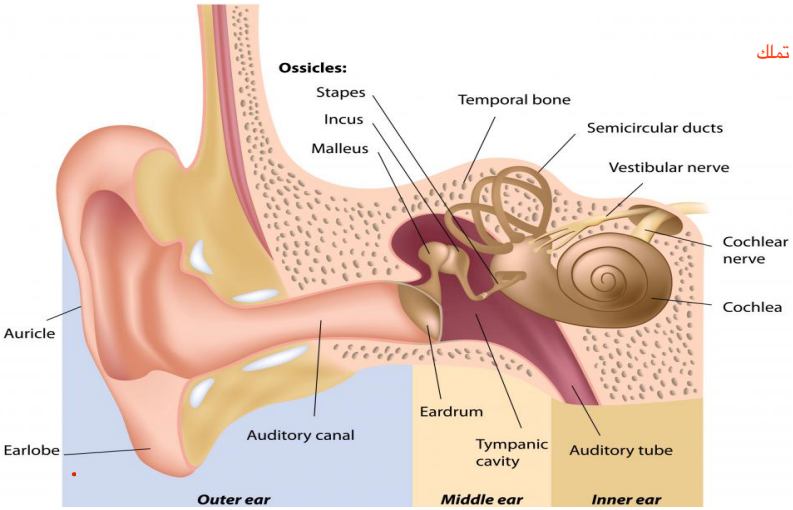
The anterior sinuses open into the infundibulum; the middle sinuses open into the middle meatus, on or above the bulla ethmoidalis; and the posterior sinuses open into the superior meatus, the table below shows the paranasal sinuses and their site of drainage in to the nose:

موقع التفريغ

Sinus	**Site of Drainage**
Maxillary sinus	Middle meatus through hiatus semilunaris
Frontal sinuses	Middle meatus via infundibulum
Sphenoidal sinuses	Sphenoethmoidal recess
Ethmoidal sinuses	
Anterior group	Infundibulum and into middle meatus
Middle group	Middle meatus on or above bulla ethmoidalis
Posterior group	Superior meatus

Auditory ossicles

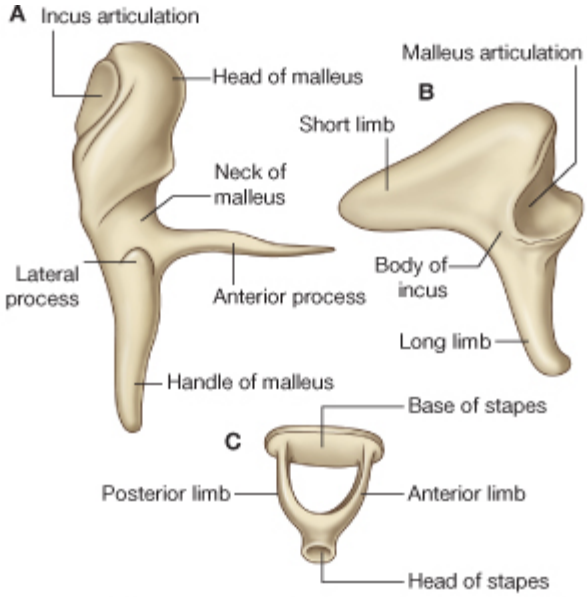
The auditory ossicles are the malleus, incus, and stapes.



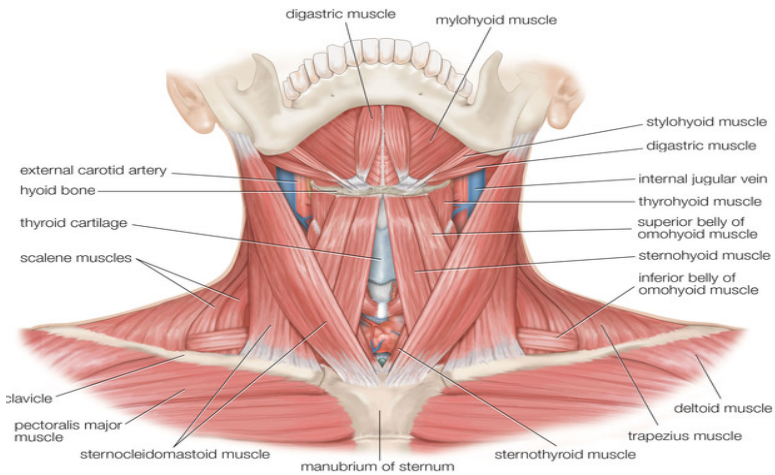
تملك

The malleus is the largest ossicle and possesses a head, a neck, a long process or handle, an anterior process, and a lateral process, the head is rounded and articulates posteriorly with the incus, the neck is the constricted part below the head, the handle passes downward and backward and is firmly attached to the medial surface of the tympanic membrane. It can be seen through the tympanic membrane on otoscopic examination, the anterior process is a spicule of bone that is connected to the anterior wall of the tympanic cavity by a ligament, yhe lateral process projects laterally and is attached to the anterior and posterior malleolar folds of the tympanic membrane.

The incus possesses a large body and two processes, the body is rounded and articulates anteriorly with the head of the malleus, the long process descends behind and parallel to the handle of the malleus, it`s lower end bends medially and articulates with the head of the stapes. It`s shadow on the tympanic membrane can sometimes be recognized on otoscopic examination, the short process projects backward and is attached to the posterior wall of the tympanic cavity by a ligament.

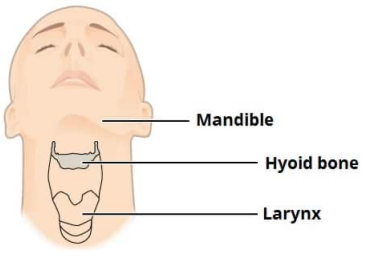


The stapes has a head, a neck, two limbs, and a base , the head is small and articulates with the long process of the incus, the neck is narrow and receives the insertion of the stapedius muscle. The two limbs diverge يفترقن from the neck and are attached to the oval بيضويه base, the edge of the base is attached to the margin of the fenestra vestibuli by a ring of fibrous tissue, the anular ligament.

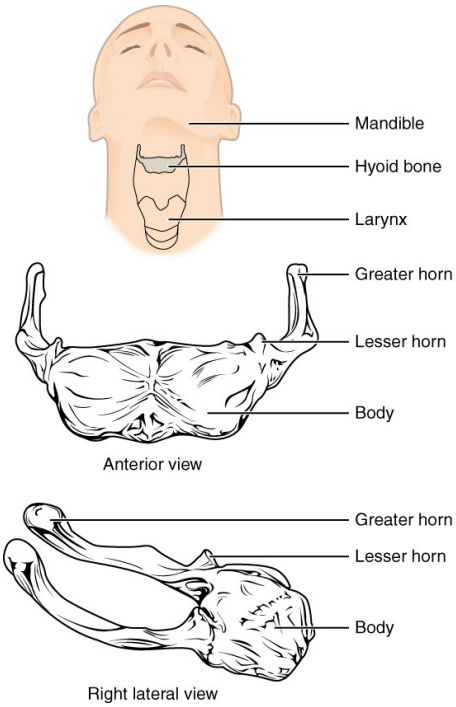


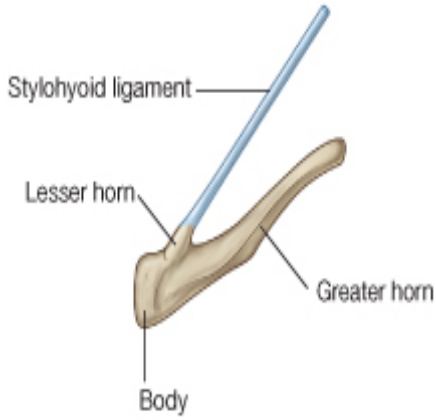
Hyoid bone

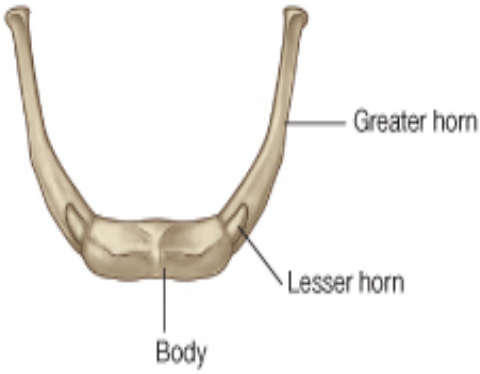
Is a small U-shaped bone in the neck between the larynx and the mandible, it has an anterior body and two large greater horns, one on each side, which project posteriorly and superiorly from the body, there are two small conical lesser horns on the superior surface where the greater horns join with the body, stylohyoid ligaments attach to the apices of the lesser horns.



The hyoid bone is a key bone in the neck because it connects the floor of the oral cavity in front with the pharynx behind and the larynx below.







Al- Muthan`na University
College of Dentistry
Dept. of Basic Medical Science
1st. Stage - Semester: 2

Anatomy for Dentistry
Lec. : 10
Date: Thurs. Mar. 23 2023

Basic anatomy

Vertebral column

The vertebral column is a vertical series (سلسلة) of approximately 33 small bones (known as vertebrae), which are separated by intervertebral discs, it can be divided into five different regions, each region characterized by a different vertebral structure. The vertebral column has four main functions:

- Protection; encloses and protects the spinal cord within the spinal canal.
- Support; carries the weight of the body above the pelvis.
- Axis; forms the central axis of the body.
- Movement; has roles in both posture and movement.

All vertebrae share a basic common structure, they each consist of a vertebral body, situated anteriorly, and a posterior vertebral arch.

The vertebral body

The vertebral body is the anterior part of the vertebrae, it is the weight-bearing (يتحمل الوزن) component, and it`s size increases as the vertebral column descends (مع النزول) (having to support increasing amounts of weight), the superior and inferior aspects of the vertebral body are lined with hyaline cartilage, adjacent vertebral bodies are separated by a fibrocartilginous intervertebral disc.

The vertebral arch

The vertebral arch refers to the lateral and posterior parts of the vertebrae, with the vertebral body, the vertebral arch forms an enclosed hole, called a vertebral foramen. the foramina of the all vertebrae line up to form the vertebral canal, which encloses the spinal cord. Vertebral arches have a number of bony prominences, which act as attachment sites for muscles and ligaments:

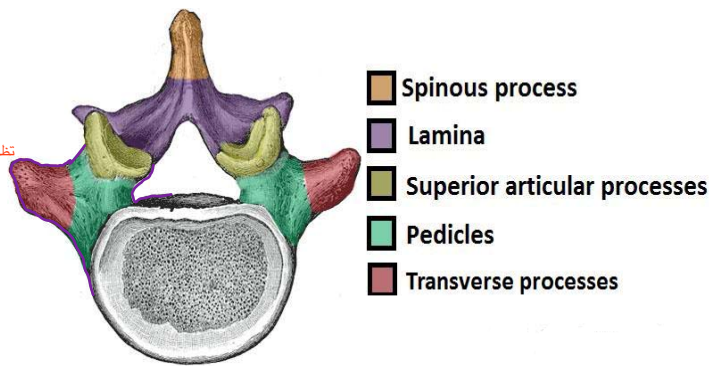
Pedicles: they are two; one on left and one right, they point posteriorly, meeting the flatter laminae.

Lamina: is the bone between the transverse and spinal processes.

Transverse processes: these extend laterally and posteriorly away from the pedicles, in the thoracic vertebrae, the transverse processes articulate with the ribs.

Articular processes: at the junction of the lamina and the pedicles, superior and inferior processes arise, these articulate (تظهر) with the articular processes of the vertebrae above and below.

Spinous processes: posterior and inferior projection of bone, a site of attachment for muscles and ligaments.

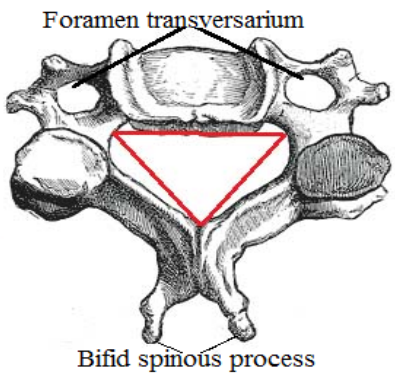


Classification of vertebrae

Cervical vertebrae

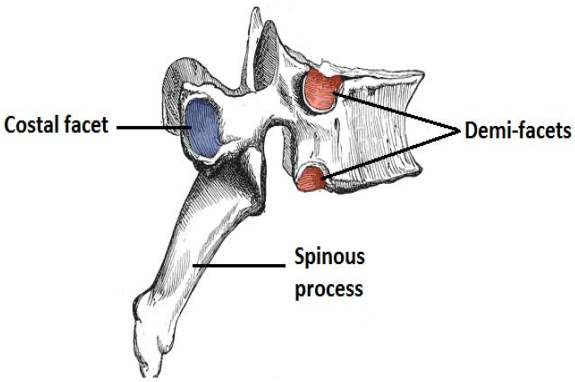
There are seven cervical vertebrae in the human body, they have three main distinguishing features:

- The spinous process bifurcates into two parts, and so is k process.
- There are two transverse foramina, one in each transverse process, these conduct the vertebral arteries. تصرف
- The vertebral foramen is triangular in shape
- There are some cervical vertebrae that are unique. C1 and C2 (called the atlas and axis respectively), are specialized to allow for the movement of the head. فريد من نوعه
- The C7 vertebrae have a much longer spinous process, which does not bifurcate.



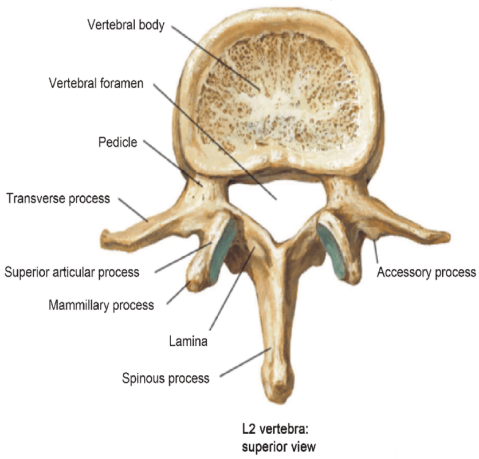
Thoracic vertebrae

The twelve thoracic vertebrae are medium-sized, and increase in size as they move down, their main function is to articulate with ribs, producing the bony thorax.



Each thoracic vertebrae has two "demi facets " on each side of it`s vertebral body which articulate with the head of the respective rib, and the rib inferior to it. On the transverse processes of the thoracic vertebrae there is a costal facet for articulation with the respective "tubercle of the rib". بالتسلسل

The spinous processes are slanted inferiorly and anteriorly, this offers increased protection to the spinal cord, preventing an object like a knife entering the spinal canal through the intervertebral discs, in contrast to the cervical vertebrae, the vertebral foramen is circular. تميل يمنع



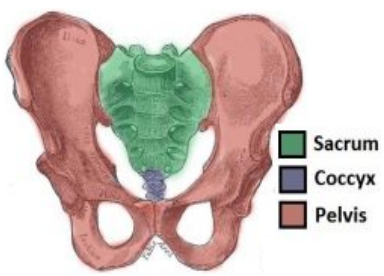
L2 vertebra: superior view

زياده

Lumber vertebrae

These are the largest of the vertebrae, of which there are five, they act to support the weight of the upper body, and have various specializations to enable them do this , lumbar vertebrae have very large vertebral bodies, which are kidney-shaped, lacking the characteristic features of other vertebrae, with no transverse foramina, costal facets, or bifid spinous processes. However, like the cervical vertebrae, they have a triangular shaped vertebral foramen.

تفتقر الى



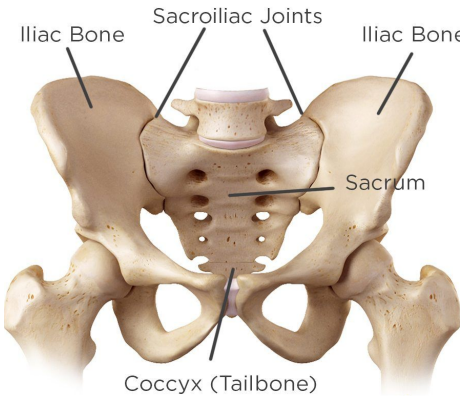
Sacrum & coccyx

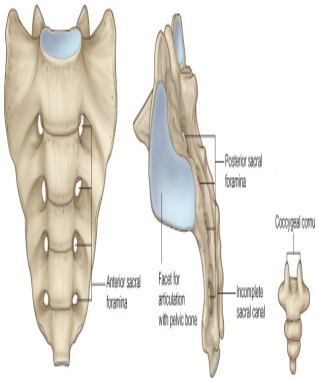
The sacrum is a collection of five fused vertebrae, it is described as an upside down triangle, with the apex pointing inferiorly, on the lateral walls of the sacrum are facets, for articulation with the pelvis at the sacro-iliac joints.

مثلث مقلوب

The coccyx is a small bone, which articulates with the apex of the sacrum, it is recognized by it`s lack of vertebral arches, due to the lack of vertebral arches, there is no vertebral canal, and so the coccyx does not transmit the spinal cord.

The coccyx is formed of either three, four or five rudimentary بدائية vertebrae, it articulates superiorly with the sacrum , in each of the first three segments اجزاء may have a rudimentary body and articular and transverse processes; the last piece (sometimes the third) is a mere nodule عقده of bone, the transverse processes are most prominent and noticeable on the first coccygeal segment.





All the segments lack pedicles, laminae and spinous processes, the first is the largest; it resembles the lowest sacral vertebra and often shown as a separate piece; the remaining ones diminish تقل in size from above downward.

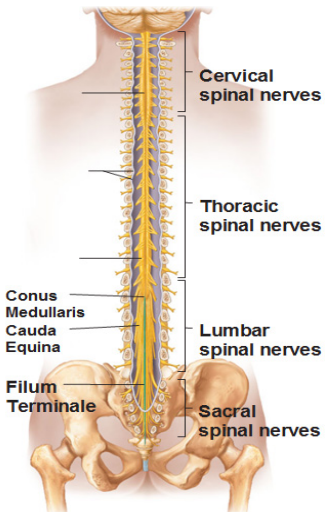
Most anatomy books state that the coccyx is normally fused in adults, in fact it has been shown that the coccyx may consist of up to five separate bony segments, the most common configuration being two or three segments.

Curvatures of the vertebral column

There are four natural curves in the spinal column; cervical, thoracic, lumbar, and sacral curvatures, they along with the intervertebral disks, help to absorb and distribute توزيع stresses that occur from everyday activities such as walking or from more intense اشد activities such as running and jumping , the vertebral curvatures provide a flexible support (shock-absorbing resilience) for the body.

The thoracic and sacral (pelvic) curvatures are concave anteriorly, they اطلقوا عليها termed primary curvatures, because they alone are present during fetal life حياة الجنين, cervical curvature forms as a result of lifting the head رفع الراس and the lumbar curvature forms as a result of walking, they are secondary curves developing after birth.

The spinal canal follows the different curves of the column; it is large and triangular in those parts of the column that enjoy the greatest freedom of movement, such as the cervical and lumbar regions, and is small and rounded in the thoracic region, where motion is more limited ,the spinal cord terminates in the ***conus medullaris*** and ***cauda equina.*** Conus medullaris is (Latin for "medullary cone") or conus terminalis is the tapered, lower end of the spinal cord, it occurs near (L1) and (L2), occasionally lower.



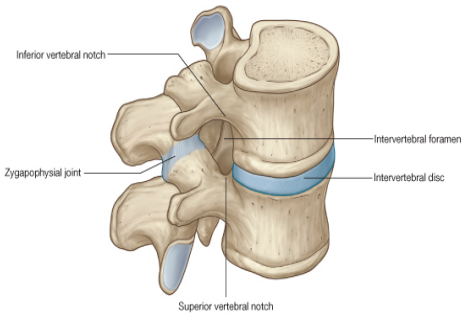
Cauda equina (from Latin *horse's tail*) is a bundle of spinal nerves and spinal nerve , the first through fifth sacral nerve pairs and the coccygeal nerve, all of which arise from the lumbar enlargement and the conus medullaris of the spinal cord, the cauda equina occupies the lumbar cistern, a subarachnoid space inferior to the conus medullaris.

The nerves that compose the cauda equina innervate the pelvic organs and lower limbs to include motor innervation of the hips, knees, ankles, feet, internal and external anal

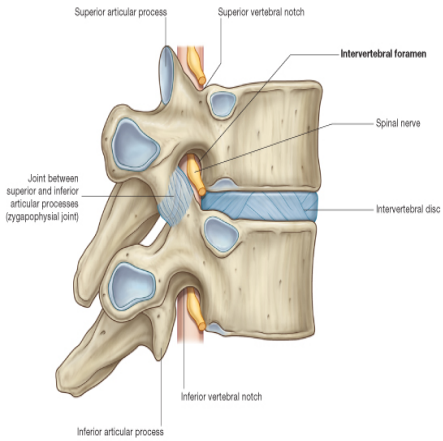
sphincters, in addition, the cauda equina extends to sensory innervation of the perineum and partially , parasympathetic innervation of the bladder.

Intervertebral foramina

Intervertebral foramina are formed on each side between adjacent parts of vertebrae and associated intervertebral discs ,the foramina allow structures, such as spinal nerves and blood vessels, to pass in and out of the vertebral canal, an intervertebral foramen is formed by the inferior vertebral notch on the pedicle of the vertebra above and the superior vertebral notch on the pedicle of the vertebra below, the foramen is bordered:



- posteriorly by the zygapophysial joint between the articular processes of the two vertebrae.
- anteriorly by the intervertebral disc and adjacent vertebral bodies.



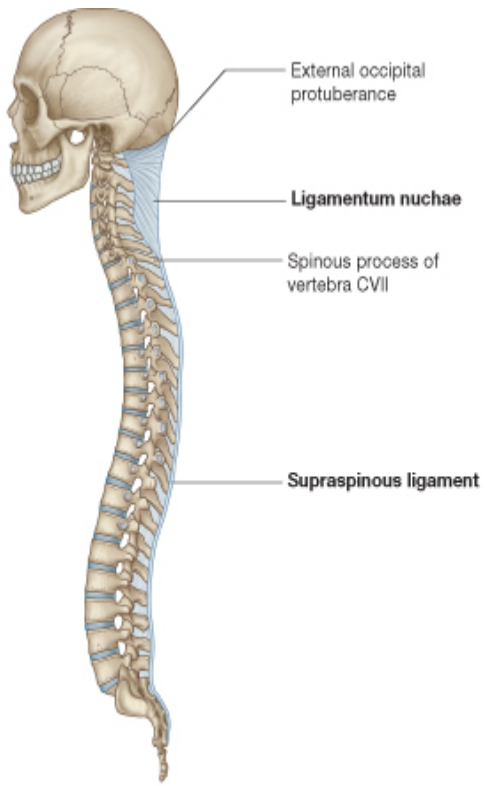
Each intervertebral foramen is a confined space surrounded by bone and ligament, and by joints, any pathology that occludes or reduces the size of an intervertebral foramen, such as bone loss , herniation of the intervertebral disc, or dislocation of the zygapophysial joint (the joint between the articular processes), can affect the function of the associated spinal nerve.

Ligamentum nuchae

Ligamentum nuchae is a triangular , sheetlike structure in the median sagittal plane:

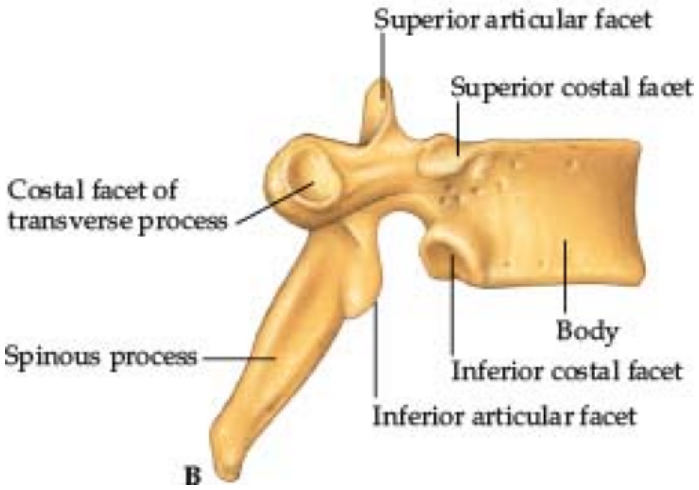
- the base of the triangle is attached to the skull, from the external occipital protuberance to the foramen magnum.
- the apex is attached to the tip of the spinous process of vertebra CVII.
- the deep side of the triangle is attached to the posterior tubercle of vertebra CI and the spinous processes of the other cervical vertebrae.

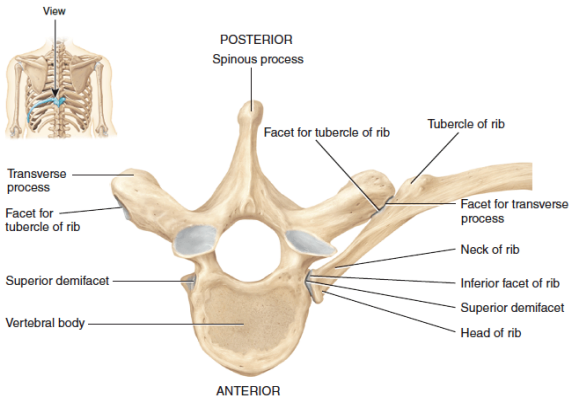
The ligamentum nuchae supports the head, it resists flexion and facilitates returning the head to the anatomic position, the broad lateral surfaces and the posterior edge of the ligament provide attachment for adjacent muscles.



Seventh Thoracic Vertebrae

B—Lateral view





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Lec. : 11
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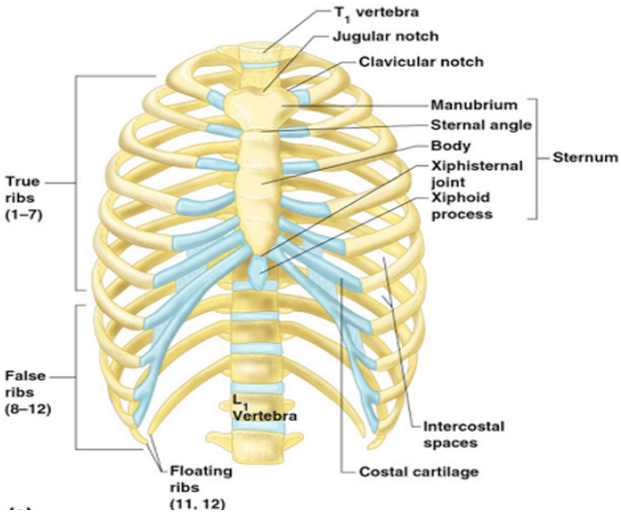
Thorax

Structure of the thoracic wall

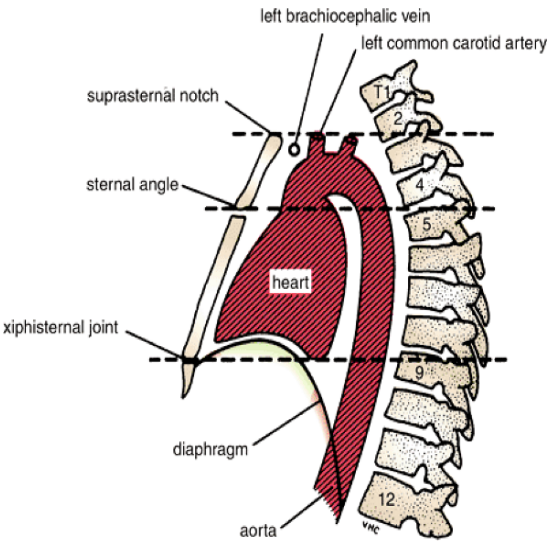
Thoracic wall is covered on it`s outside by skin and muscles attaching the shoulder girdle to the trunk, it is lined with parietal pleura, it is formed posteriorly by the thoracic part of the vertebral column; anteriorly by the sternum and costal cartilages, laterally by the ribs and intercostal spaces; superiorly by the suprapleural membrane; and inferiorly by the diaphragm, which separates the thoracic cavity from the abdominal cavity.



Sternum

The sternum lies in the midline of the anterior chest wall, it is a flat bone divided into three parts: manubrium sterni, body of the sternum, and xiphoid process, manubrium is the upper part of the sternum, articulating with the body of the sternum at the manubriosternal joint, and it also articulates with the clavicles and with the first costal cartilage and the upper part of the second costal cartilages on each side, it lies opposite the third and fourth thoracic vertebrae.

The body of the sternum articulates above with the manubrium at the manubriosternal joint and below with the xiphoid process at the xiphisternal joint, on each side it articulates with the 2nd. to the 7th. costal cartilages.



The xiphoid process is a thin plate of cartilage that becomes ossified at it`s proximal end during adult life, no ribs or costal cartilages are attached to it.

Sternal angle (angle of Louis) formed by the articulation of the manubrium with the body of the sternum, can be recognized by the presence of a transverse ridge on the anterior aspect of the sternum, the transverse ridge lies at the level of the second costal cartilage, the point from which all costal cartilages and ribs are counted. Sternal angle lies opposite the intervertebral disc between the 4th. and 5th. thoracic vertebrae, the xiphisternal joint lies opposite the body of the 9th. thoracic vertebra.

Ribs

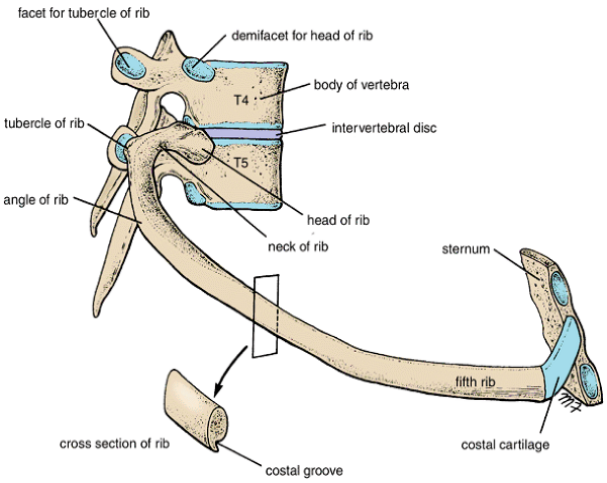
There are 12 pairs of ribs, all of which are attached posteriorly to the thoracic vertebrae, the ribs are divided into three categories "types":

- True ribs are the upper seven pairs are attached anteriorly to the sternum by their costal cartilages.
- False ribs are the 8th., 9th., and 10th. pairs of ribs are attached anteriorly to each other and to the 7th. rib by means of their costal cartilages and small synovial joints.

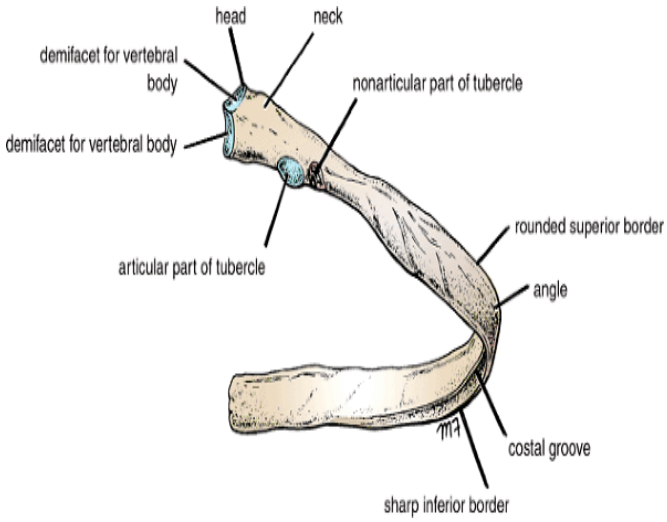
- Floating ribs are the 11th. and 12th. pairs have no anterior attachment.

Typical rib

A typical rib is a long, twisted, flat bone having a rounded, smooth superior border and a sharp, thin inferior border , the inferior border overhangs and forms the costal groove, which accommodates the intercostal vessels and nerve, the anterior end of each rib is attached to the corresponding costal cartilage.



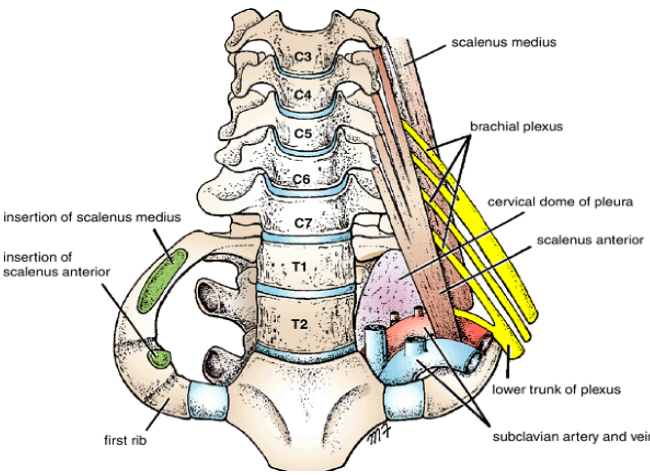
A rib has a head, neck, tubercle, shaft, and angle, the head has two facets for articulation with the numerically corresponding vertebral body and that of the vertebra immediately above, the neck is a constricted portion situated between the head and the tubercle, the tubercle is a prominence on the outer surface of the rib at the junction of the neck with the shaft.



The neck has a facet for articulation with the transverse process of the numerically corresponding vertebra, the shaft is thin and flattened and twisted on it`s long axis, it`s inferior border has the costal groove, the angle is where the shaft of the rib bends sharply forward.

Atypical rib

The first rib is important clinically because of it`s close relationship to the lower nerves of the brachial plexus and the main vessels to the arm, namely, the subclavian artery and vein, this rib is small and flattened from above downward, the scalenus anterior muscle is attached to it`s upper surface and inner border.



Anterior to the scalenus anterior, the subclavian vein crosses the rib; posterior to the muscle attachment, the subclavian artery and the lower trunk of the brachial plexus cross the rib and lie in contact with the bone.

Clinical notes

Cervical rib

A cervical rib (i.e., a rib arising from the anterior tubercle of the transverse process of the 7th. cervical vertebra) occurs in about 0.5% of humans , it may have a free anterior end, may be connected to the first rib by a fibrous band, or may articulate with the first rib.

The importance of a cervical rib is that it can cause pressure on the lower trunk of the brachial plexus in some patients, producing pain down the medial side of the forearm and

hand and wasting of the small muscles of the hand, it can also exert pressure on the overlying subclavian artery and interfere with the circulation of the upper limb.

Costal cartilages

Are bars of cartilage connecting the upper seven ribs to the lateral edge of the sternum and the 8th., 9th., and 10th. ribs to that of 7th. rib, cartilages of the 11th. and 12th. ribs end in the abdominal musculature.

The costal cartilages contribute significantly to the elasticity and mobility of the thoracic walls, in old age, the costal cartilages tend to lose some of their flexibility as the result of superficial calcification.

Joints of the chest wall

Joints of the sternum "covered above"

Joints of the ribs

Joints of the heads of the ribs

The first and the lowest three ribs have a single synovial joint with their corresponding vertebral body, for the second to the ninth ribs, the head articulates by means of a synovial joint with the corresponding vertebral body and that of the vertebra above it, there is a strong intraarticular ligament that connects the head to the intervertebral disc.

Joints of the tubercles of the ribs

The tubercle of a rib articulates by means of a synovial joint with the transverse process of the corresponding vertebra, this joint is absent on the 11th. and 12th. ribs.

Joints of the ribs and costal cartilages

These joints are cartilaginous joints, no movement is possible. .

Joints of the costal cartilages with the sternum

The first costal cartilages articulate with the manubrium, by cartilaginous joints that permit no movement, the 2nd. to the 7th. costal cartilages articulate with the lateral border of the sternum by synovial joints, in addition, the 6th., 7th., 8th., 9th., and 10th. costal cartilages articulate with one another along their borders by small synovial joints , cartilages of the 11th. and 12th. ribs are embedded in the abdominal musculature.

Suprapleural membrane

Superiorly, the thorax opens into the root of the neck by a narrow aperture, the thoracic outlet, the outlet transmits structures that pass between the thorax and the neck (esophagus, trachea, blood vessels, etc.), on either side of these structures the outlet is closed by a dense fascial layer called the suprapleural membrane.

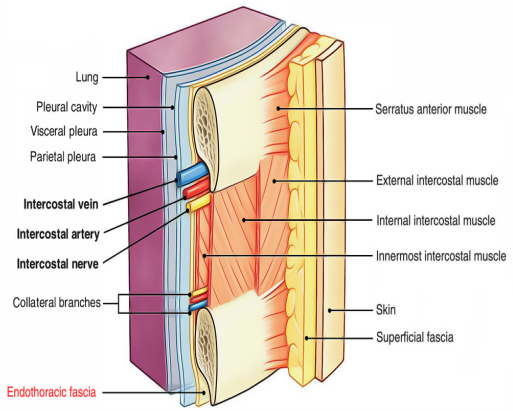
This tent-shaped fibrous sheet is attached laterally to the medial border of the first rib and costal cartilage, it is attached at it`s apex to the tip of the transverse process of the seventh cervical vertebra and medially to the fascia investing the structures passing from the thorax into the neck, it protects the underlying cervical pleura and resists the changes in intrathoracic pressure occurring during respiratory movements.

Endothoracic fascia

Endothoracic fascia is a thin layer of loose connective tissue that separates the parietal pleura from the thoracic wall , suprapleural membrane is a thickening of this fascia.

Diaphragm

The diaphragm is a thin muscular and tendinous septum that separates the chest cavity above from the abdominal cavity below, it is pierced by the structures that pass between the chest and the abdomen.

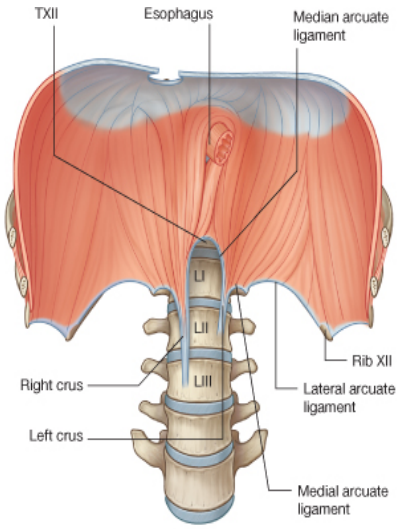


The diaphragm is the most important muscle of respiration, it is dome shaped and consists of a peripheral muscular part, which arises from the margins of the thoracic opening, and a centrally placed tendon, the origin of the diaphragm can be divided into three parts:

- A sternal part arising from the posterior surface of the xiphoid process.
- A costal part arising from the deep surfaces of the lower six ribs and their costal cartilages.
- A vertebral part arising by vertical columns or crura and from the arcuate ligaments

The right crus arises from the sides of the bodies of the first three lumbar vertebrae and the intervertebral discs; the left crus arises from the sides of the bodies of the first two lumbar vertebrae and the intervertebral disc.

Lateral to the crura the diaphragm arises from the medial and lateral arcuate ligaments, the medial arcuate ligament extends from the side of the body of the second lumbar vertebra to the tip of the transverse process of the first lumbar vertebra.



The lateral arcuate ligament extends from the tip of the transverse process of the first lumbar vertebra to the lower border of the 12th. rib, the medial borders of the two crura are connected by a median arcuate ligament, which crosses over the anterior surface of the aorta.

The diaphragm is inserted into a central tendon, which is shaped like three leaves, the superior surface of the tendon is partially fused with the inferior surface of the fibrous pericardium, some of the muscle fibers of the right crus pass up to the left and surround the esophageal orifice in a slinglike loop, these fibers appear to act as a sphincter and possibly assist in the prevention of regurgitation of the stomach contents into the thoracic part of the esophagus.

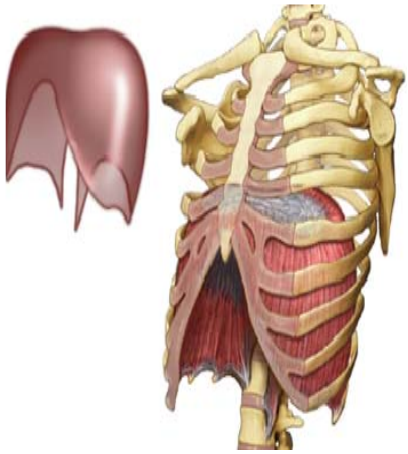
Shape of the diaphragm

As seen from in front, the diaphragm curves up into right and left domes, or cupulae, the right dome reaches as high as the upper border of the fifth rib, and the left dome may reach the lower border of the fifth rib.

The right dome lies at a higher level, because of the large size of the right lobe of the liver, the central tendon lies at the level of the xiphisternal joint, the domes support the right and left lungs, whereas the central tendon supports the heart.

The levels of the diaphragm vary with the phase of respiration, the posture, and the degree of distention of the abdominal viscera, the diaphragm is lower when a person is sitting or standing; it is higher in the supine position and after a large meal.

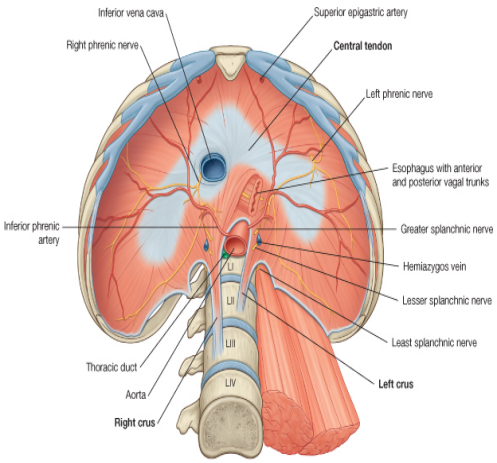
When seen from the side, the diaphragm has the appearance of an inverted J, the long limb extending up from the vertebral column and the short limb extending forward to the xiphoid process.



Openings in the Diaphragm

The diaphragm has three main openings:

- The aortic opening lies anterior to the body of the 12th. thoracic vertebra between the crura, it transmits the aorta, the thoracic duct, and the azygos vein.
- The esophageal opening lies at the level of the 10th. thoracic vertebra in a sling of muscle fibers derived from the right crus, it transmits the esophagus, the right and left vagus nerves, the esophageal branches of the left gastric vessels, and the lymphatics from the lower third of the esophagus.
- The caval opening lies at the level of the eighth thoracic vertebra in the central tendon, it transmits the inferior vena cava and terminal branches of the right phrenic nerve.



In addition to these openings, the sympathetic splanchnic nerves pierce the crura; the sympathetic trunks pass posterior to the medial arcuate ligament on each side; and the superior epigastric vessels pass between the sternal and costal origins of the diaphragm on each side.

Lines of orientation

For clinical purposes and description, the surface of the thorax has been mapped out by arbitrary lines, on the front of the thorax the most important vertical lines are the;

Midsternal, the middle line of the sternum.

Midclavicular or Mammary, imaginary vertical line runs downward from a point midway between the center of the jugular notch and the tip of the acromion, (the midshaft of the clavicle).

Other vertical lines on the front of the thorax are the;

Lateral sternal along the sternal margin.

Parasternal midway between the lateral sternal and the mammary, on either sides of the thorax the;

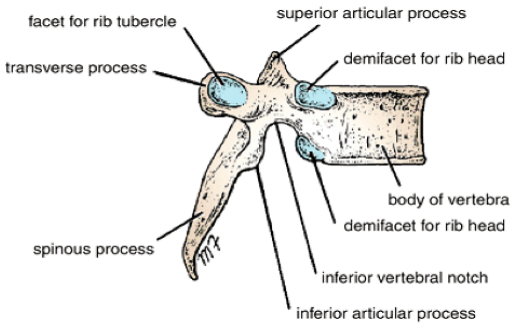
Anterior and Posterior axillary lines are drawn vertically from the corresponding axillary folds.

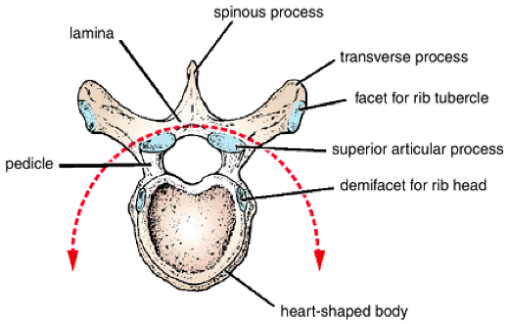
Midaxillary line runs downward from the apex of the axilla, (through the middle of the axilla).On the posterior surface of the thorax the

Scapular line is drawn vertically through the inferior angle of the scapula.

Surface markings of the thorax

Structure/Space	Description/Boundaries	Significance
Suprasternal notch **also known as: Jugular notch**	The notch located at the superior border of the manubrium of the sternum, between the medial (sternal) ends of the clavicles.	Lies opposite the lower border of the body of the 2nd. thoracic vertebra.
Sternal angle **(Angle of Louis)**	A protrusion on the anterior thoracic wall at the junction of the manubrium and body of the sternum (manubriosternal symphysis), it is the location of the attachment of the costal cartilage of the 2nd. rib to the sternum.	An imaginary horizontal plane through the sternal angle passes through the T4/T5 intervertebral disc and marks the inferior boundary of the superior mediastinum
Nipple	Located superficial to the 4th. intercostal space in the male and prepuberal female,	Location of the left nipple may be used to help locate the apex of heart, which is approximately 8 cm from the midline in the left 5th. intercostal space; a surface landmark used to place the stethoscope for auscultation of the bicuspid valve
Xiphisternal joint	The junction between the body and xiphoid process of the sternum.	Lies against the body of the 9th. thoracic vertebra.
Subcostal angle **(Epigastric fossa)**	Situated at the inferior end of the sternum (infrasternal notch).	Lies between the sternal attachments of the 7th. costal cartilages.
Costal margin	The lower boundary of the thorax, formed by the cartilages of the 7th. - 10th. ribs and the ends of the 11th. & 12th. ribs. The lowest part of the costal margin formed by the 10th. rib serves as part of the origin of the respiratory diaphragm	The lowest part of the margin lies at the level of the 3rd. lumbar vertebra. It is most plainly seen by bending the body backward.
Clavicle	It is subcutaneous and can be palpated along it's entire length, medially it articulates with the manubrium sterni and laterally with the acromion process of the scapula.	
Ribs	On either side of the thorax, from the axilla downward, the flattened external surfaces of the ribs may be defined.	The obliquity of the ribs can be shown "If a horizontal line be drawn


facet for rib tubercle
superior articular process
transverse process
demifacet for rib head
body of vertebra
demifacet for rib head
spinous process
inferior vertebral notch
inferior articular process


spinous process
lamina
transverse process
facet for rib tubercle
superior articular process
pedicle
demifacet for rib head
heart-shaped body