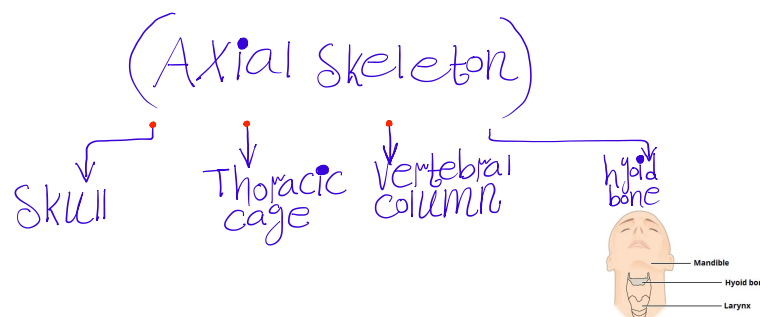




Skeletal System-3

Axial Skeleton

Introduction to Anatomy and Embryology



Dr. Heba Kalbounieh

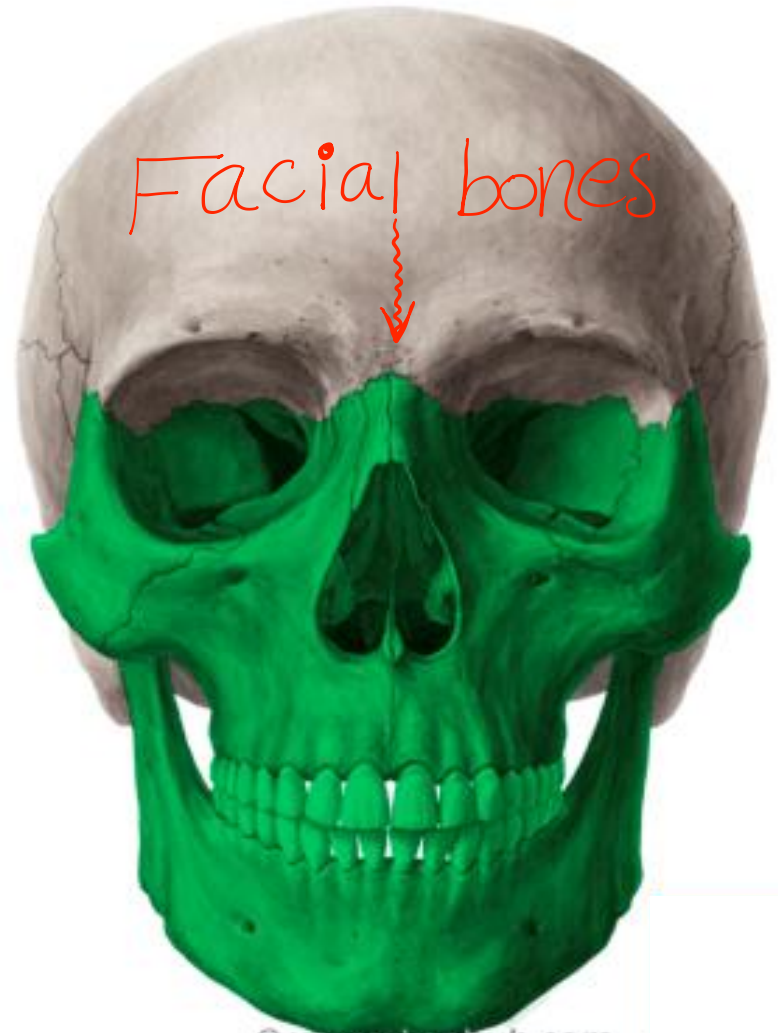
DDS, MSc, DMD/PhD

Professor of Anatomy, Histology and Embryology

Cranial bones here
are highlighted by the
greenish color



Facial bones



Skull is formed by 22 bones.

The bones of the skull can be divided into

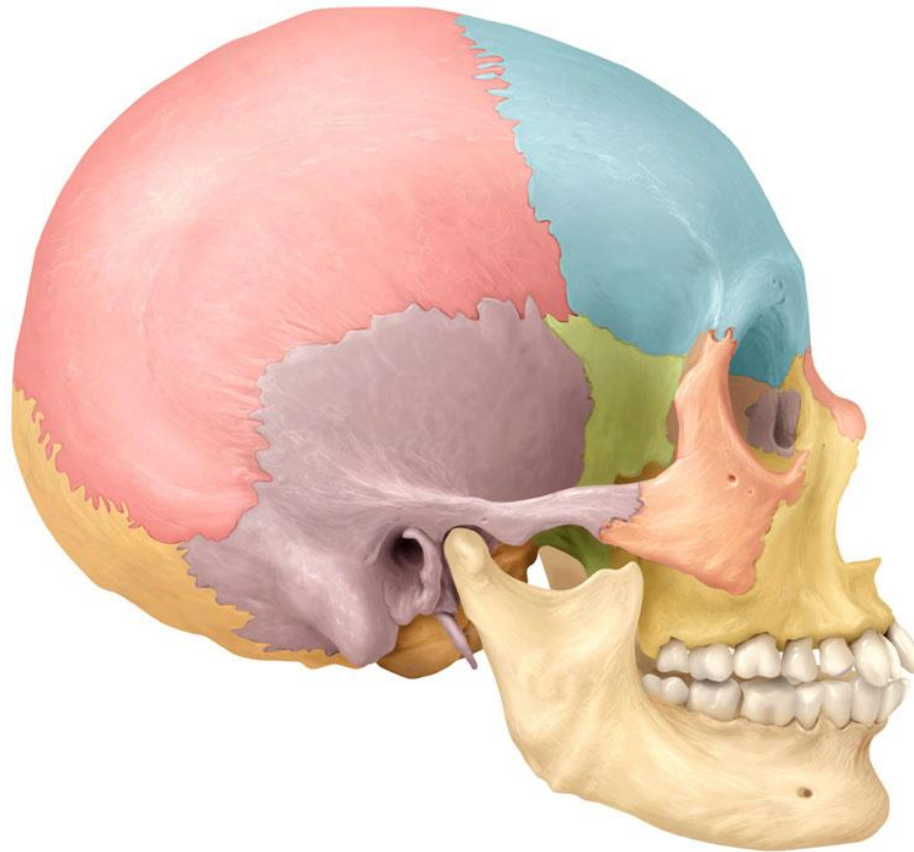
- 1- Cranial bones → Form your cranium (skull)
- 2- Facial bones → Form your face.

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Cranial cavity: A cavity in your skull that houses your brain.

• Note:
(Skull bones) → (Paired) → some of them
→ (Single)

Cranial Bones (8 bones)



Frontal

(1)

Parietal

(2)

Occipital

(1)

Temporal

(2)

Sphenoid

(1)

Ethmoid

(1)

Facial Bones (14 bones)

Zygomatic (2)

Maxilla (2)

Nasal (2)

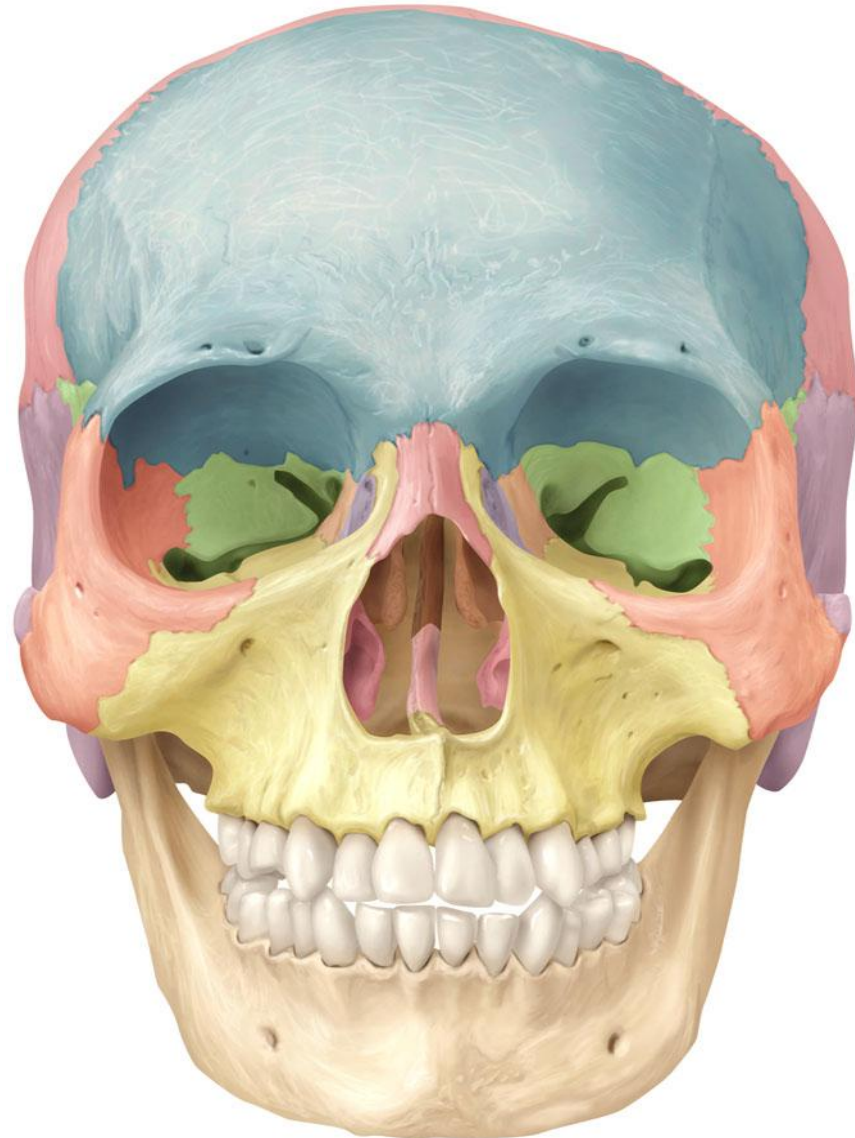
Lacrimal (2)

Vomer (1)

Palatine (2)

Inferior Conchae (2)

Mandible (1)



Single
bone

Frontal bone

A Single cranial
bone that forms
your forehead

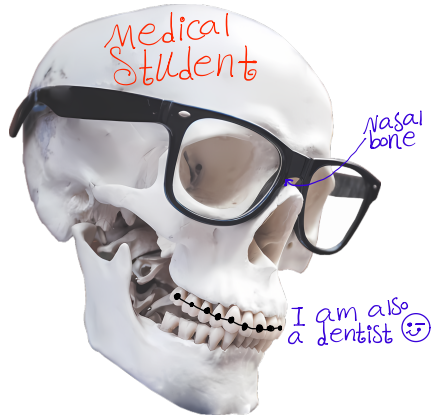


Paired bone



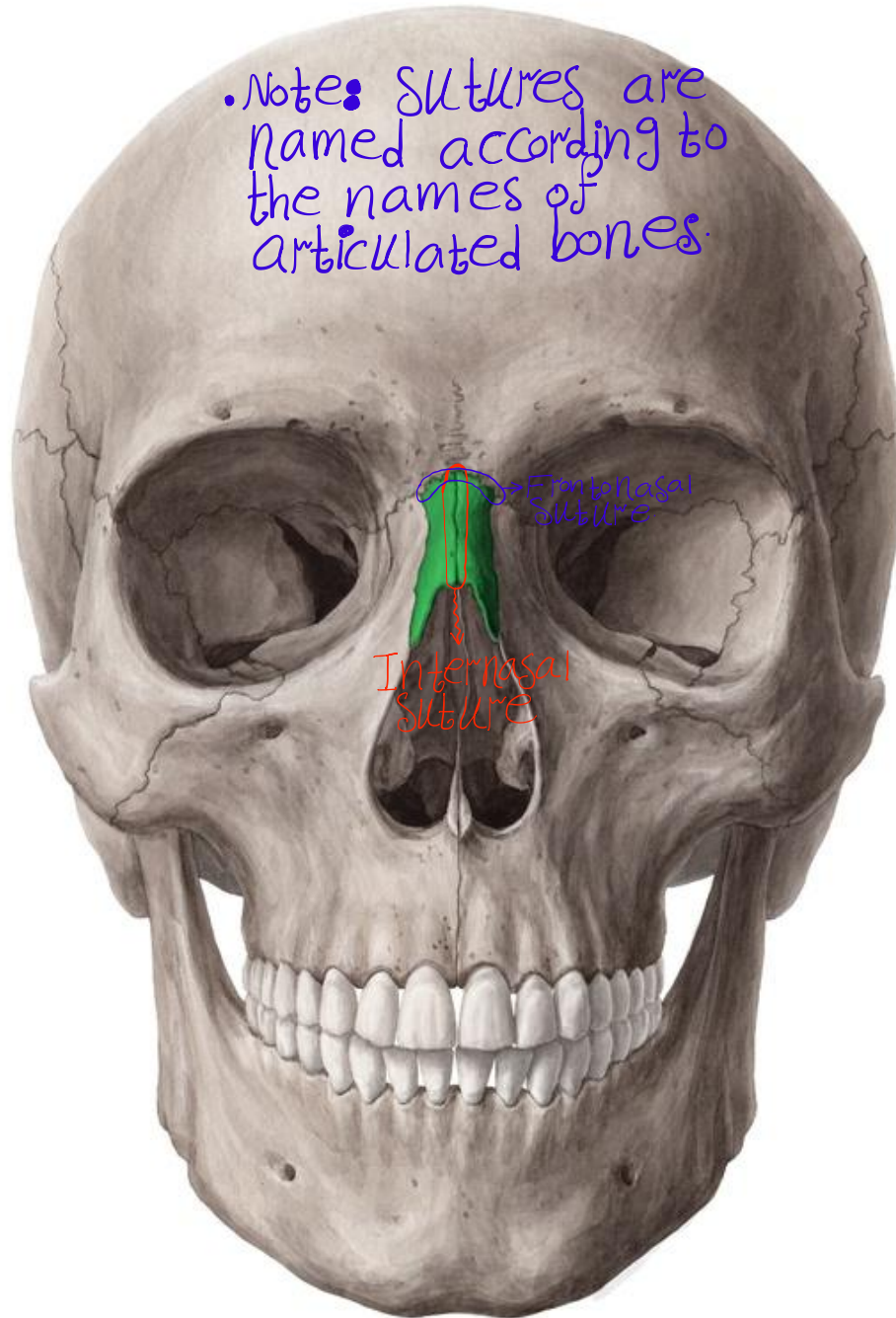
Nasal bone

A paired facial bone forms the root of your nose (that is the area where the glass is put)



Note: The bones of your cranium attach to each other by: **Sutures** means: fibrous joints (synarthrotic joints)

Note: Sutures are named according to the names of articulated bones.



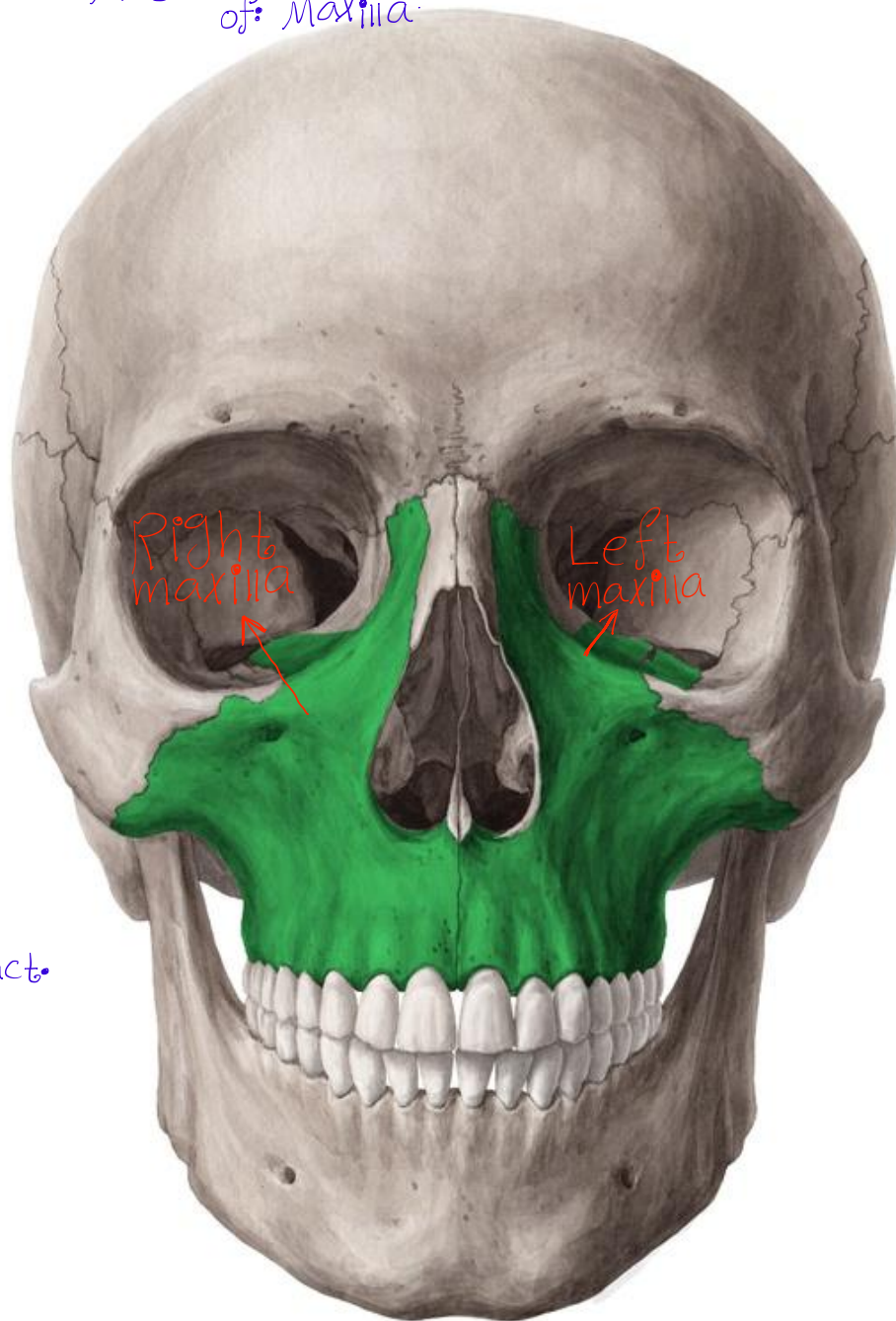
Note: Maxillae is plural
of Maxilla.

Maxilla

paired facial
bones which contribute
to formation of
upper jaw and
carrying your upper
teeth.

Note: Both maxillae are
connected to each other
by Intermaxillary suture.

Note: Maxillae are in contact.



Zygomatic bone (cheek bone)

A Paired facial bone
that forms the
prominent area
of your cheek.

Note: Cheek bones
aren't in contact
(Away from each
other).



Mandible

A single facial bone that forms your lower jaw and carries your teeth.



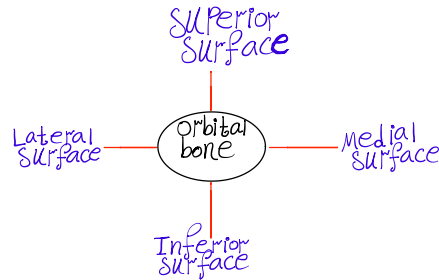
Sphenoid



Palpable Part of sphenoid

eye cavity
Orbital bone (orbit)
"قبة العين"
"مجر العين"
conjugally

Surfaces of the orbital bone

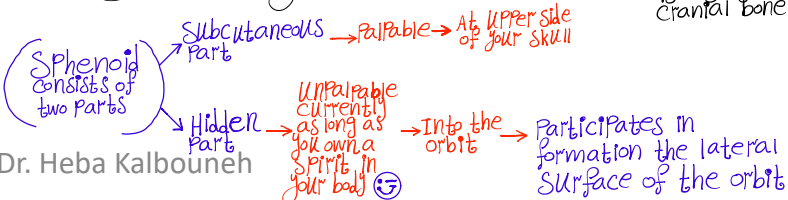


Note: A part of sphenoid is palpable (not entire sphenoid) on the upper side of your head (It is subcutaneous).

Note: The Unpalpable Part of sphenoid Participates in formation of the lateral Surface of each orbit

Note: Sphenoid is a single cranial bone.

* Summary *



Nasal Septum

Definition: A midline partition dividing the nasal cavity into left and right halves.

Composition:

- Bony Part: Formed by:
 - Vomer (postero-inferior).
 - Perpendicular plate of the ethmoid bone (anterosuperior).
- Cartilaginous Part: Hyaline cartilage (anteriorly, called the septal cartilage).

Vomer Bone

Definition: A thin, plow-shaped single bone forming the postero-inferior part of the bony nasal septum.

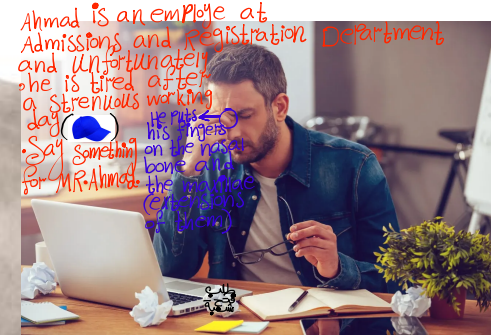
Function: Supports the septum but does not constitute it entirely.

Note: In your skull you can't touch ethmoid

- You must reach to the medial surfaces of both orbits to touch it from two sides.

Note: Ethmoid bone participates in formation of each medial surface of the orbit cavity.

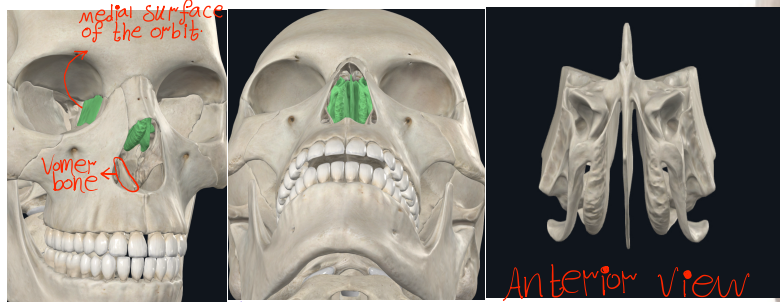
Note: Ethmoid bone participates in formation of the nasal cavity and its lateral walls.



Ethmoid participates in formation of:

- 1-Nasal walls
- 2-Nasal Septum

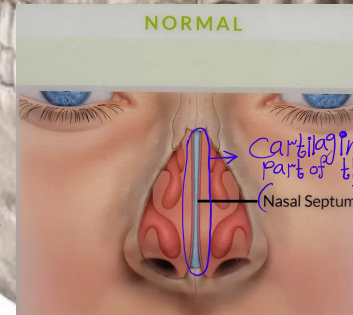
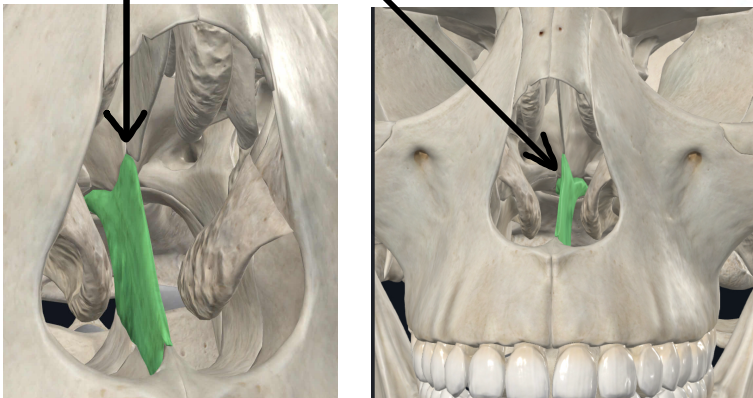
Nasal cavity is divided into two halves (right and left) by: Nasal septum



Anterior view

Resource: Complete anatomy -APP

Vomer bone



(Bony Part) ← (Nasal Septum) → (Cartilaginous Part)

Posterior part is formed by: Vomer bone

Anterosuperior part is formed by: Ethmoid

Anteriorly

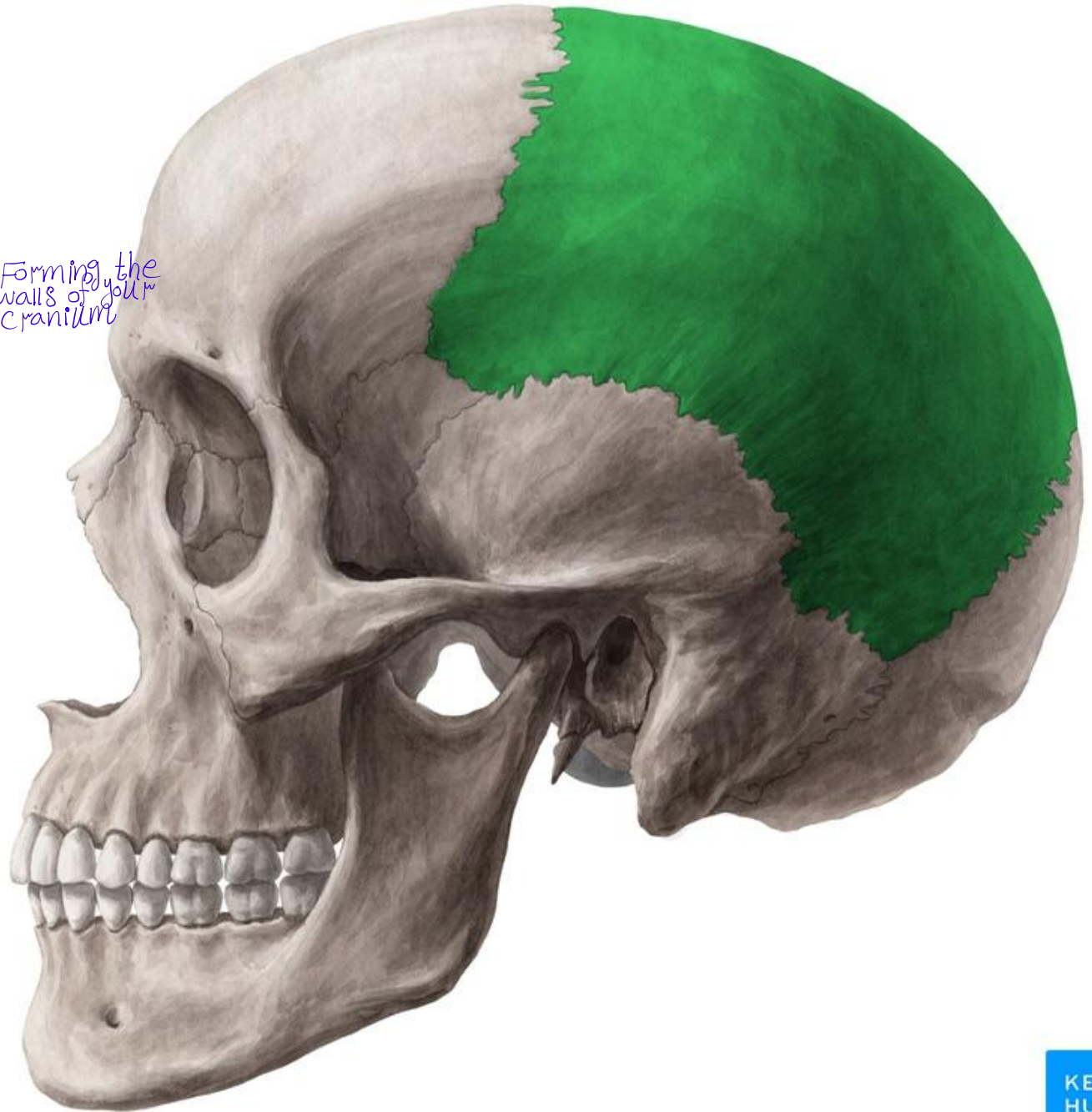
Frontal bone



Parietal bone

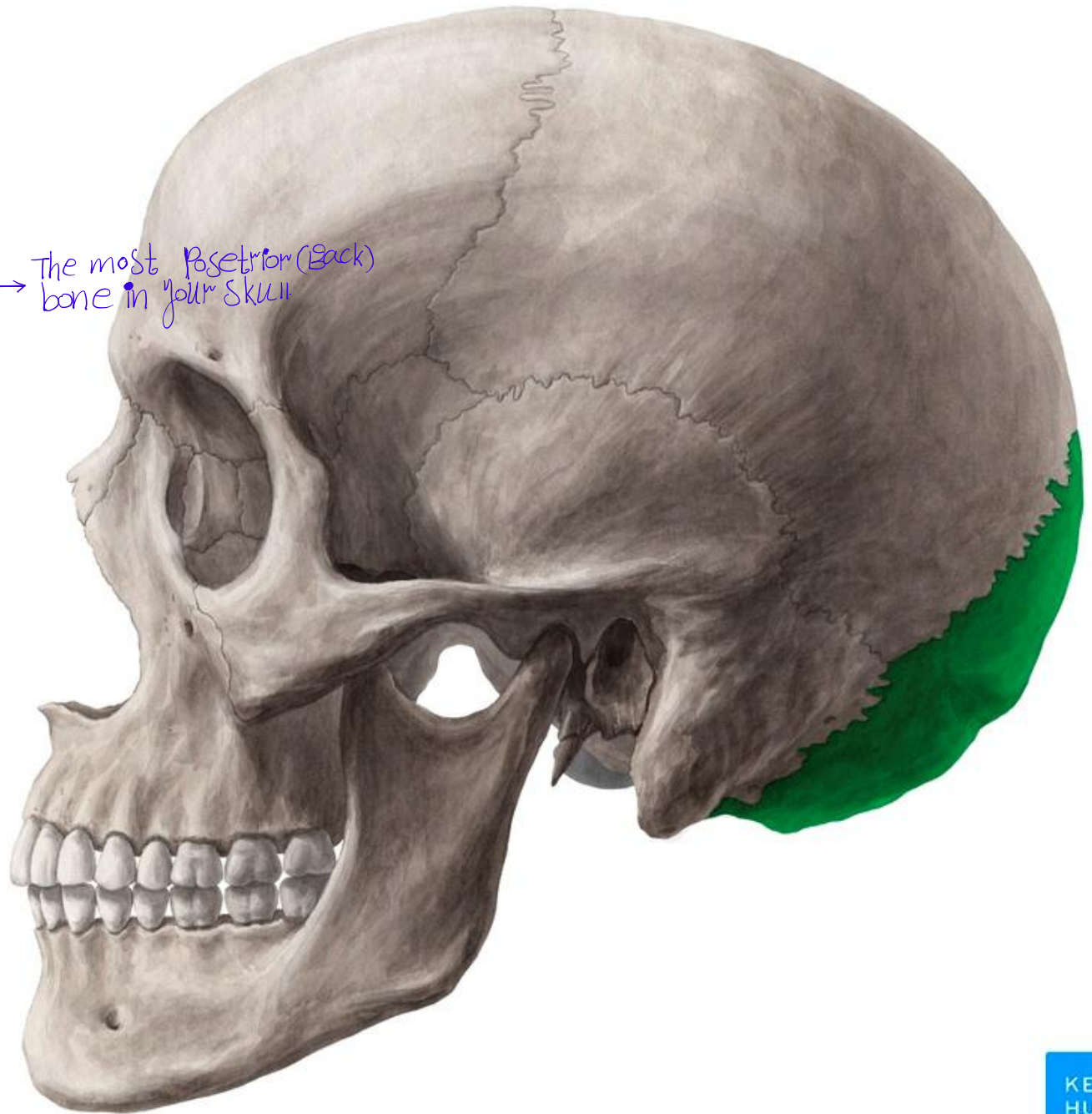
(A paired cranial bone)

→ Forming the walls of your cranium



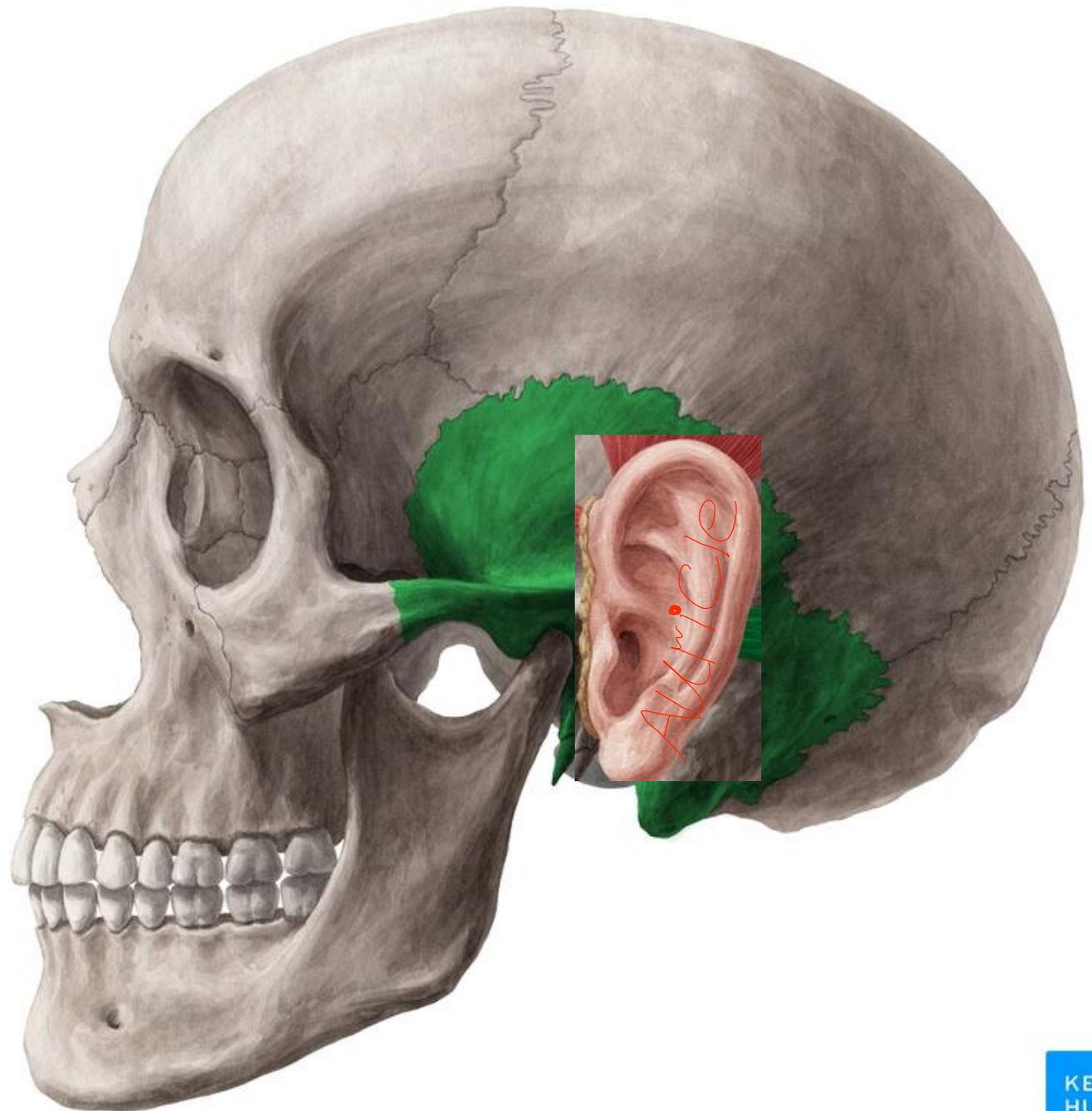
Occipital bone → The most posterior (Back) bone in your skull

In latin, **occip** means: Back of the head.



(Temporal bone)

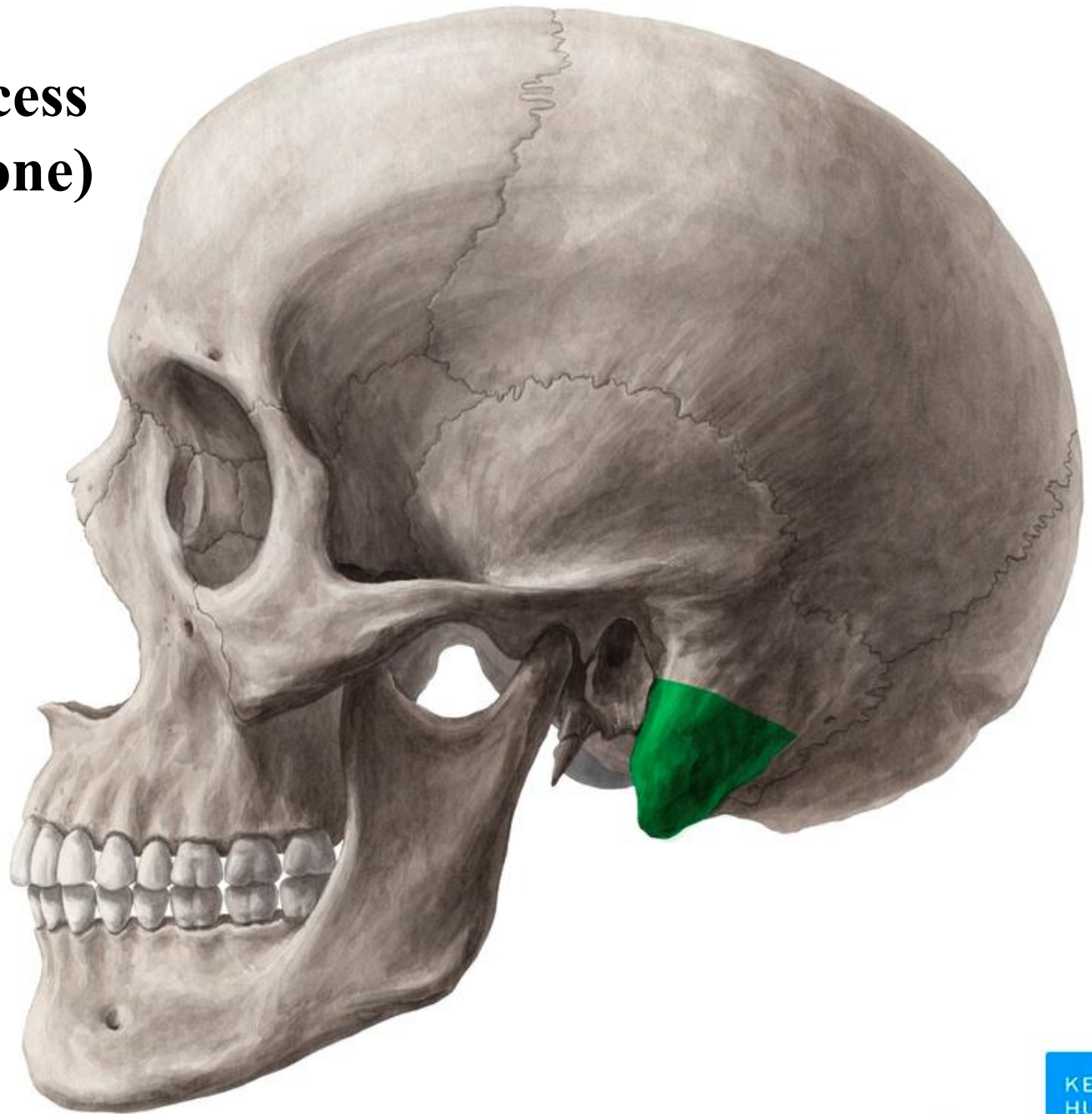
→ Related to aging where the beginning of appearance of gray hair is there.



Mastoid process (Temporal bone)

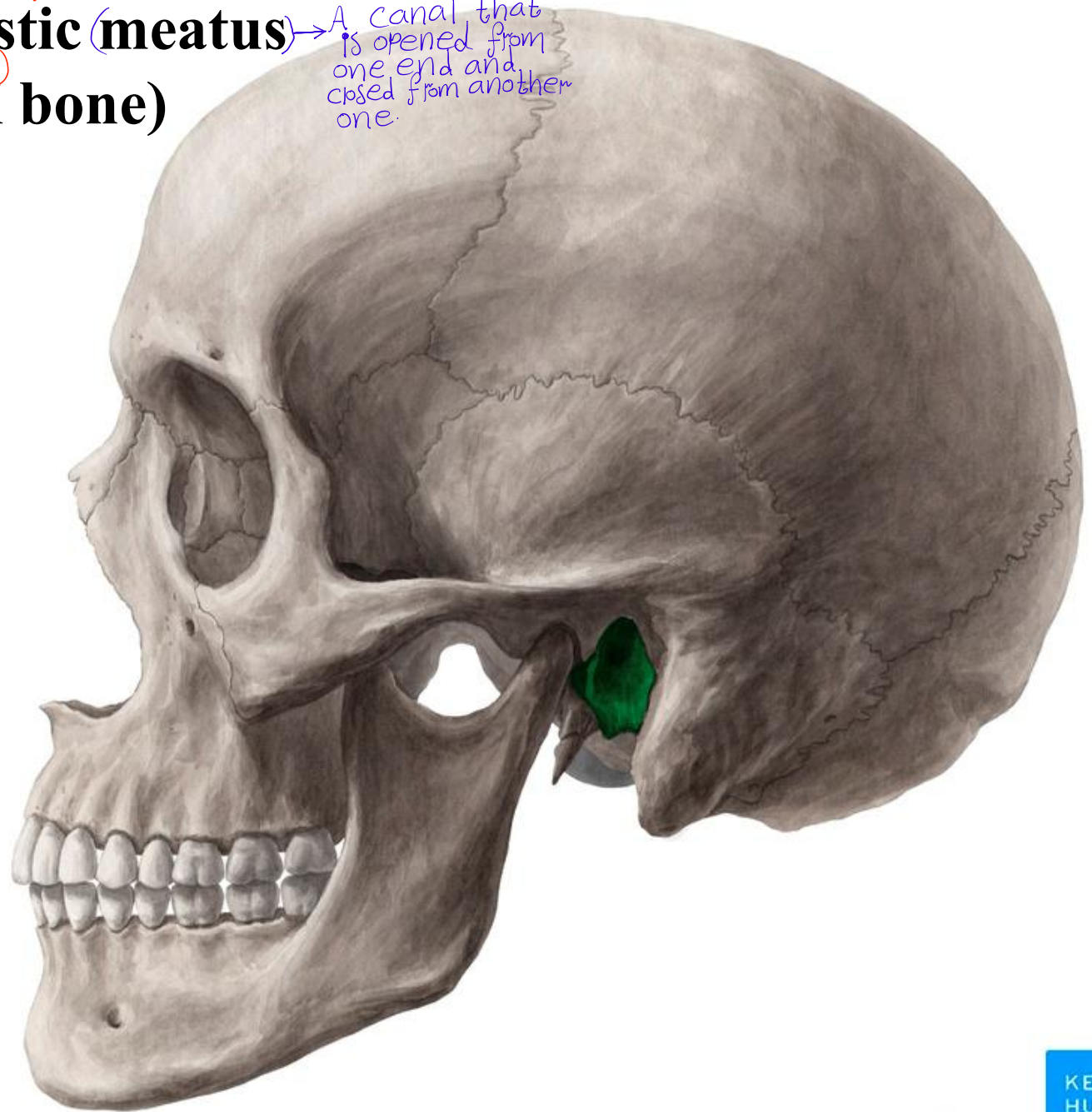
→ Rounded bony
prominent area
just behind your
ear (auricle) and related
to your temporal bone
called: Mastoid
process

cartilagenous area of
your ear.

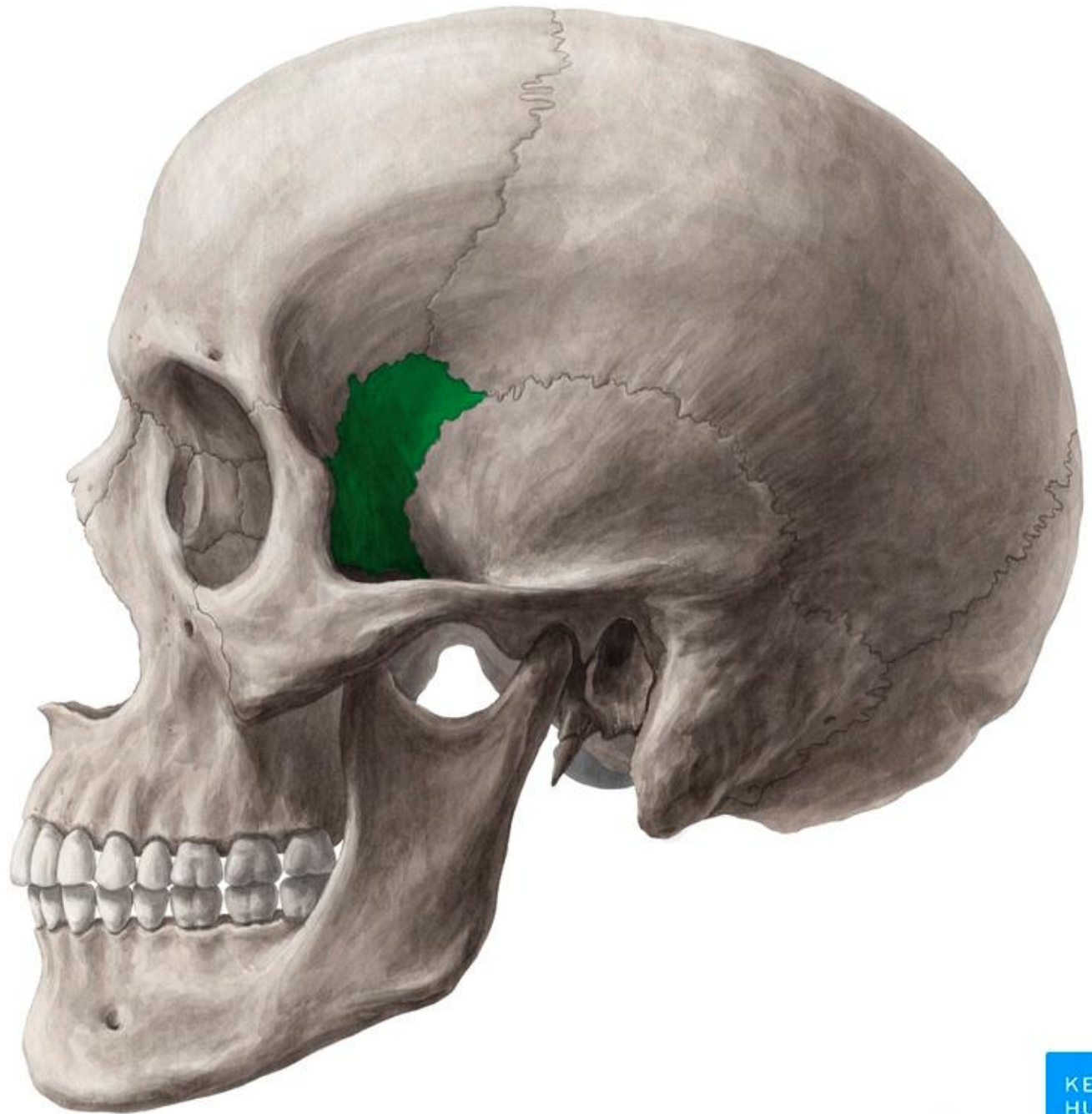


External acoustic (meatus) → (Auditory) (Temporal bone)

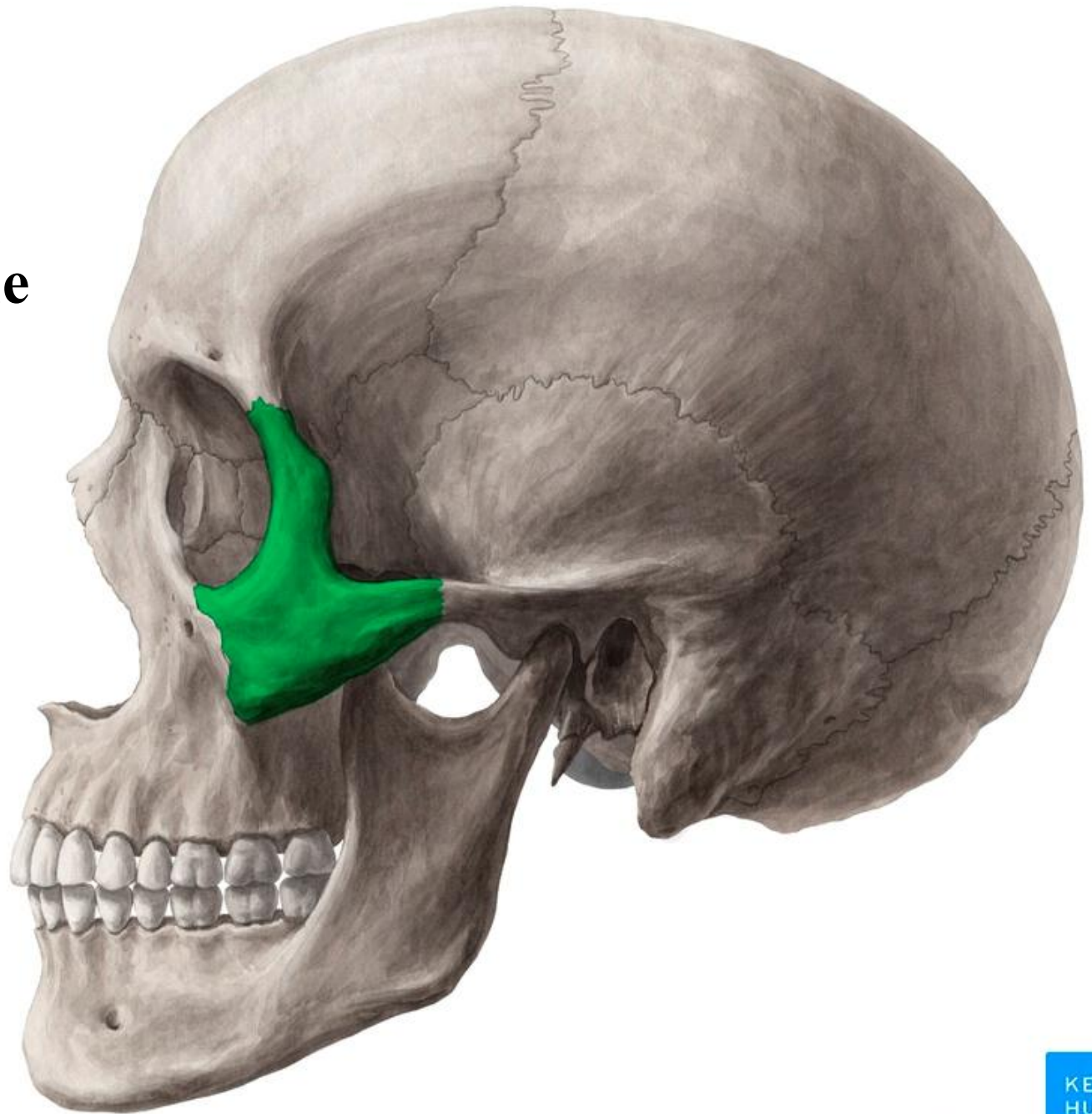
A canal that is opened from one end and closed from another one.



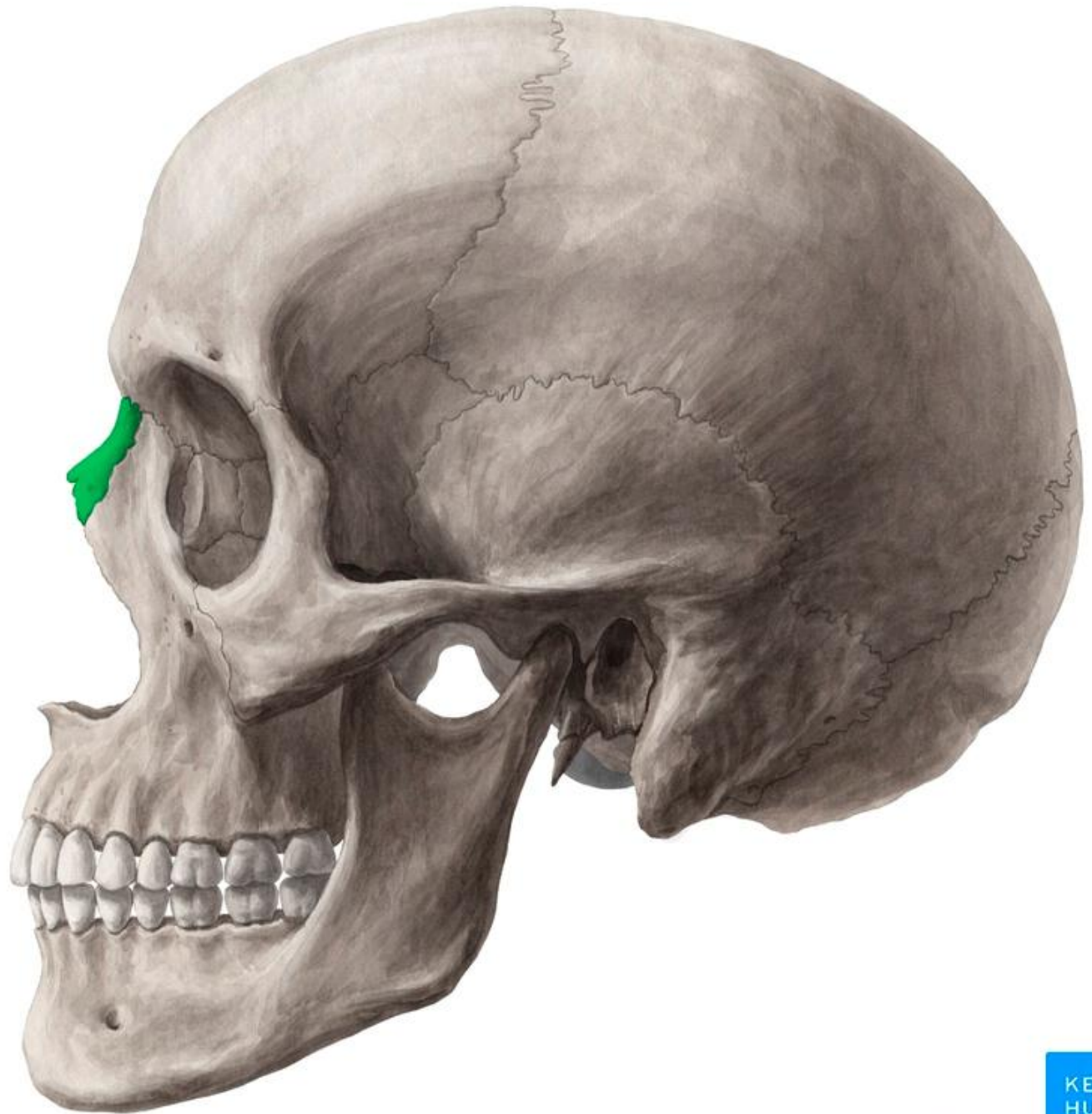
Sphenoid bone



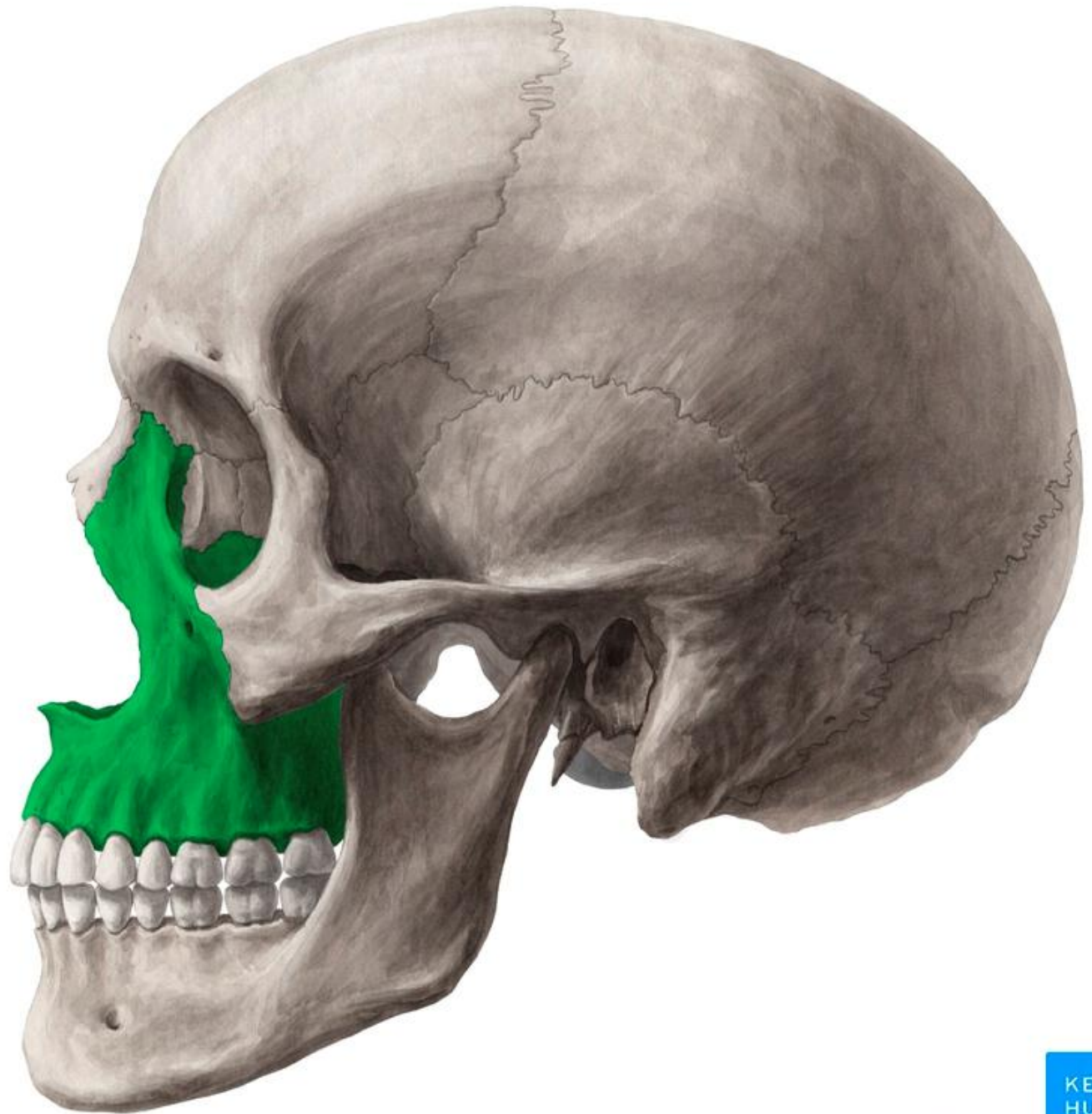
Zygomatic bone



Nasal bone



Maxilla



Mandible

Note: All bones of the skull are connected with each other by sutures – except one bone which is the mandible bone.



Temporomandibular joint (TMJ)

Between the temporal bone of the skull above and the mandible below

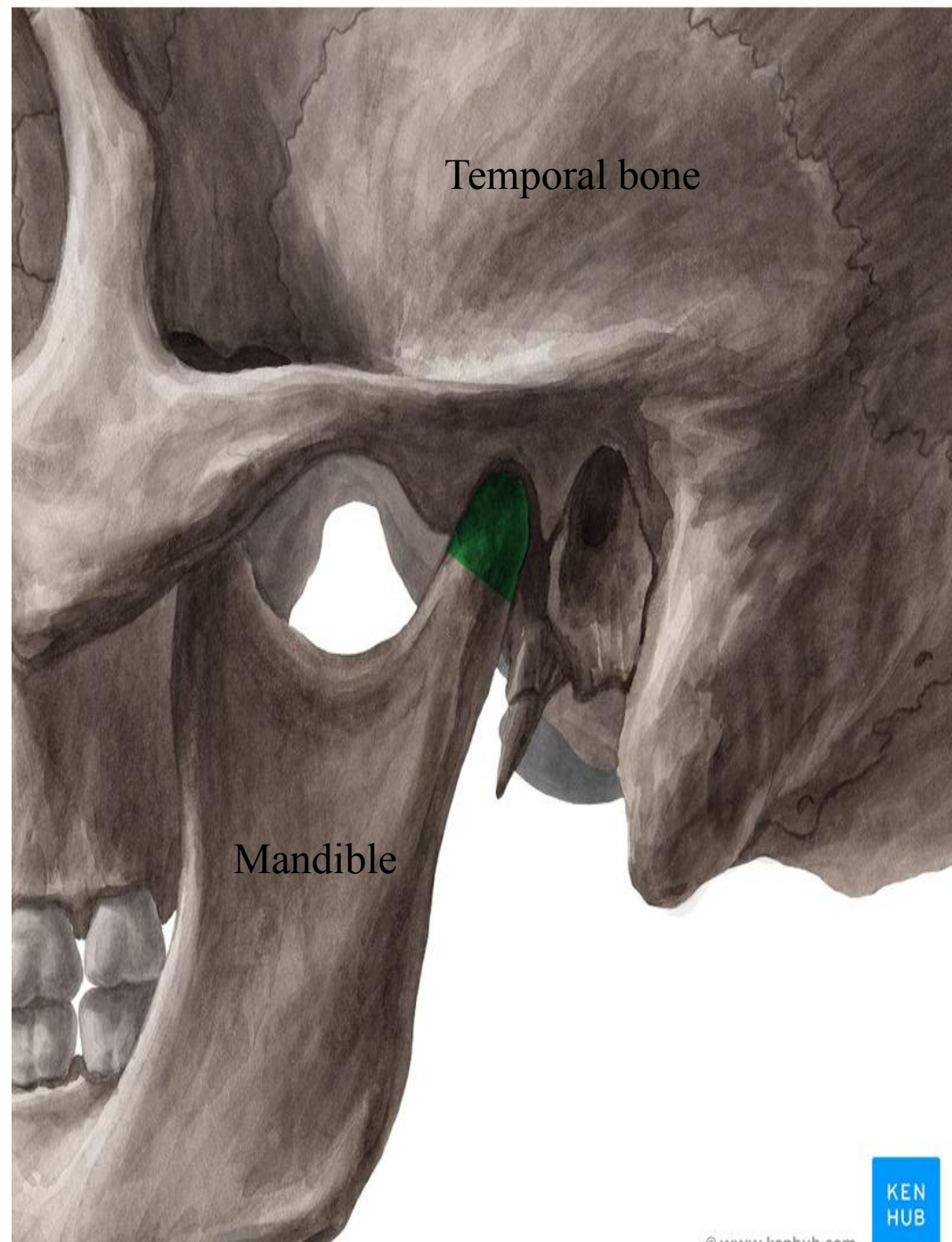
Type of Joint: Synovial hinge joint

Movements

The mandible can be depressed or elevated, protruded or retracted.

Rotation can also occur, as in chewing

Note: TMJ is considered as modified hinge joint since it provides side to side movement



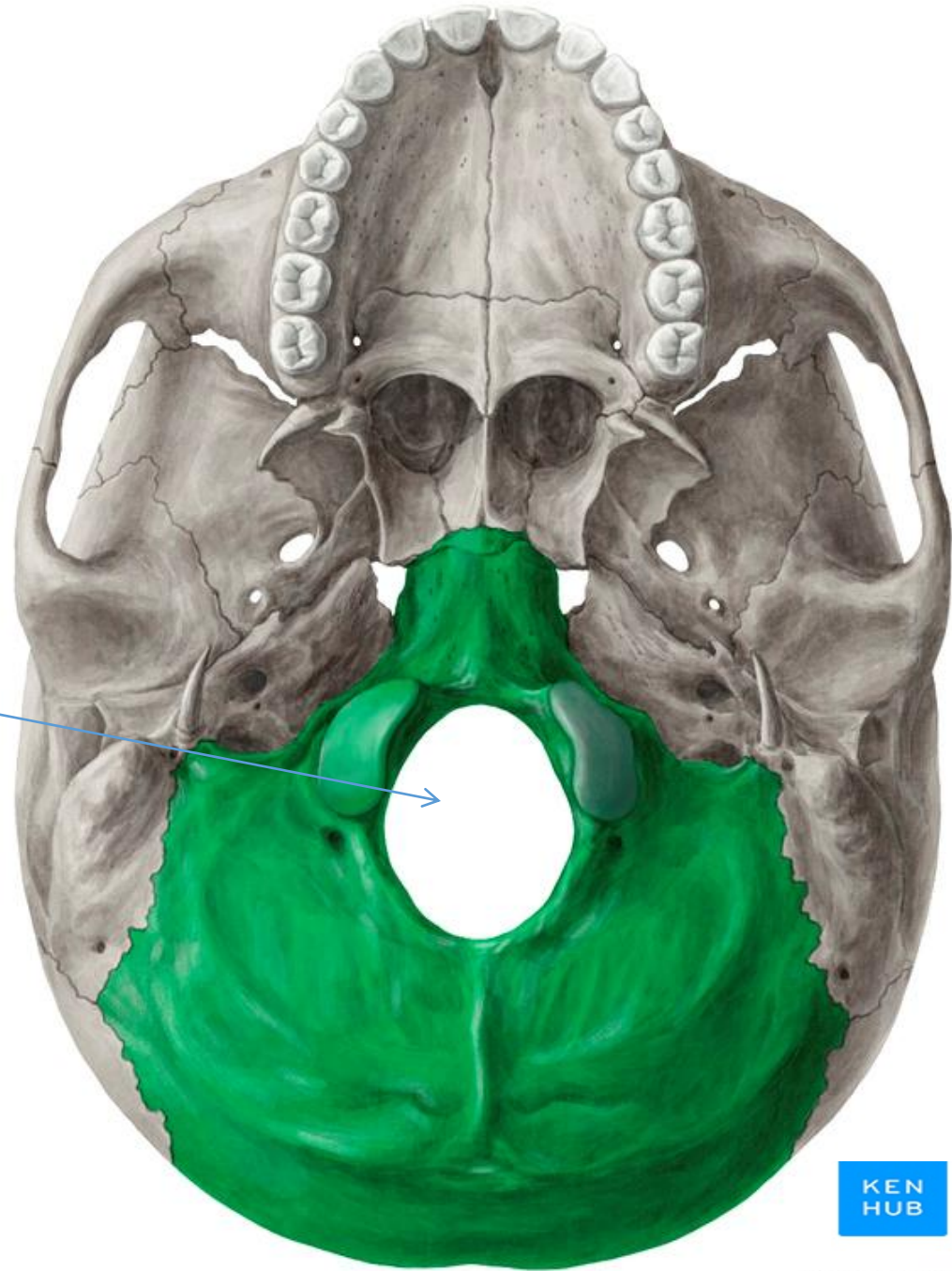
Occipital bone



Occipital bone

Foramen magnum

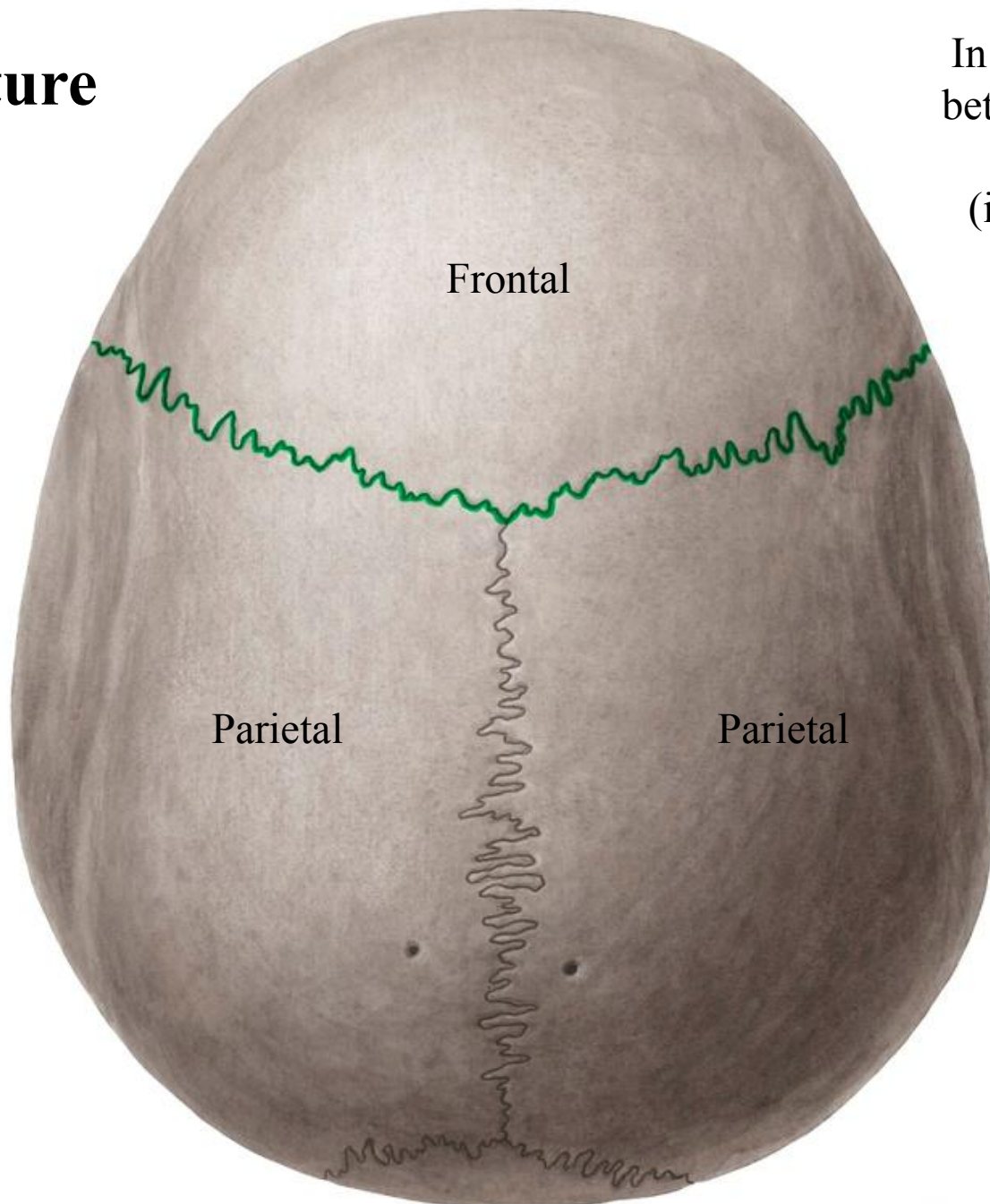
(Latin: *great hole*) is a large oval opening in the occipital bone of the skull, through which the spinal cord passes



Coronal suture

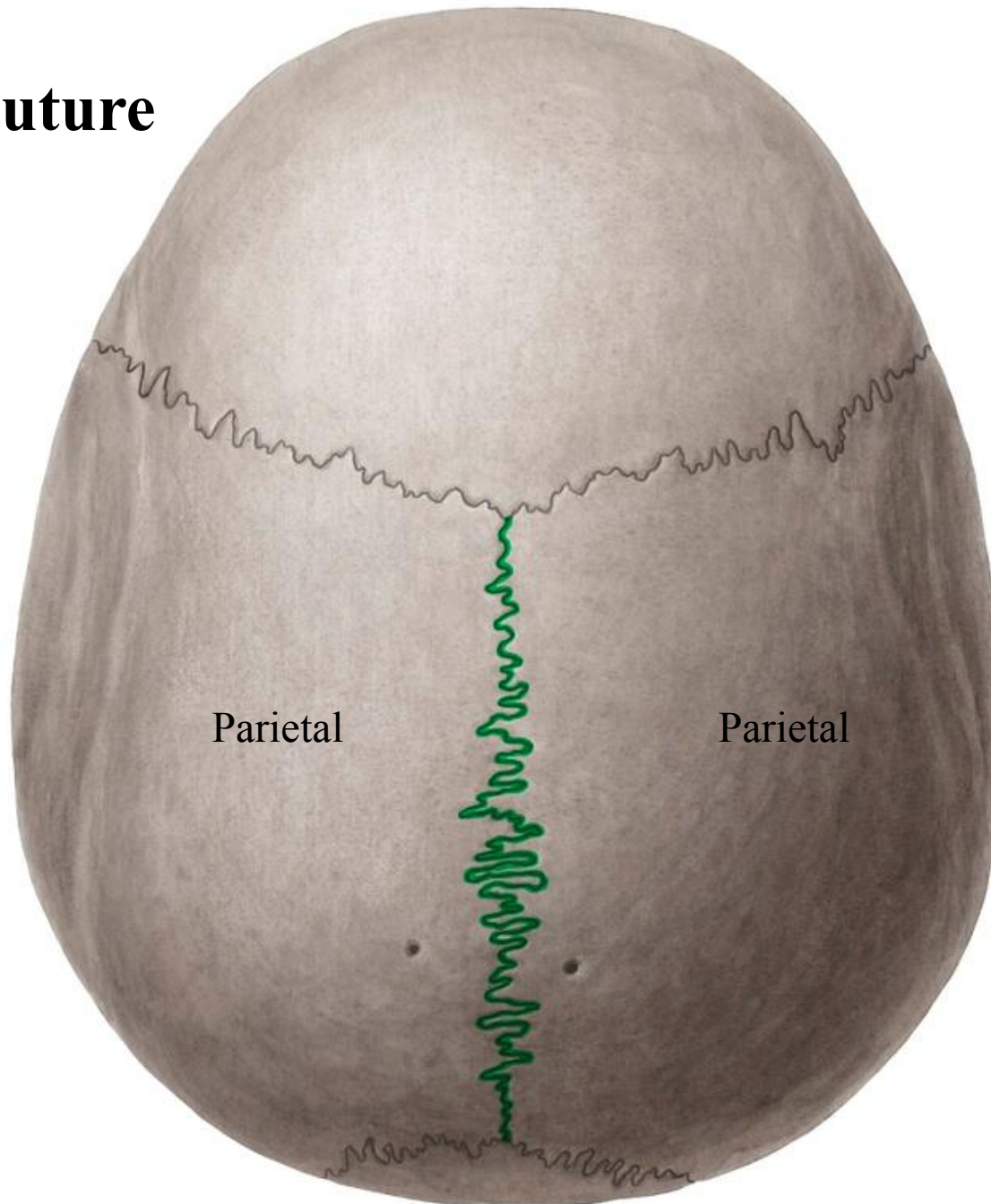
In the skull the joints between the bones are called **sutures**.
(immovable joints)

Which bones?



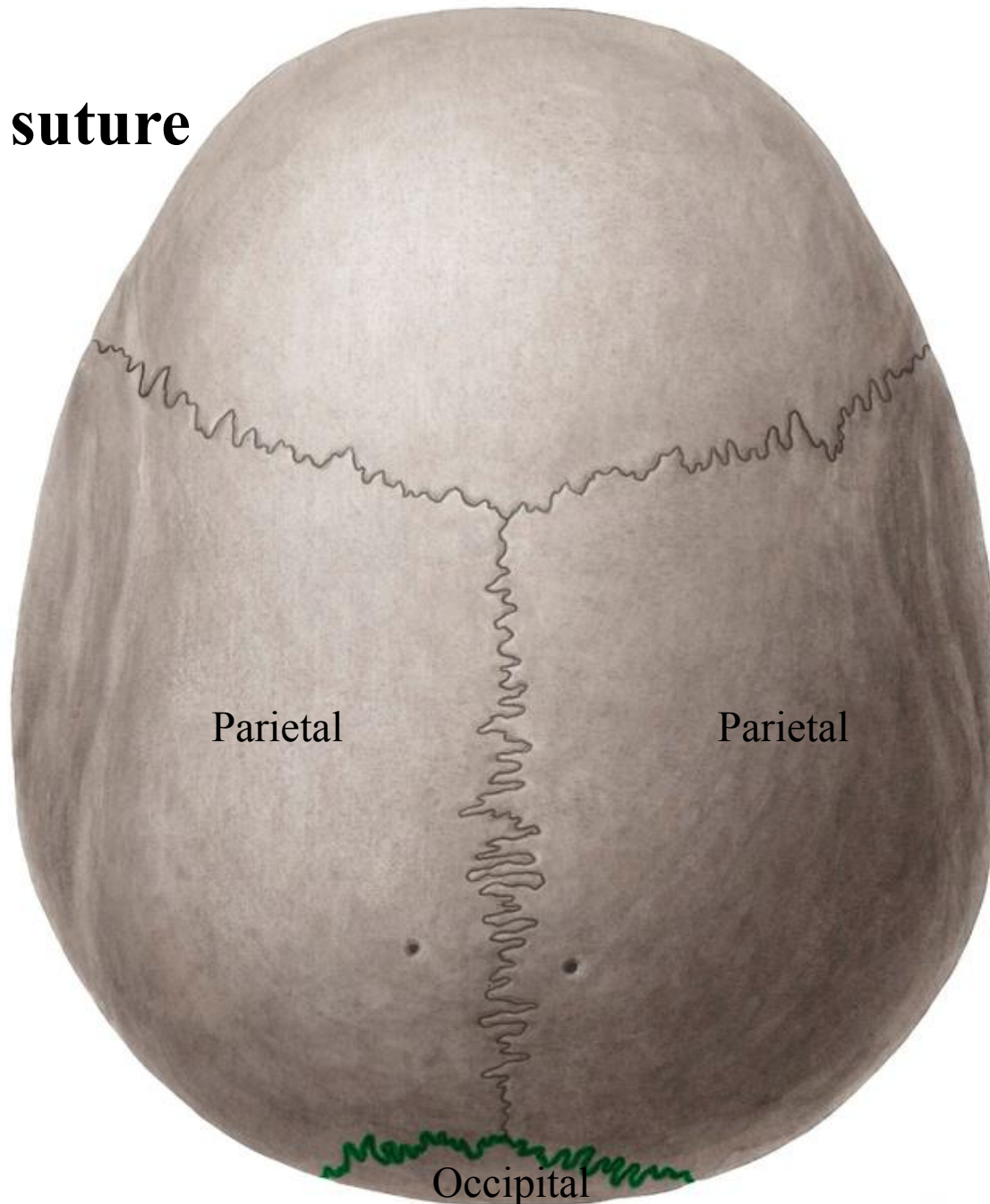
Sagittal suture

Which bones?

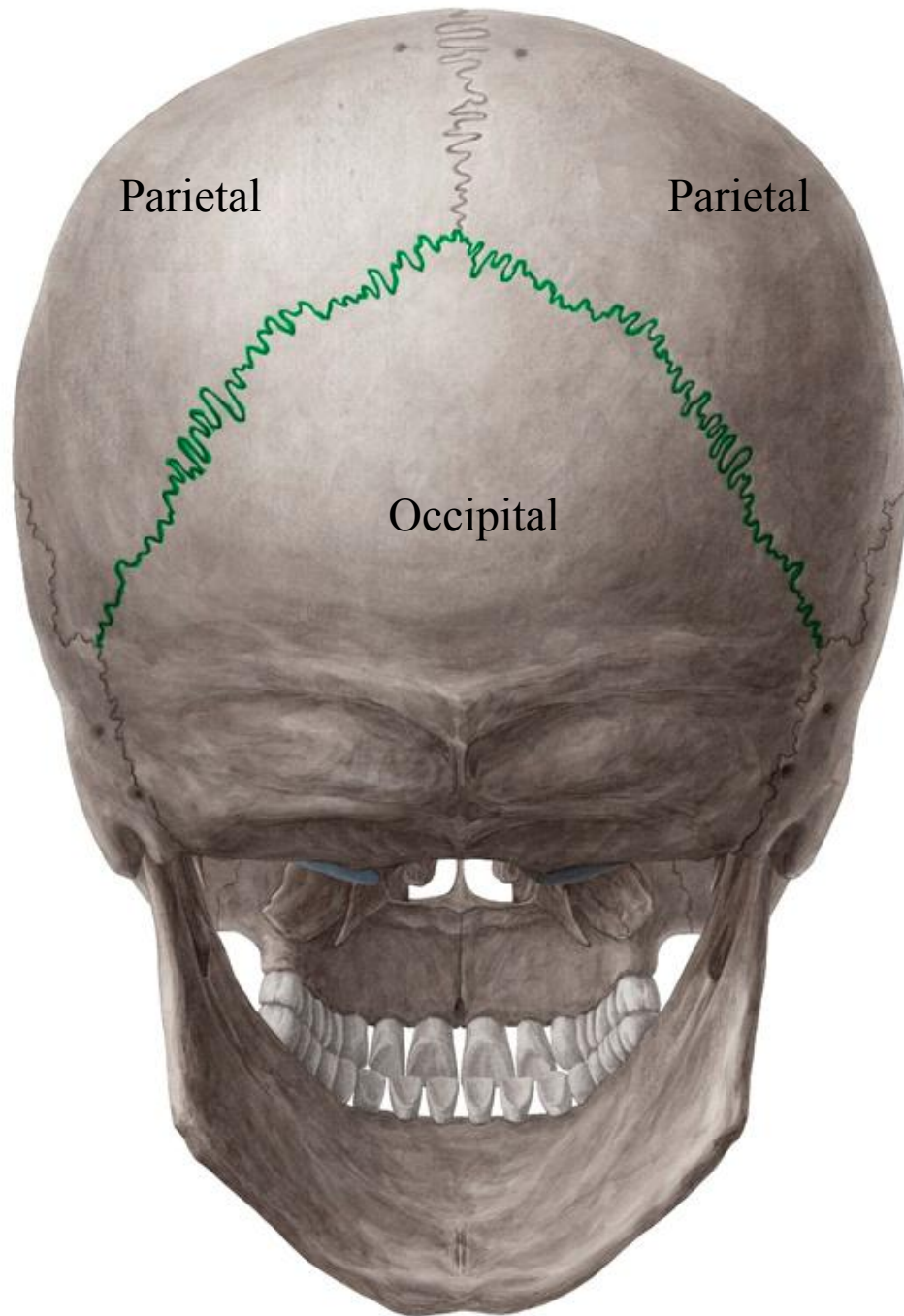


Lambdoid suture

Which bones?

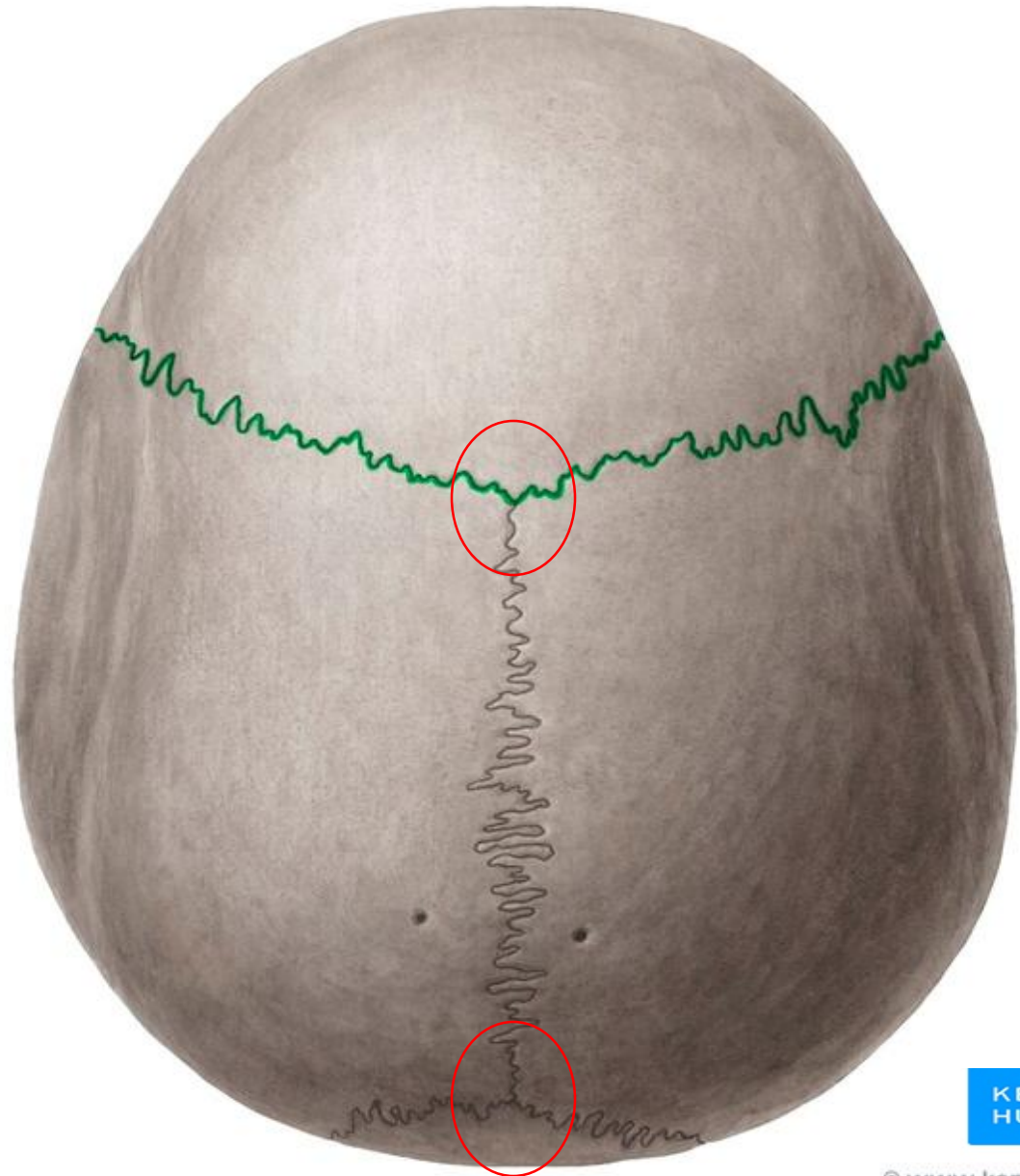


Lambdoid suture



The junction of the
sagittal and coronal
sutures is the
Bregma

The junction of the
sagittal and lambdoid
sutures is the
Lambda

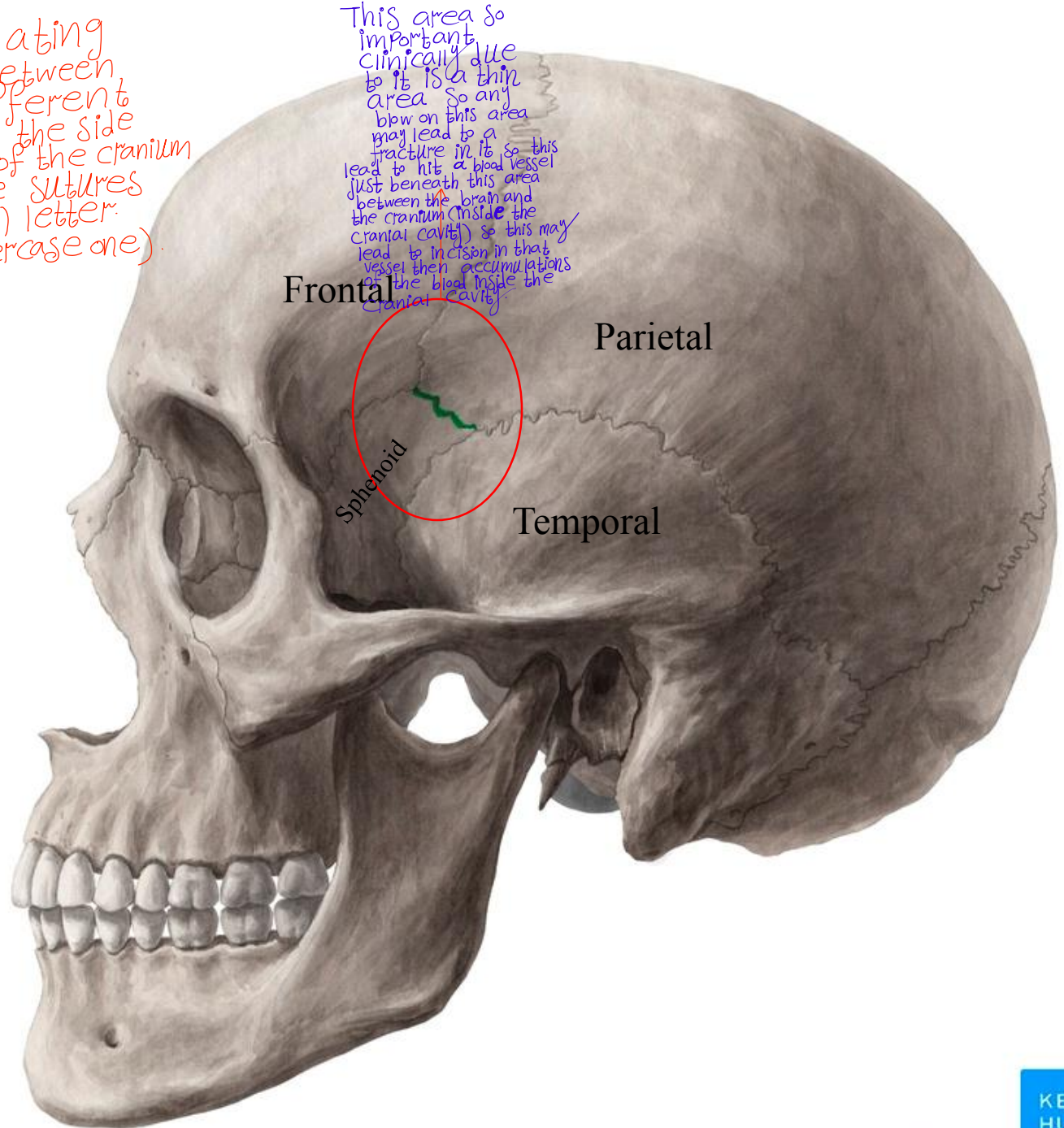


~~(P)terion~~

→ Articulating area between four different bones in the side aspect of the cranium where the sutures form (H) letter. (In Upercase one).

- 1- Frontal bone
- 2- Parietal bone
- 3- Temporal bone
- 4- Sphenoid bone

Dangerous area (why?)



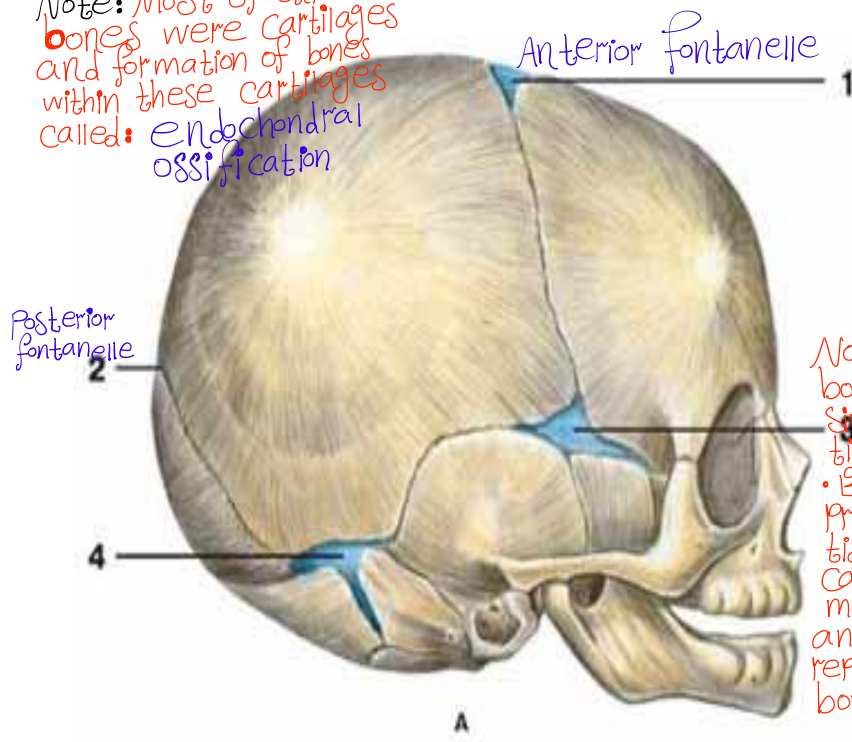
Fontanel is a soft spot in the skull of an (infant) covered with tough, fibrous membrane where ossification is not complete

Fontanelles close between 3 months and 2 years

Fontanelles:

1. Allow room for the baby's brain to grow
2. Enable the head to be compressed during delivery.

Note: Most of our bones were cartilages and formation of bones within these cartilages called: **endochondral ossification**



Note: we don't form bones directly, since the bony tissue can't grow.

- Bone has to be preceded by a tissue that can undergo mitosis to grow and then is replaced by bony union.

Note: Intramembranous ossification:
Formation of bone within a fibrous membrane

Example: flat bones of the skull

(Flat bones of the skull)

Fibrous membrane → During fetal life → Not completed ossification → Bony tissue but the fibrous tissue is still exist. completed ossification During puberty

Fontanelle
A soft area of fibrous membrane on the infant cranium that didn't ossify completely yet.

Bony plates

The most important fontanelles are anterior and posterior ones.

All fibrous membrane is replaced by bony unions

Two types of tissues that precede the formation of the bone:

A- Cartilaginous tissue

or

B- Fibrous membrane (connective tissue)

The Paranasal Sinuses

→ Spaces filled in with air.

Named by this due to they have a communication with the nasal cavity

الجيوب الأنفية

Mucous membrane (Mucosa):

It is a protective, absorptive and secretory tissue layer that lines body cavities exposed to the external environment.

- (Components of mucosa)
- 1- Epithelium tissue
 - 2- Lamina Propria (loose connective tissue-rich in blood vessels)
 - 3- Muscularis mucosae → Thin layer of smooth muscle that creates local movements like in: (GIT)

- The paranasal sinuses are cavities found in the interior of the maxilla, frontal, sphenoid, and ethmoid bones.
- They are lined with **mucous membrane** and filled with air.
- They communicate with the nasal cavity through relatively small apertures.

Sinusitis: A pathological condition occurs when the paranasal sinuses are filled with a fluid instead the air.

Mucous membrane (Mucosa)
↓
A membrane that lines the body cavities which they are in contact with the external environment like:
• Oral cavity
• Stomach
• Urinary bladder
• Paranasal sinuses
• Trachea

The type of epithelium that forms the lining mucosa varies relative to the med location. I mean: Lining mucosa of trachea differs from the one that is in stomach and so on...

(Three basic types of membranes)

Serous membrane (serosa)

A membrane that lines cavities within your body and these cavities haven't communication with the external environment. like:

• Pleural cavity

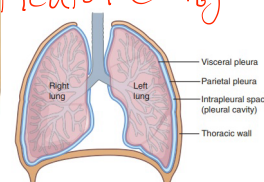


FIGURE 21-7 The lungs reside in the pleural cavities, subdivisions of the thoracic cavity. They are lined with a serous membrane called the pleura. The intrapleural space is located between the visceral and parietal pleura.

Cutaneous membrane "The Skin"

(Dermis and epidermis)

Epithelium tissue and underlying connective tissue

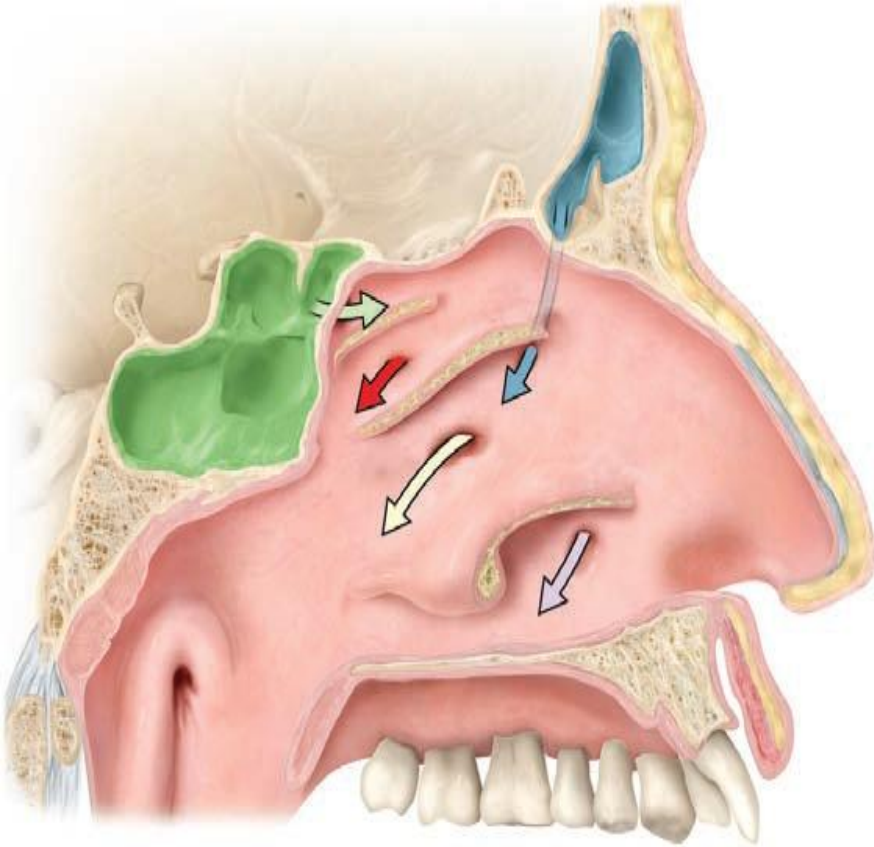
note: Epidermis is formed by: stratified squamous keratinized epithelium.

Frontal sinus

Ethmoidal sinuses

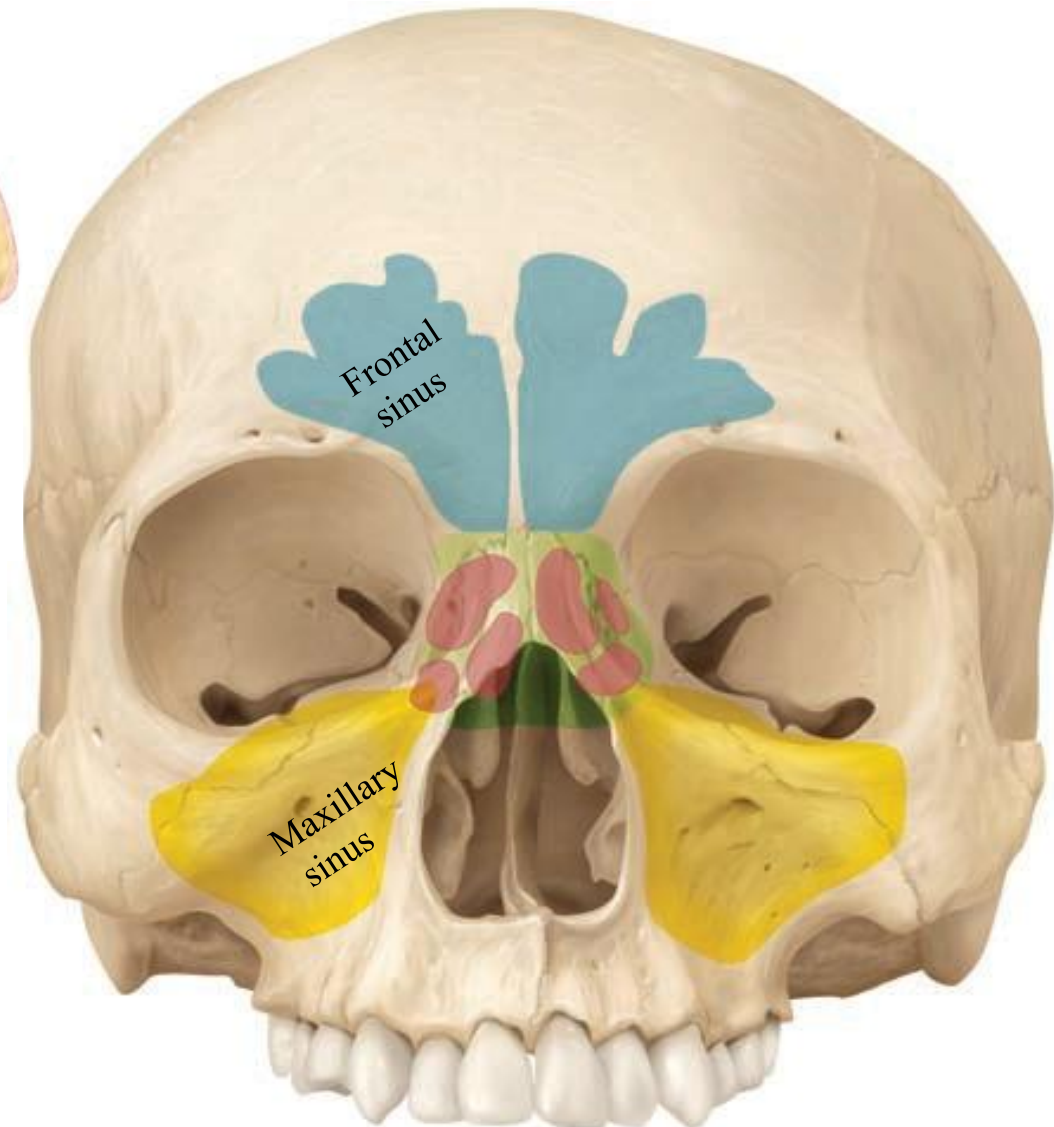
Sphenoidal sinus

Maxillary sinus



Functions:

1. Resonators of the voice
2. They also reduce the skull weight
3. Help warm and moisten inhaled air
4. Act as shock absorbers in trauma



Vertebral Column

(33 Vertebrae):

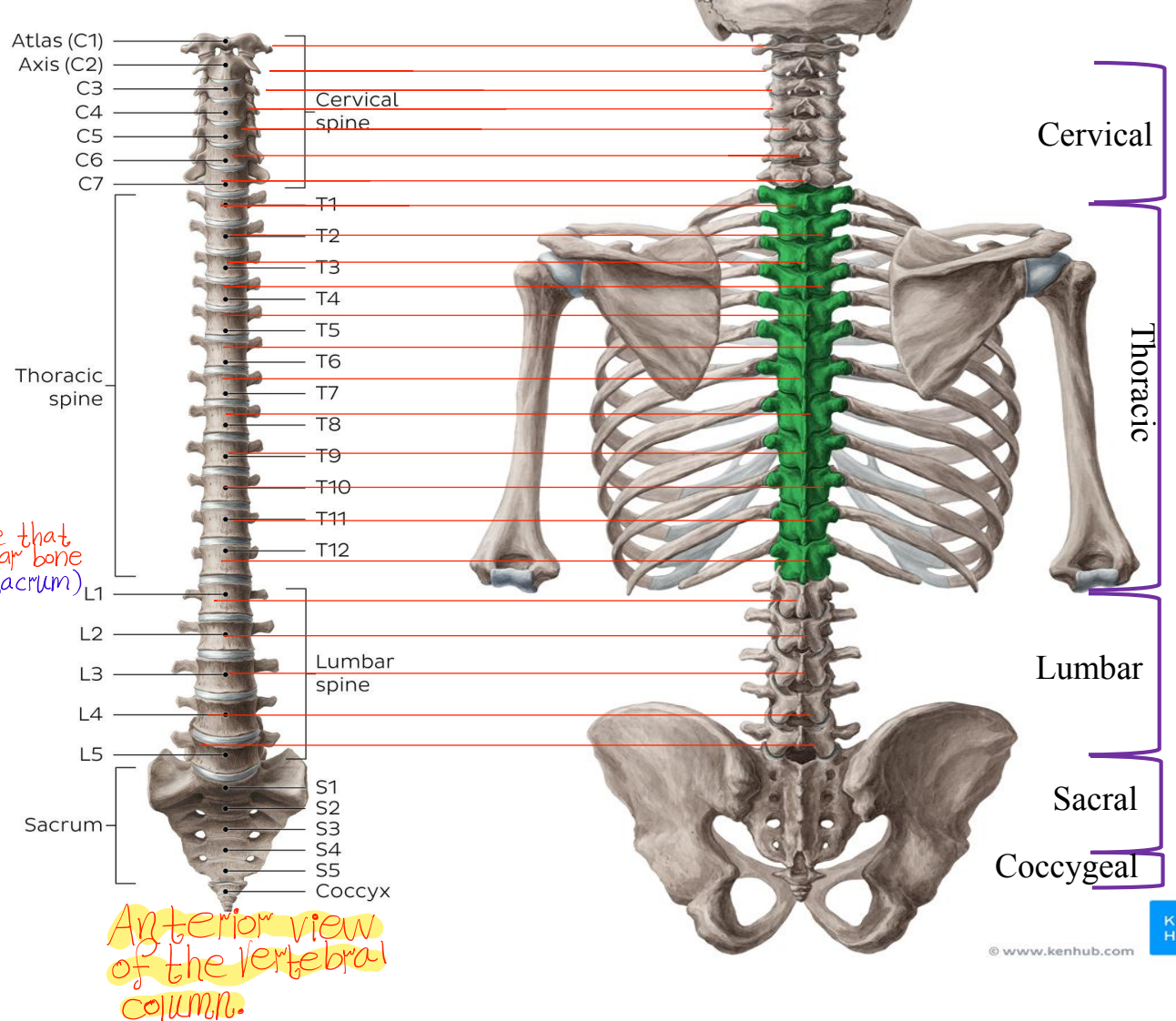
7 Cervical

12 Thoracic

5 Lumbar (Low back)

5 Sacral → Fused vertebrae that make a triangular bone in the shape (Sacrum)

4 Coccygeal
↓
Four vertebrae and three fused ones that make a triangular bone in the shape (Coccyx)



Functions & Importance

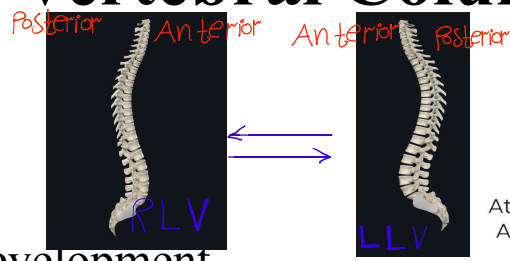
- Protects the spinal cord & spinal nerves
- Supports the head
- Provides flexibility & resilience to the trunk
- Helps in movement

Curvatures of Vertebral Column

Primary Curves:

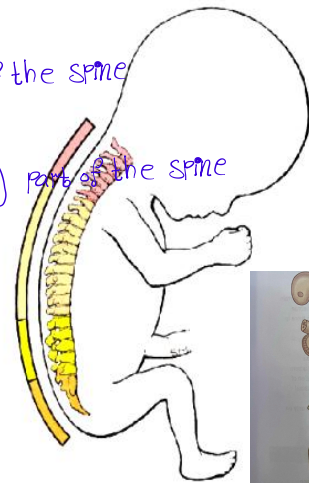
Concave anteriorly
(Convex posteriorly)

Occur during fetal development



Note:
Lordosis → concave posteriorly part of the spine

Kyphosis → concave anteriorly part of the spine



Secondary Curves:

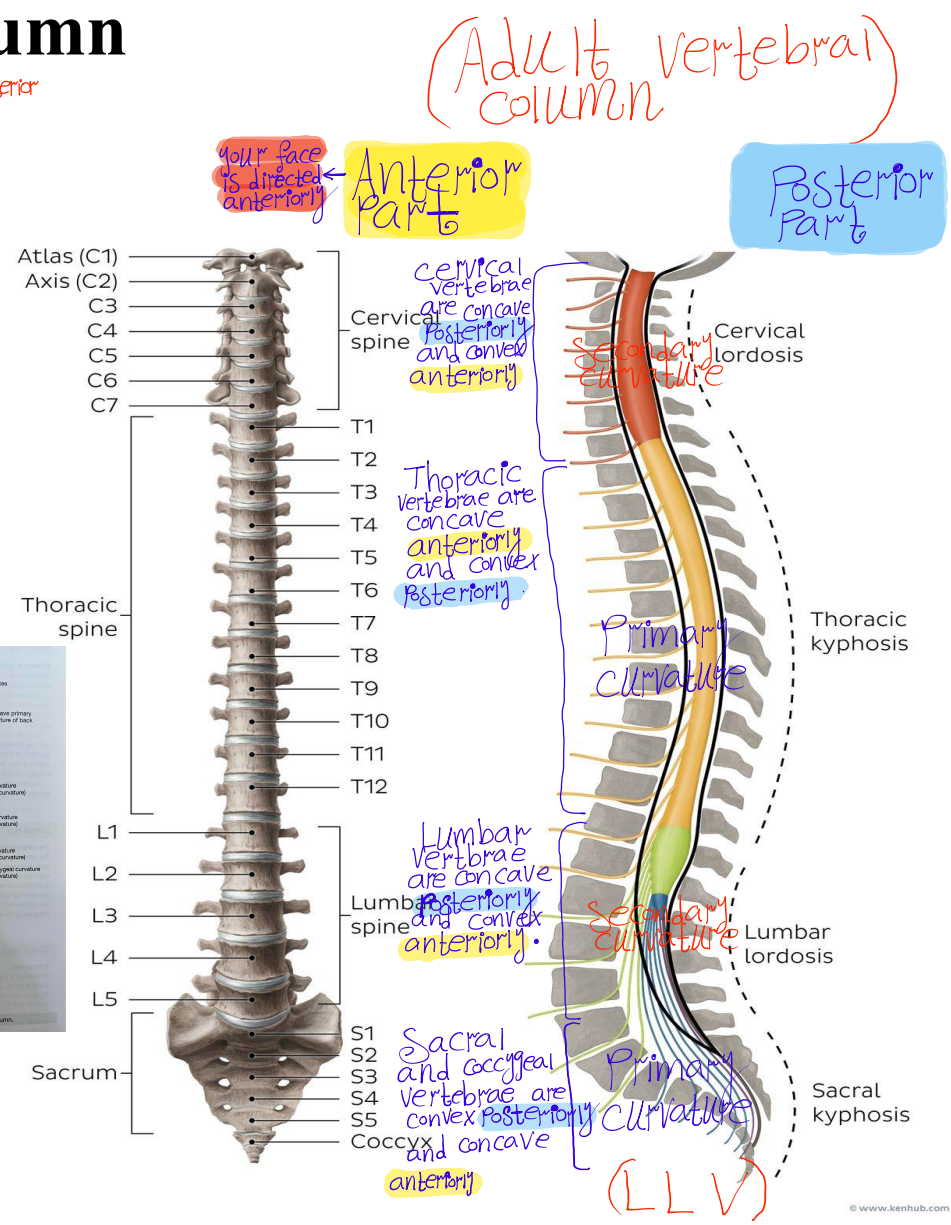
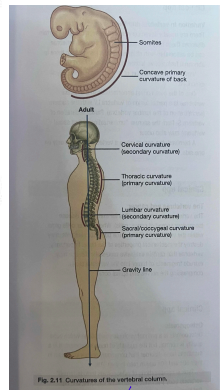
Concave posteriorly

- Cervical curvature:

As the child starts to hold his head up

- Lumbar curvature:

As the child begins to walk & assumes upright posture



RLV → Right lateral view
LLV → Left lateral view

Intervertebral Discs

2 parts:

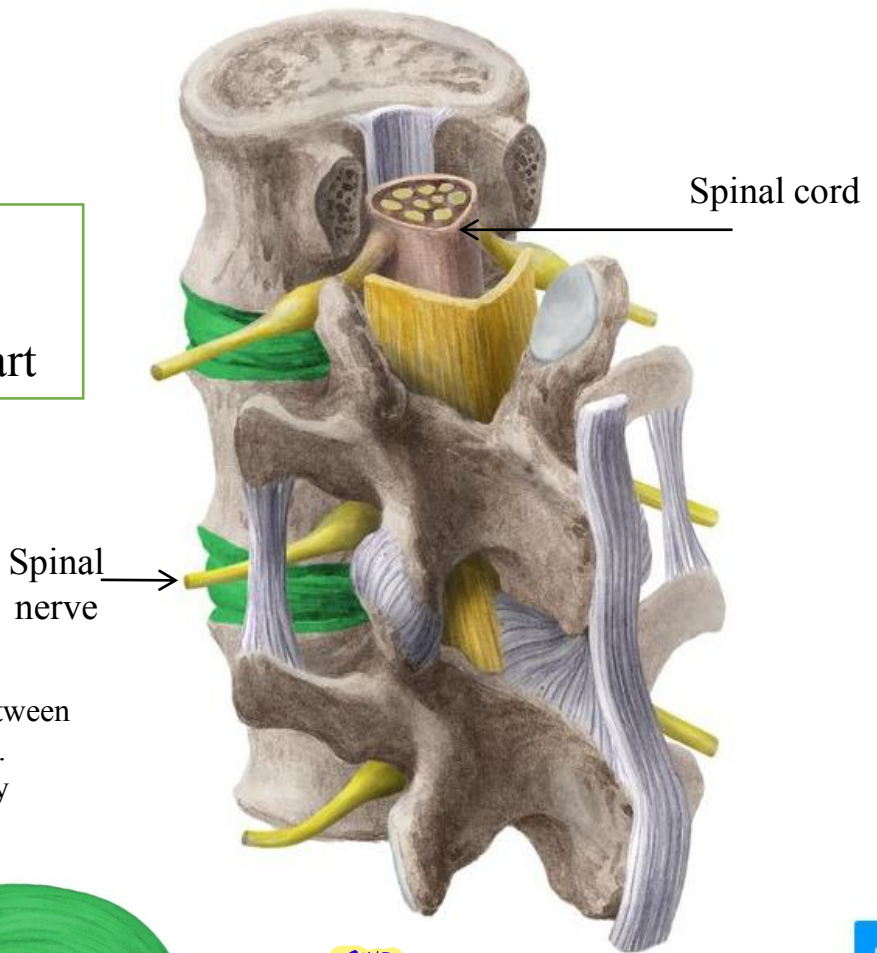
Annulus fibrosus (fibrous):

- ✓ Concentric layers of fibrocartilage
- ✓ Strengthens the disc & protects the central part

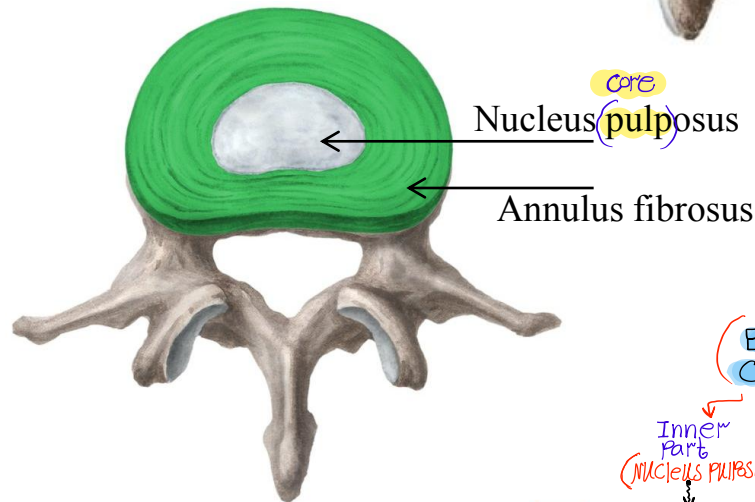
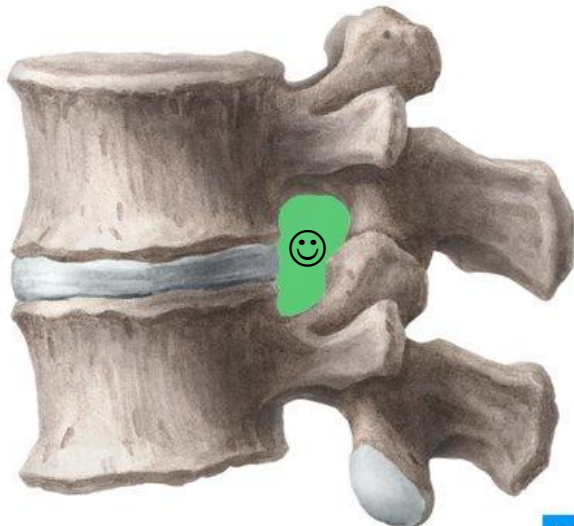
Nucleus pulposus (gelatinous):

- ✓ Central core of the disc
- ✓ More elastic (↑ water)
- ✓ Shock absorber

☺ The **intervertebral foramen** is an oval-shaped opening formed between the pedicles of two adjacent vertebrae of the vertebral column. These foramina provide passageways for spinal nerves to carry information to and from the spinal cord



Dr. Heba Kalbouneh



• Between each two vertebrae, there is a disc.

(Each disc composed of:)

- Inner part (Nucleus pulposus) → Forms the gelatinous material
- Outer part (Annulus fibrosus) → Formed by a fibrocartilage

Annulus → outer ring - peripheral part.

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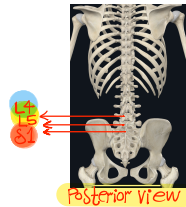
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Disc Herniation

Protrusion (leakage) of the gelatinous nucleus pulposus through the annulus fibrosus of intervertebral disc

**Posterolateral direction:
Thinner annulus fibrosus**



95% in (L4/L5 or L5/S1)

→ The commonest vertebrae which exposed to the disc herniation in the discs between them.

POSTERIOR

Compression on the spinal nerve during the herniation of the intervertebral discs causes many symptoms at the patient like:

- 1- Difficulties of the movement
- 2- Weakness of the muscles.
- 3- Sensory symptoms like: losing the ability of sensation at the lower part.

Spinal cord

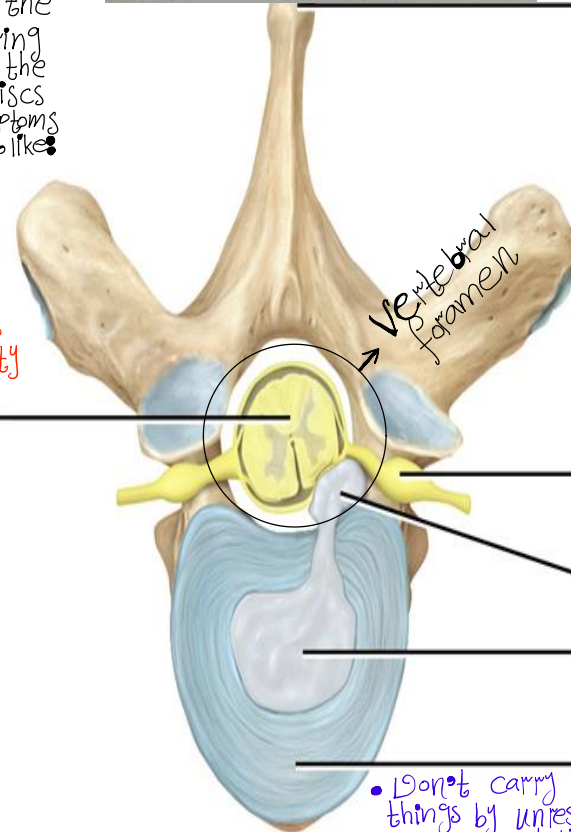
ANTERIOR

Clinical app

Herniation of intervertebral discs

The discs between the vertebrae are made up of a central portion (the nucleus pulposus) and a complex series of fibrous rings (annulus fibrosus). A tear can occur within the annulus fibrosus through which the material of the nucleus pulposus can track. After a period of time, this material may track into the vertebral canal or into the intervertebral foramen to impinge on neural structures (Fig. 2.17). This is a common cause of back pain. A disc may protrude posteriorly to directly impinge on the cord or the roots of the lumbar nerves, depending on the level, or may protrude posterolaterally adjacent to the pedicle and impinge on the descending root.

Spinous process of vertebra



Spinal nerve

Herniation

Nucleus pulposus

Annulus fibrosus

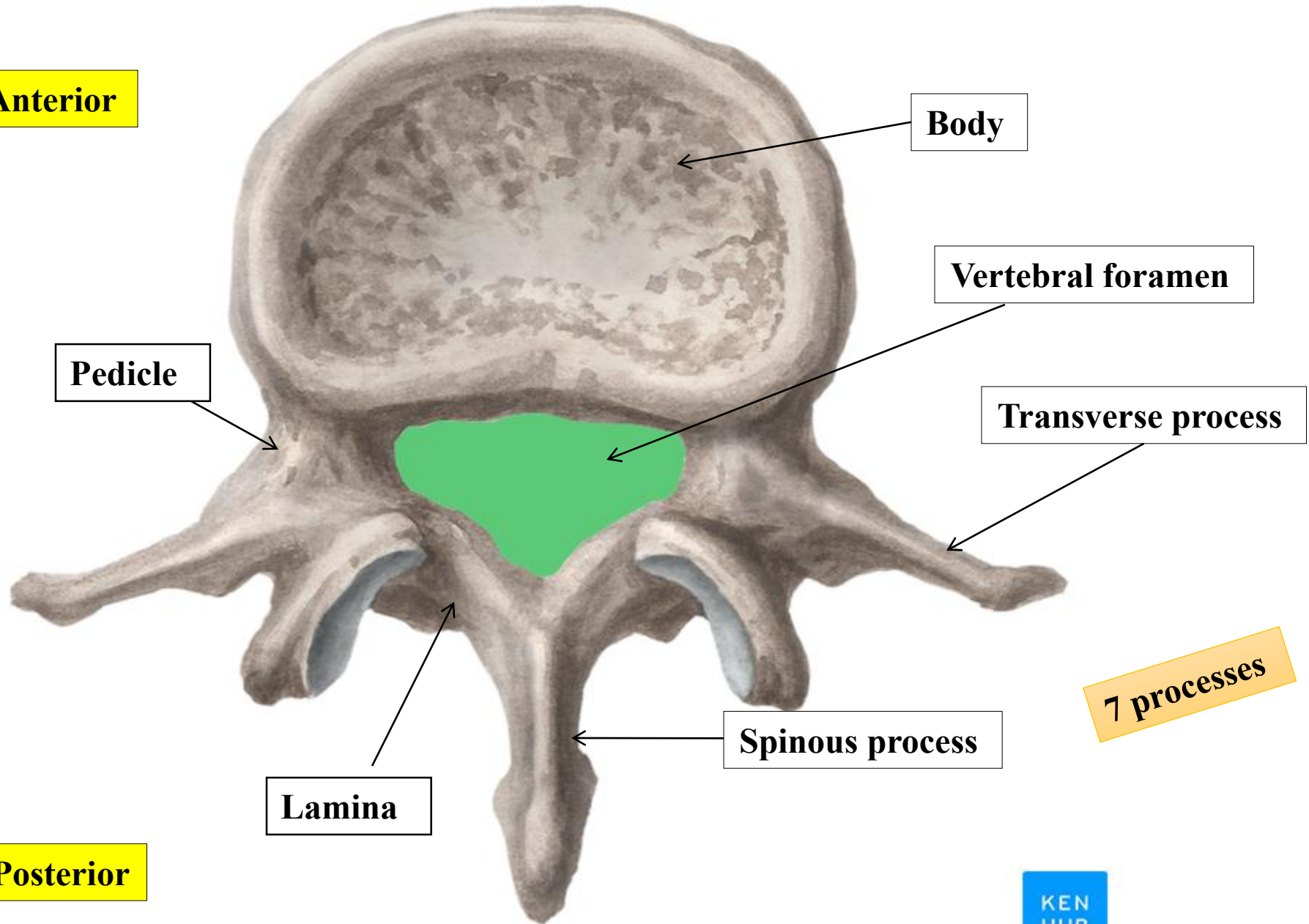
- Don't carry heavy things by irresponsible way to avoid the disc herniation

(Superior view)

Structure of Typical Vertebra

Dr. Heba Kalbouneh

Anterior



Lamina

Posterior

Spinous process

Vertebral foramen

Transverse process

Body

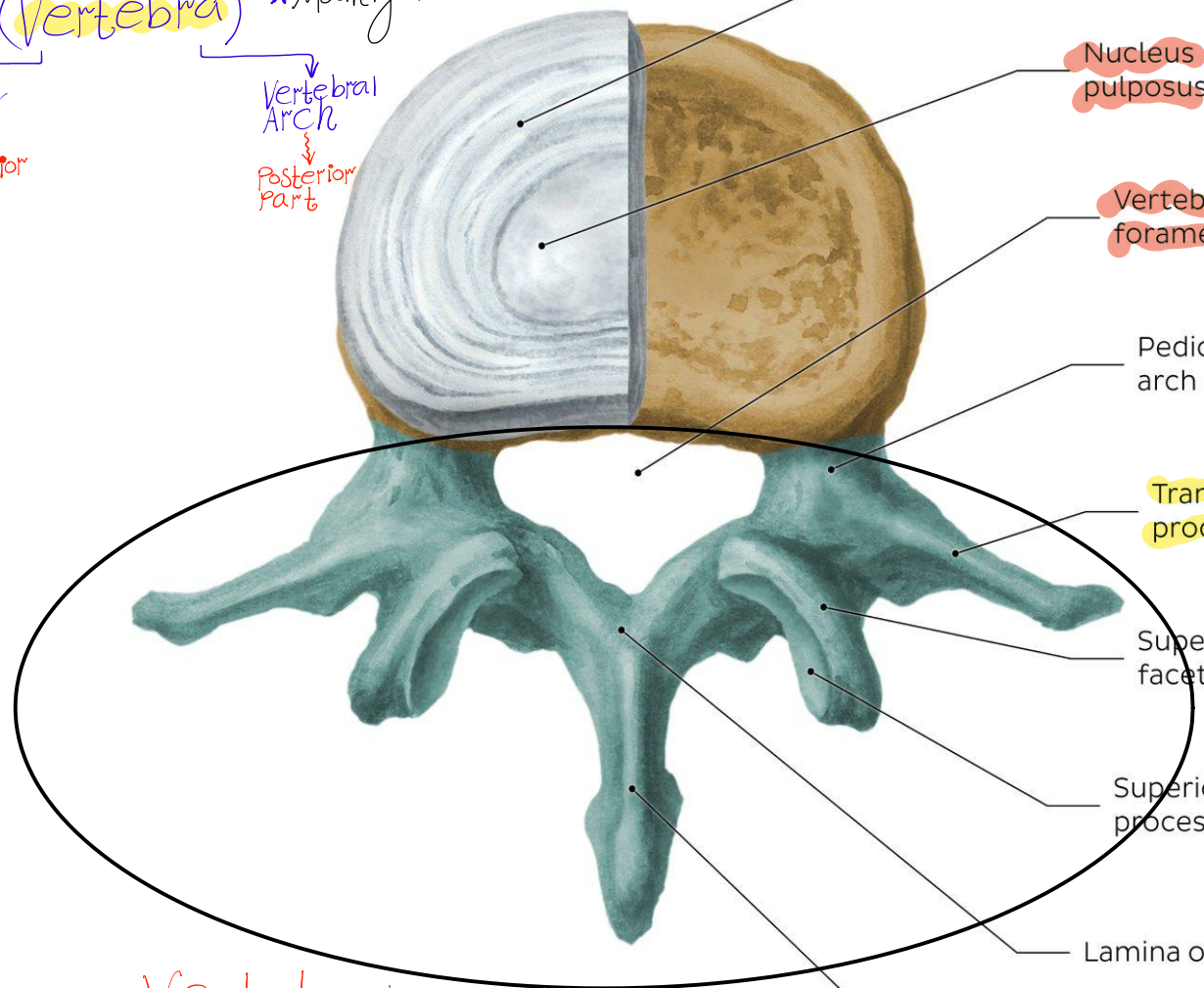
7 processes

- Vertebral body
- Vertebral arch

(Vertebra) *Mainly*

Body
↓
Anterior part

Vertebral Arch
↓
Posterior part



Intervertebral disc

Anulus fibrosis

Nucleus pulposus

Vertebral foramen

Pedicle of vertebral arch

Transverse process

Superior articular facet

Superior articular process

Lamina of vertebral arch

Spinous process

Note: Vertebral foramina above each other form the vertebral canal where the spinal cord passes through it.

Note: A pedicle: A short and stout bony projection that connects the vertebral body to the transverse process of the vertebral arch.

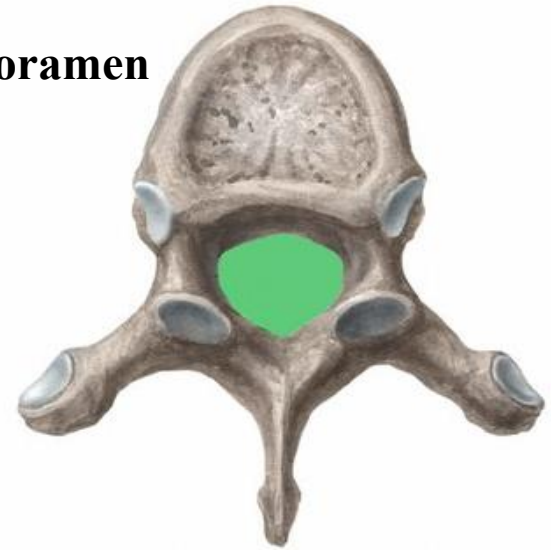
* Each vertebra has two pedicles. (Left & Right)

Vertebral Arch

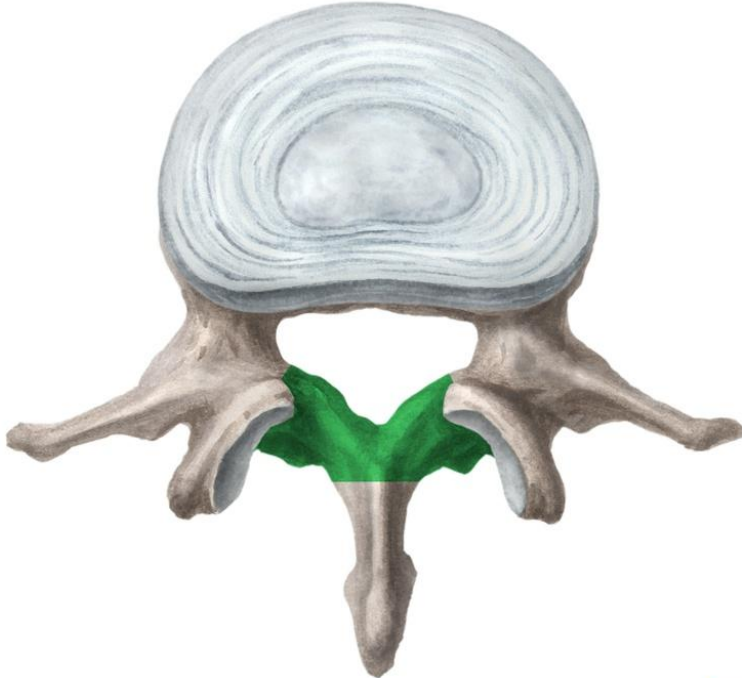
Body



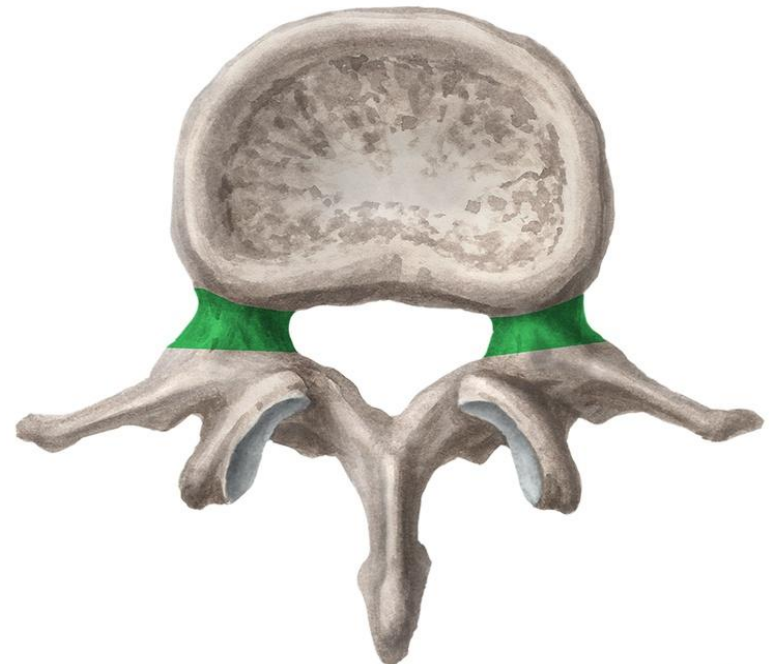
Vertebral foramen



Lamina of the vertebral arch



Pedicle of the vertebral arch

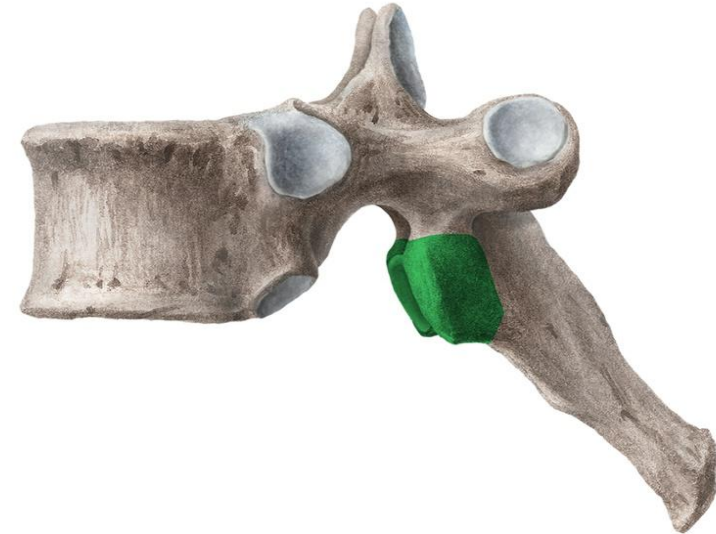


Superior articular process (2)



* Each vertebra has seven processes (to this point).

Inferior articular process (2)

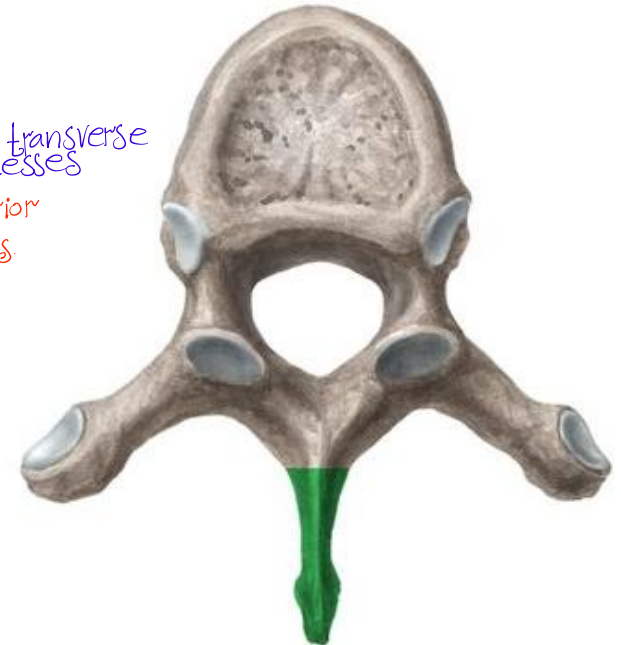


Transverse process (2)

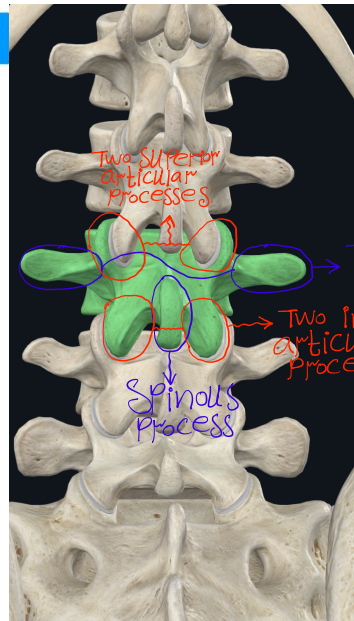


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Spinous process (1)



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Posterior view

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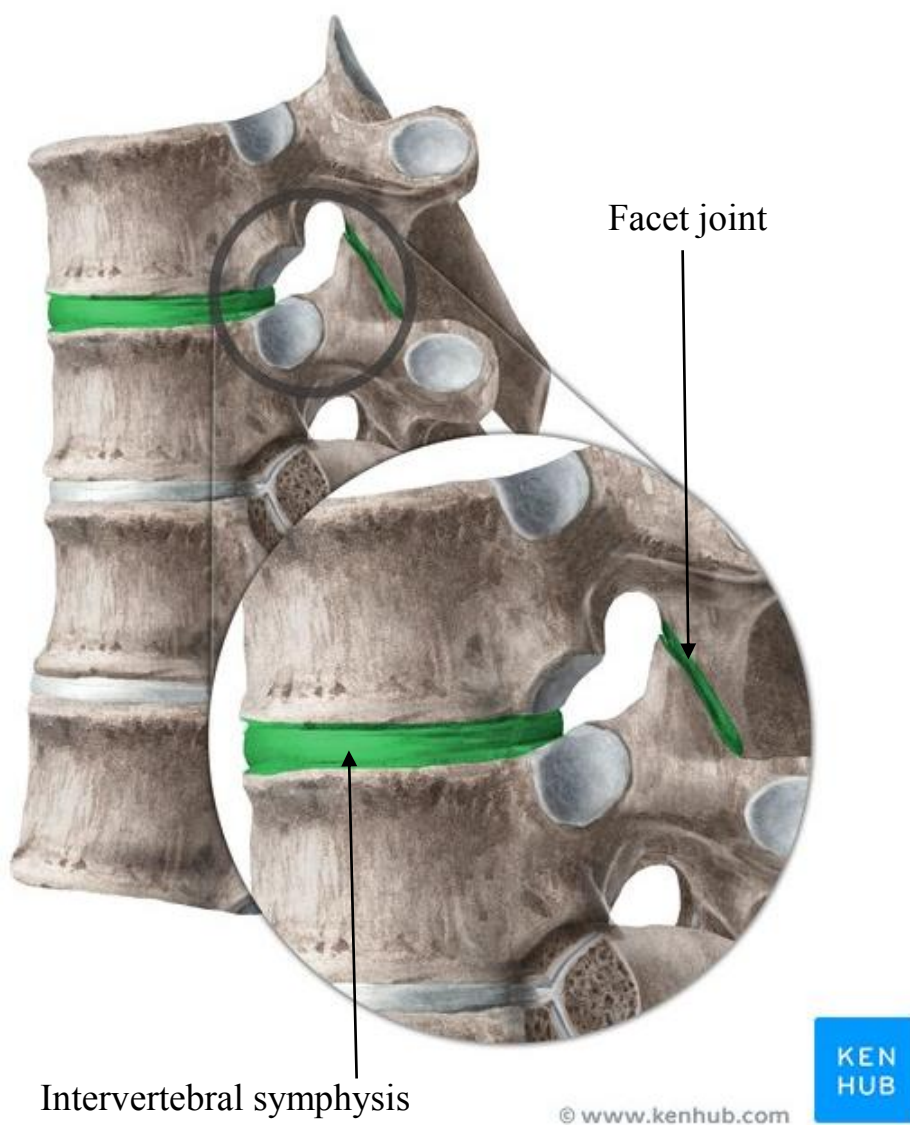
Joints of the vertebral bodies and arches

In order to maintain stability and secure movements of the vertebral column, the vertebrae articulate with each other by connecting their bodies and their arches.

The **intervertebral joints** are the articulations between the adjacent vertebrae of the vertebral column.

Each intervertebral joint is composed of three separate joints:

- **One intervertebral symphysis** (intervertebral disc joint):
- **Two facet joints**

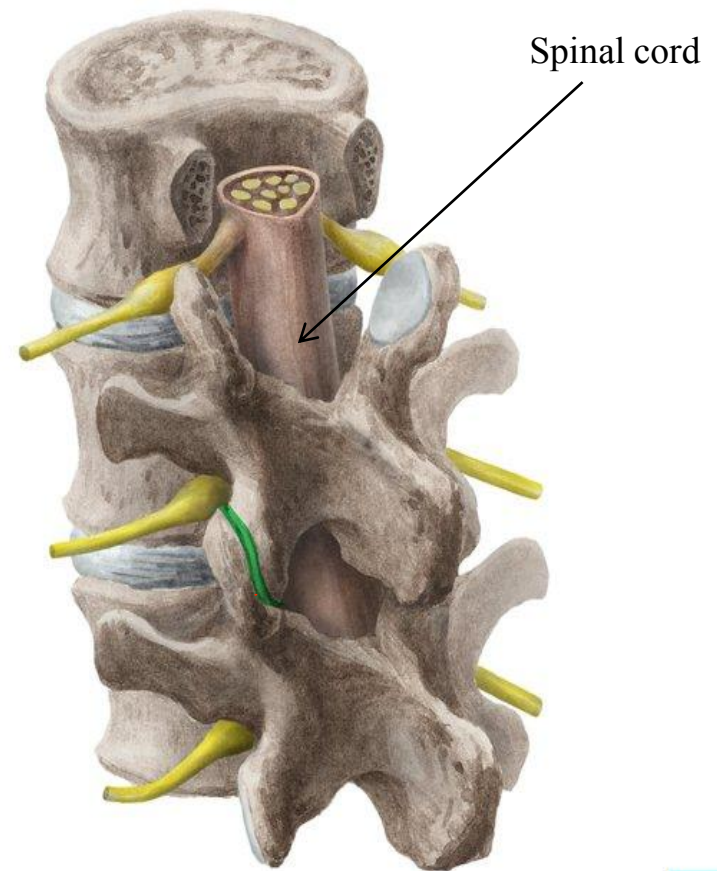
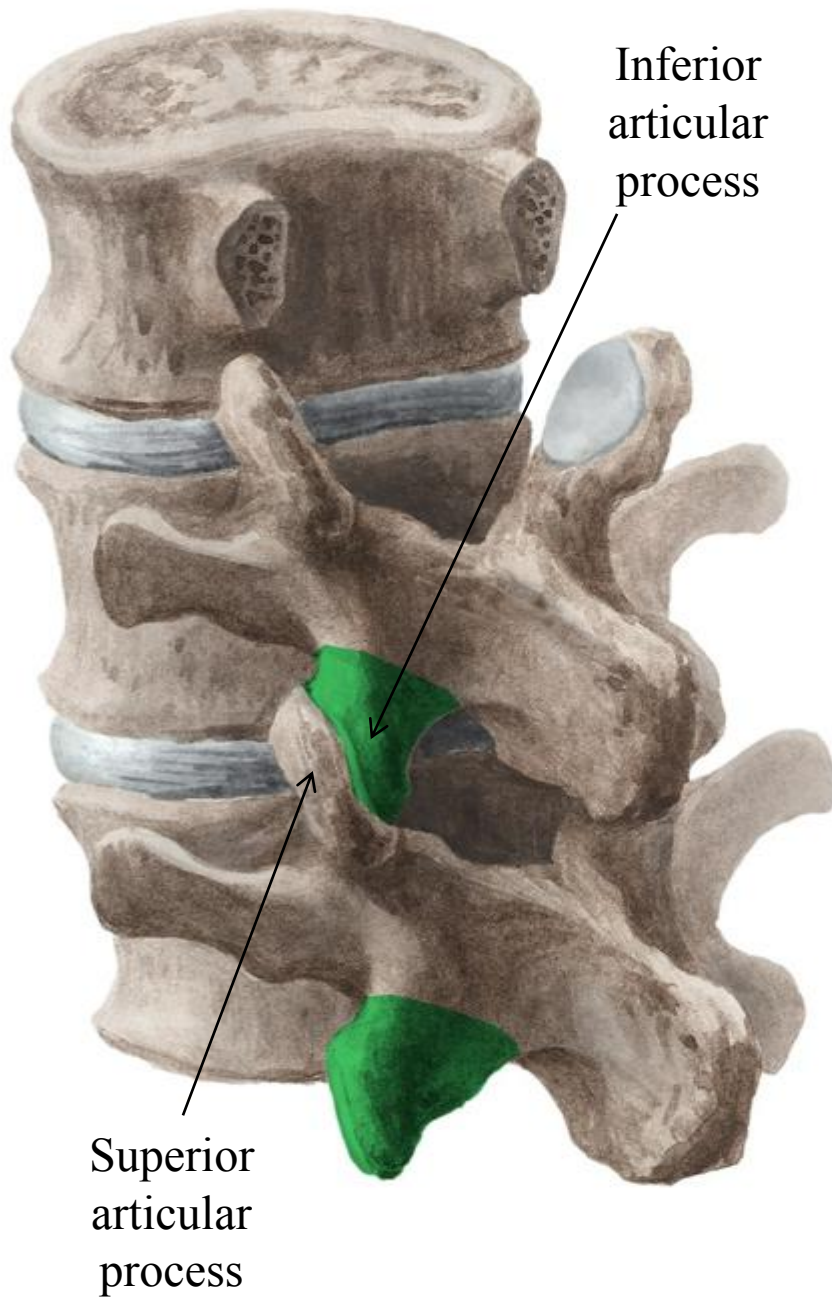


An intervertebral symphysis is the articulation of two contiguous vertebral bodies and the intervening intervertebral disc. ^{فجوة}

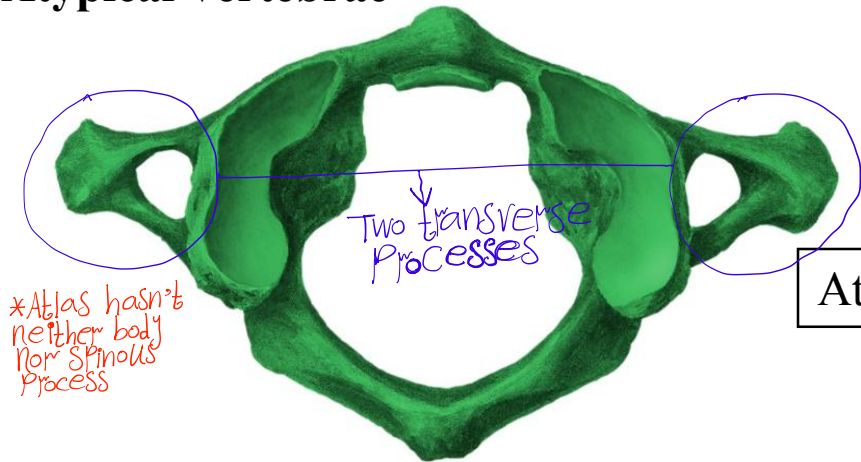
Type: Secondary cartilaginous joint or symphysis (fibrocartilage composition).

Facet joints are between the superior articular process of one vertebra and the inferior articular process of the vertebra directly above it.

Type: Synovial plane joints



Atypical Vertebrae



Note: Each type of vertebrae possesses its distinct features and the difference may occur between vertebrae that belong to the same type.

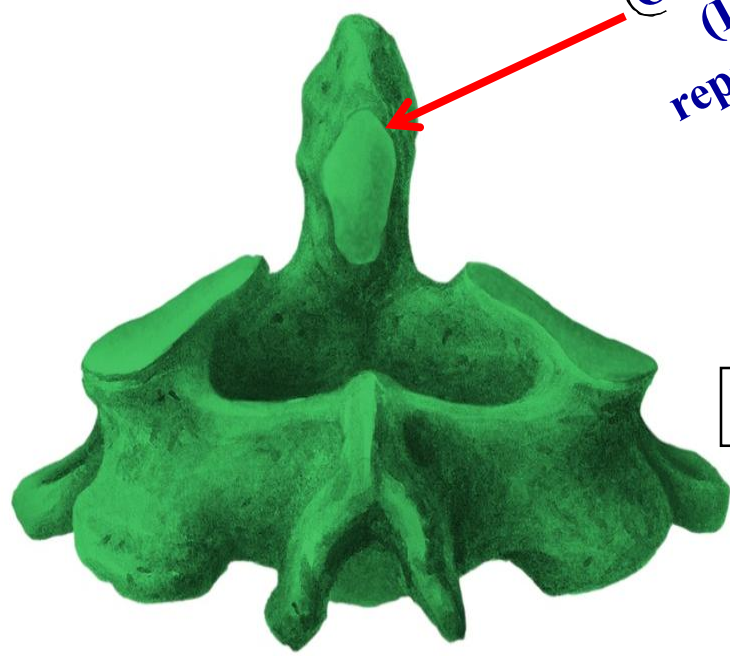
• Cervical vertebrae differ from lumbar ones.

(The difference may be:)

Functional
Size
Structural

Atlas (1st cervical vertebra)

Tooth like extension
(Odontoid) process
(Dens: tooth)
represents the body of atlas that has fused with body of axis

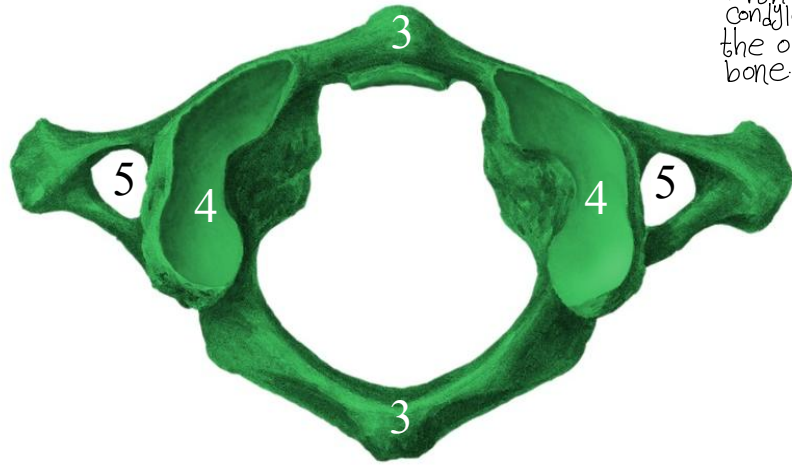


Axis (2nd cervical vertebra)

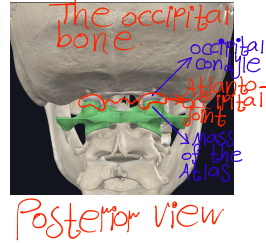
The most big in size among all vertebrae are: lumbar ones
to bear the weight of your body.



Atlas (1st cervical vertebra)



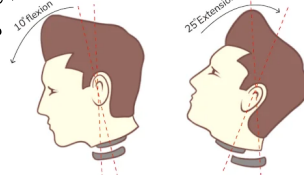
*Atlas has two lateral masses to articulate with the condyles of the occipital bone.



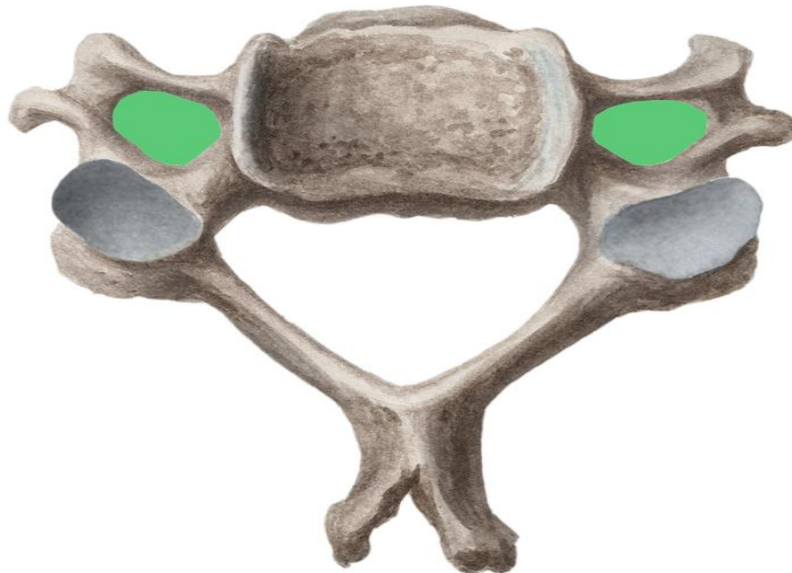
Characteristics:

1. no body
2. no spinous process
3. ant. & post. arches
4. 2 lateral masses
5. 2 transverse foramina

Provides movements by Atlanto-occipital joint:



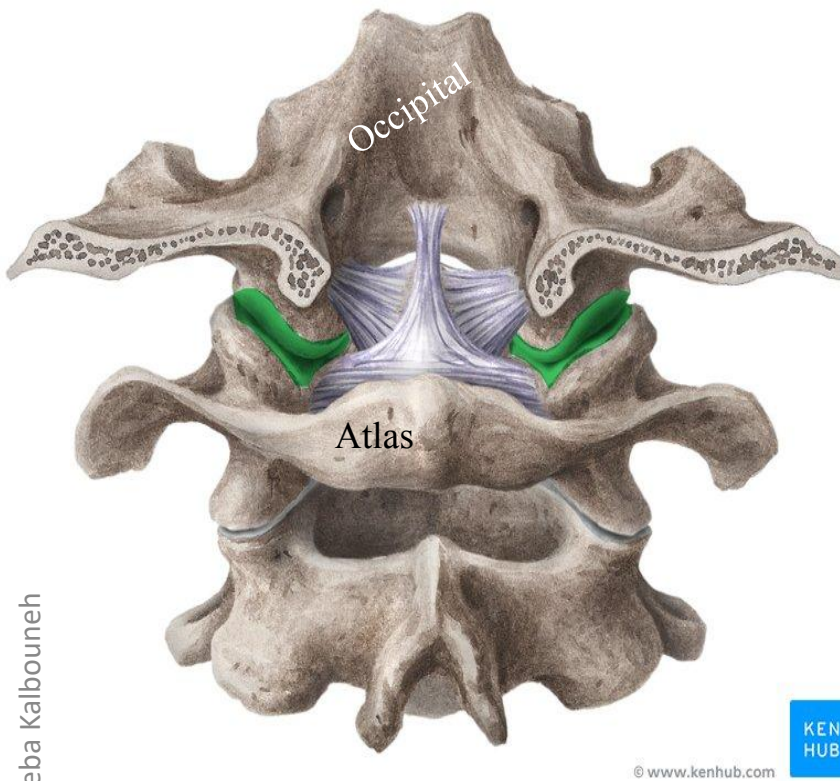
Typical cervical vertebra



Specific to the **cervical vertebra** is the **transverse foramen** (foramen transversarium).



is an opening on each of the **transverse processes** which gives passage to the **vertebral artery**



Atlas (1st cervical vertebra)



Communicates:

Superiorly: base of skull (atlanto-occipital joint)

Flexion and extension: nodding of the head (the YES movement)

Type: Synovial condyloid (ellipsoid) joint.

Inferiorly: axis (atlanto-axial joint)

Rotation: allows us to turn our head to look towards the left or towards the right

Type: Synovial pivot joint.

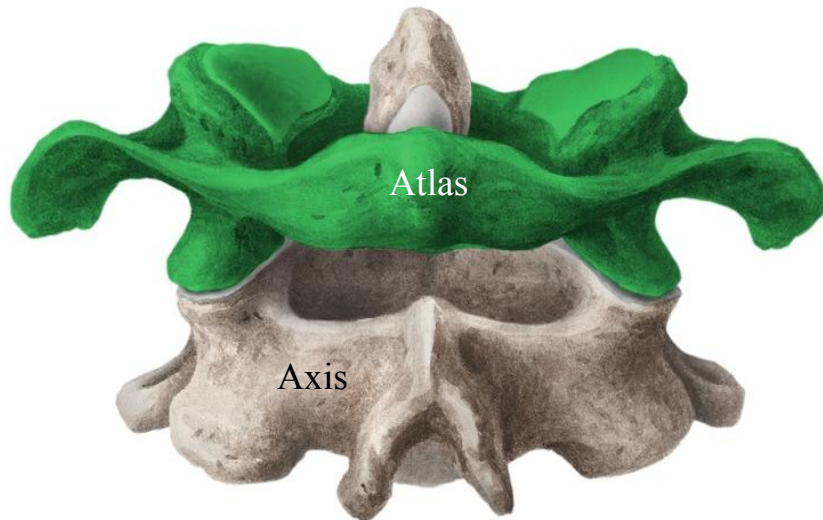





TABLE 7.5

Comparison of Major Structural Features of Cervical, Thoracic, and Lumbar Vertebrae



| CHARACTERISTIC | CERVICAL | THORACIC | LUMBAR |
|-------------------------------|---|--|---|
| Overall structure |  |  |  |
| Size | Small | Larger | Largest |
| Foramina | One vertebral and two transverse | One vertebral | One vertebral |
| Spinous processes | Slender and often bifid (C2–C6) | Long and fairly thick (most project inferiorly) | Short and blunt (project posteriorly rather than inferiorly) |
| Transverse processes | Small | Fairly large | Large and blunt |
| Articular facets for ribs | Absent | Present | Absent |
| Direction of articular facets | | | |
| Superior | Posterosuperior | Posterolateral | Medial |
| Inferior | Anteroinferior | Anteromedial | Lateral |
| Size of intervertebral discs | Thick relative to size of vertebral bodies | Thin relative to vertebral bodies | Massive |

Read only

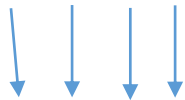
Thoracic Cage

- Sternum (*G, sternon*= *chest bone*)
- 12 pairs of ribs & costal cartilages
- 12 thoracic vertebrae

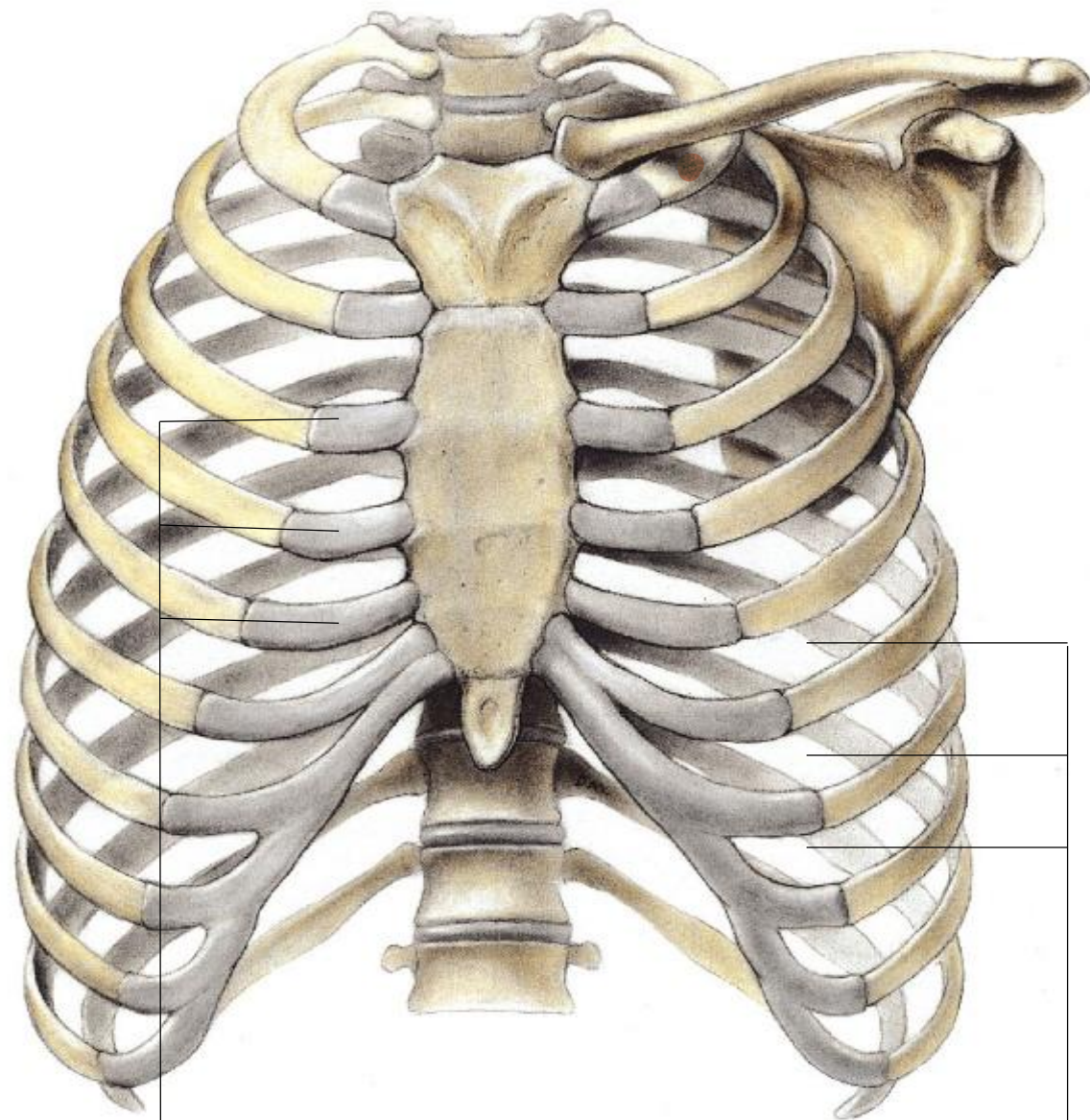
Costal Cartilages

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 the cartilage immediately above.

The 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.



Costal
cartilages

Intercostal
spaces

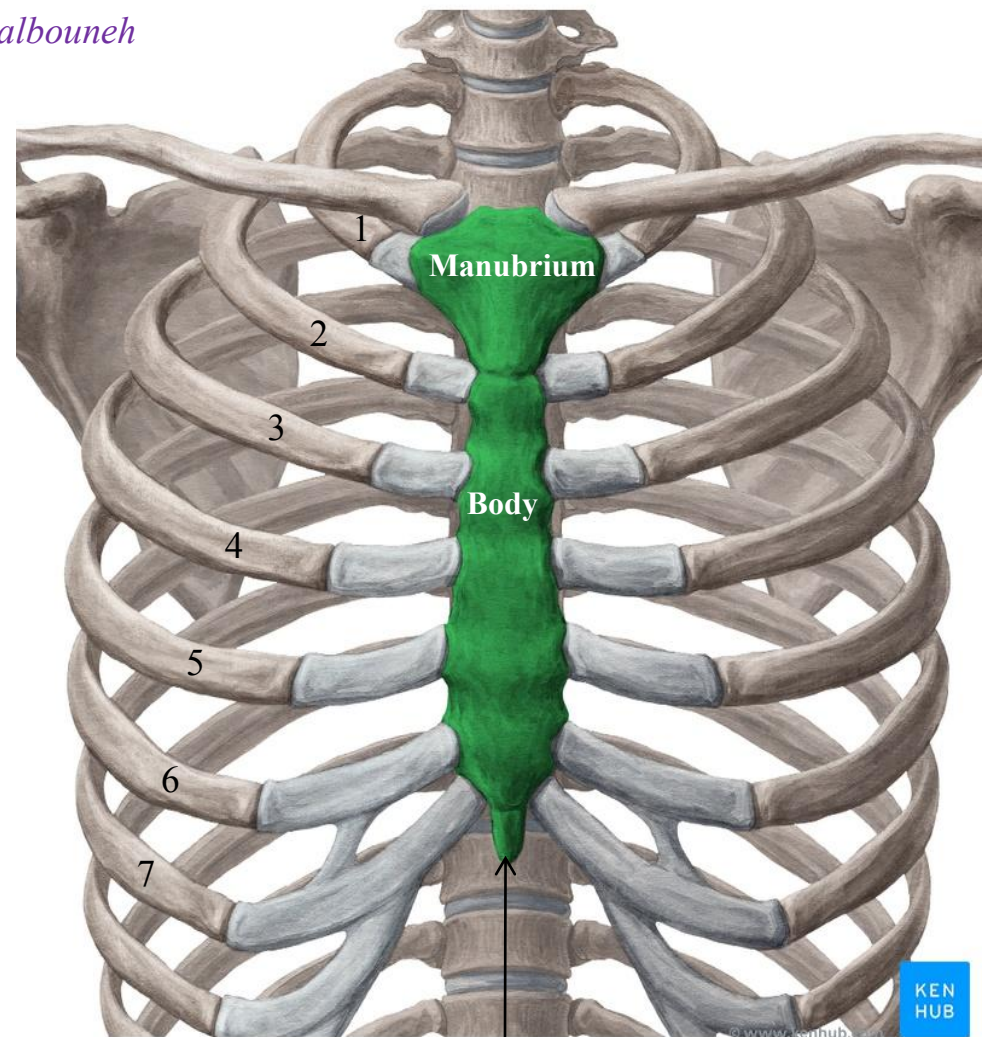
Sternum

It lies in the midline of the anterior chest wall.

It is a flat bone that can be divided into three parts: manubrium sterni, body of the sternum, and xiphoid process.

The manubrium is the upper part of the sternum. It articulates 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 second to the seventh costal cartilages.

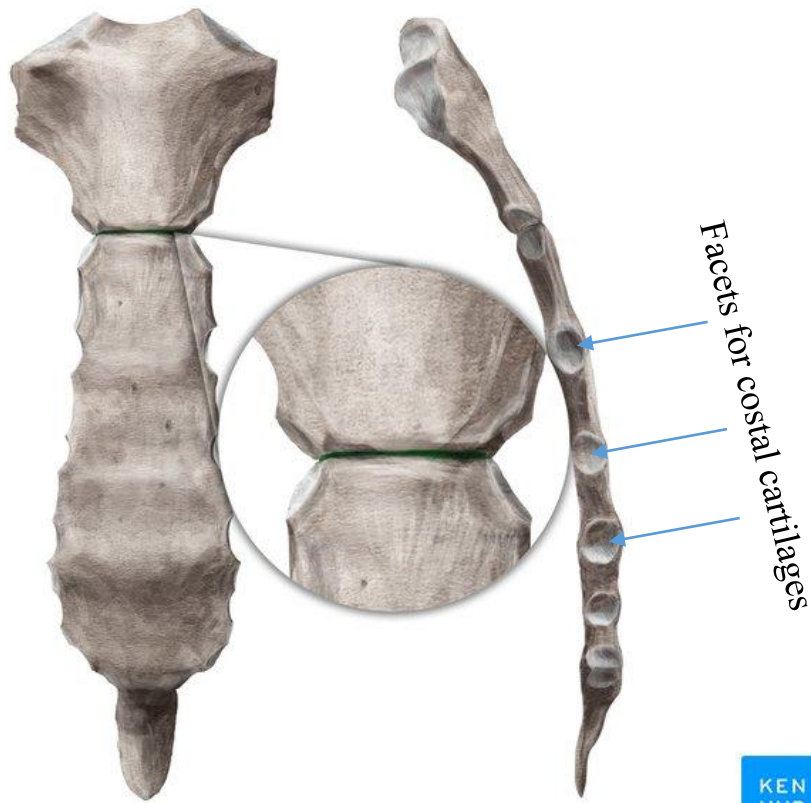


Xiphoid process →

It is still a cartilage until the middle ages. It is completely ossified.

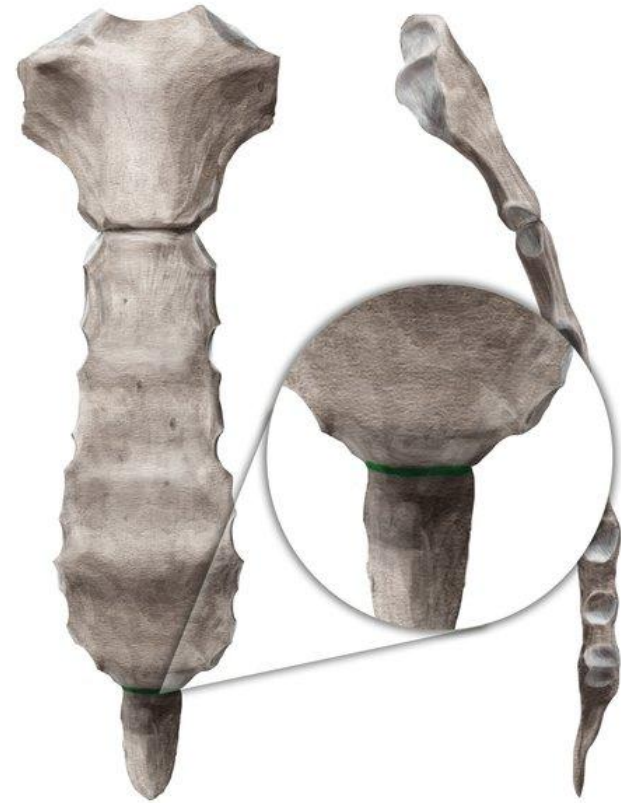
The xiphoid process is a thin plate of cartilage that becomes ossified at its proximal end during adult life. No ribs or costal cartilages are attached to it.

Cartilaginous joints



Manubriosternal joint (Sternal angle)

lies opposite the intervertebral disc between the fourth and fifth thoracic vertebrae.



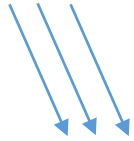
Xiphisternal joint

lies opposite the body of the ninth thoracic vertebra.

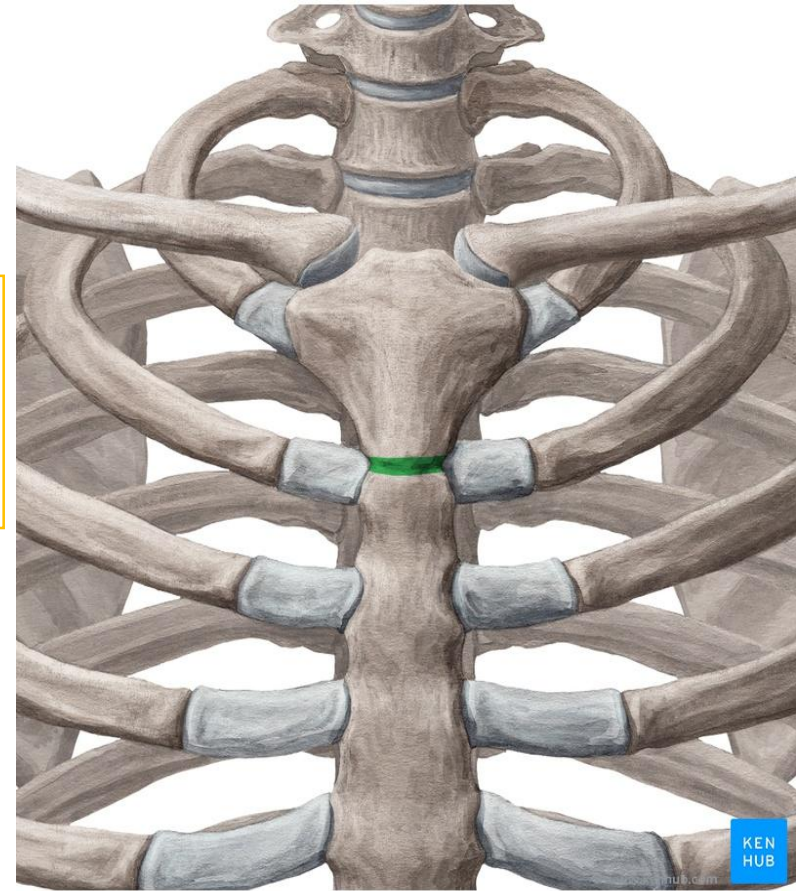
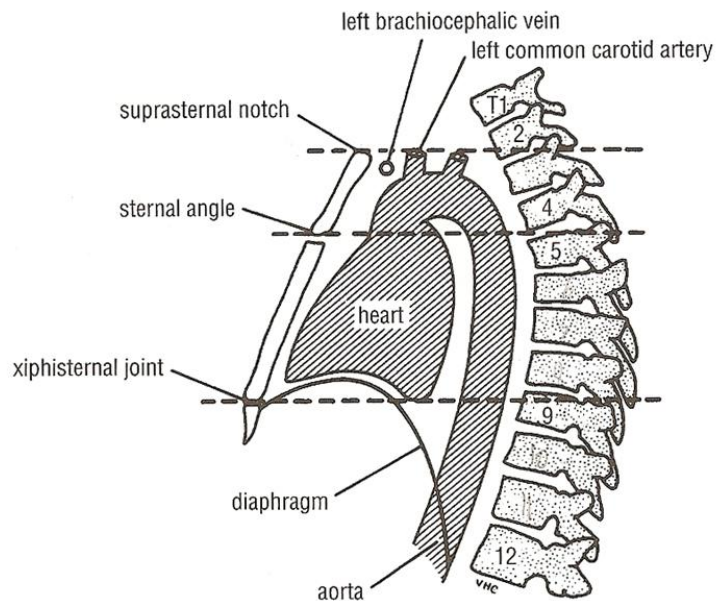
Manubriosternal Joint:

- ✓ Sternal angle (Angle of Louis)
- ✓ Easily palpated
- ✓ Opposite to T4-T5 disc
- ✓ At 2nd costal cartilage:

The sternal angle is a palpable clinical landmark in surface anatomy

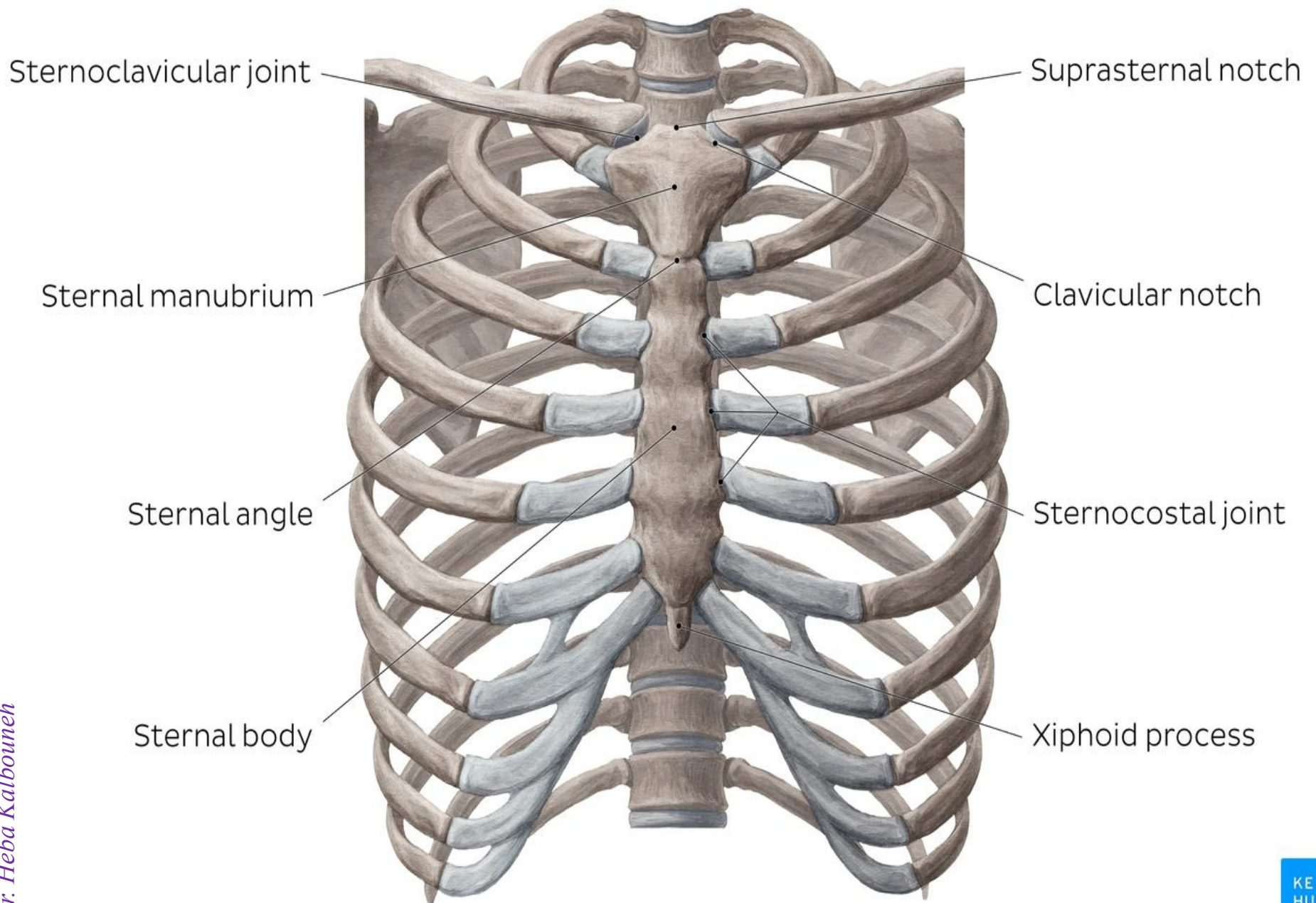


Counting the ribs & intercostal spaces



Clinical application: Sternum and Marrow Biopsy

Since the sternum possesses red hematopoietic marrow throughout life, it is a common site for marrow biopsy. Under a local anesthetic, a wide-bore needle is introduced into the marrow cavity through the anterior surface of the bone. The sternum may also be split at operation to allow the surgeon to gain easy access to the heart, great vessels, and thymus.



Ribs

Flat curved bones

✓ There are 12 pairs of ribs, all of which are attached posteriorly to the thoracic vertebrae.

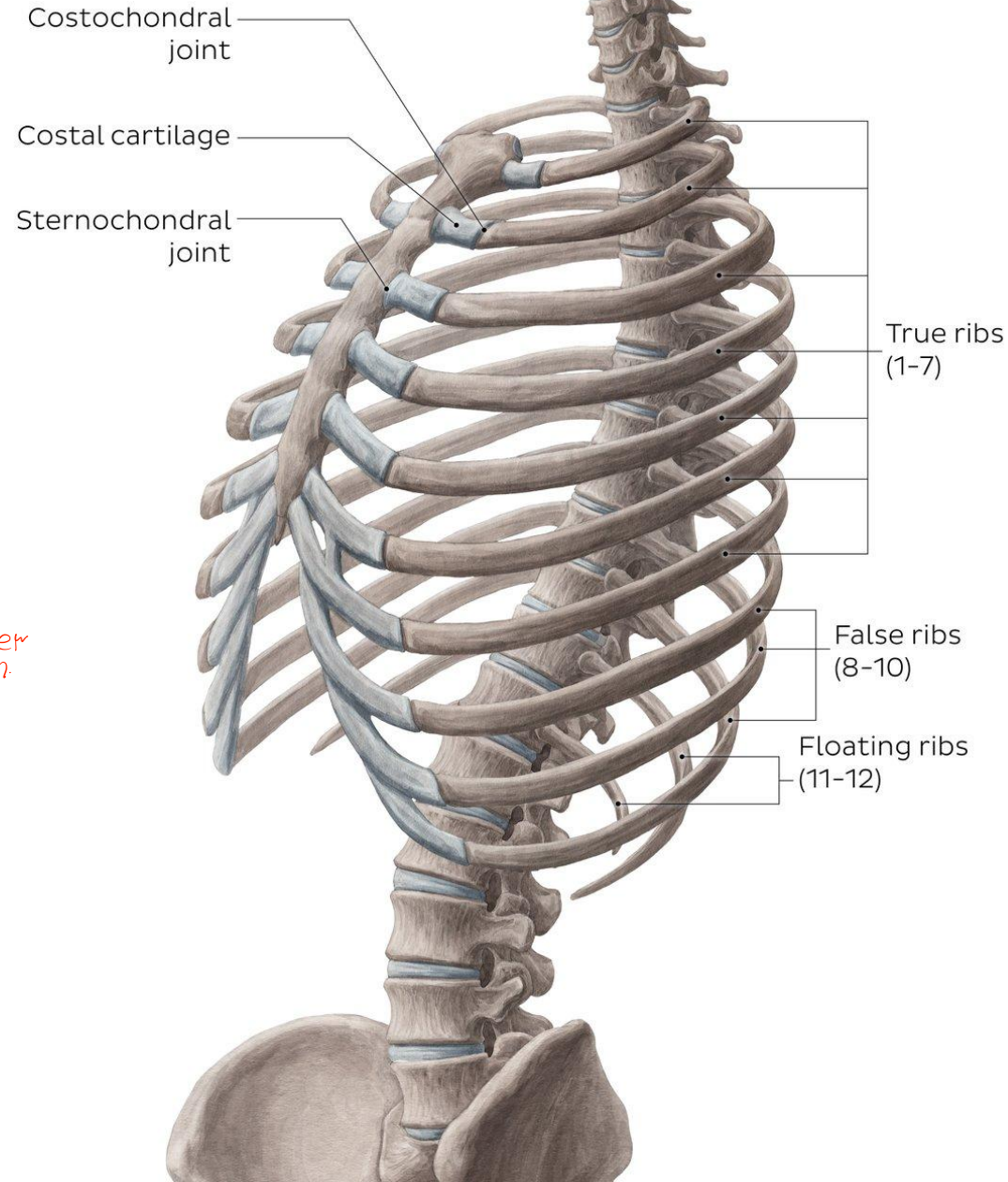
✓ The ribs are divided into three categories:

True ribs (1st – 7th): The upper seven pairs are attached anteriorly to the sternum by their costal cartilages.

→ Articulate with Sternum indirectly through articulation with costal cartilage number seven.

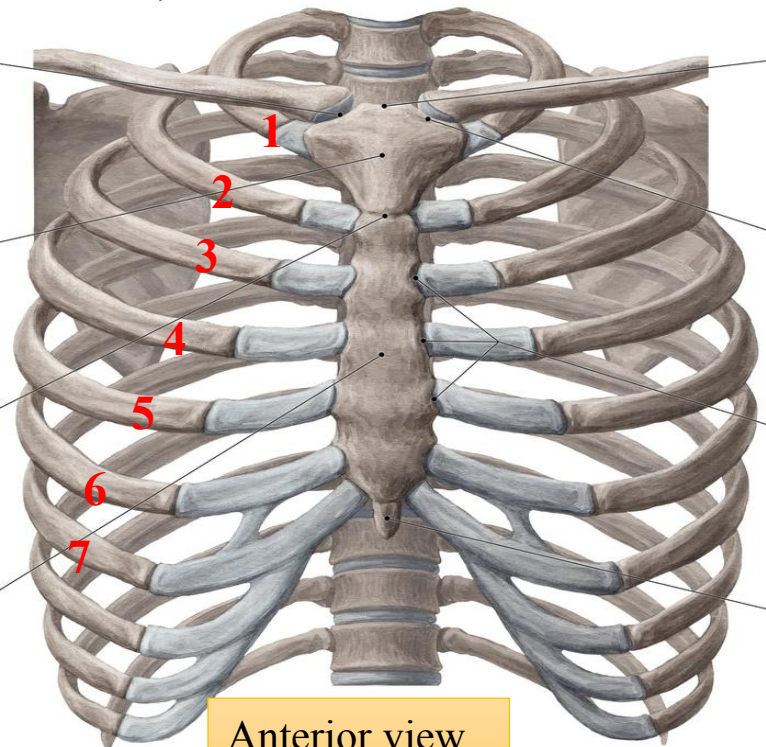
False ribs (8th – 10th): are attached anteriorly to each other and to the 7th rib by means of their costal cartilages and small synovial joints.

Floating ribs (11th & 12th): have no anterior attachment.



True ribs (1st – 7th)

Attached directly
to sternum by
their own costal
cartilages



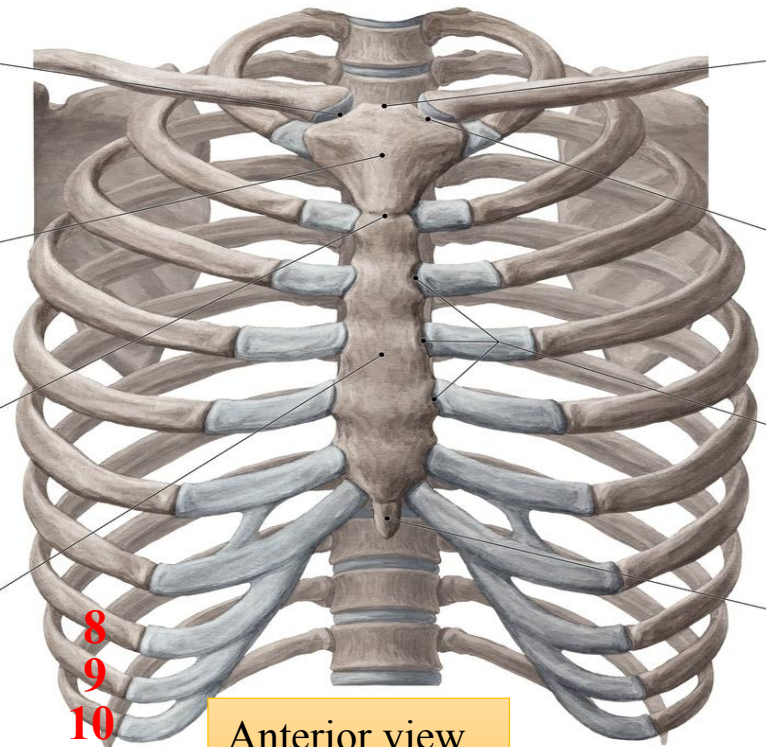
Anterior view



Posterior view

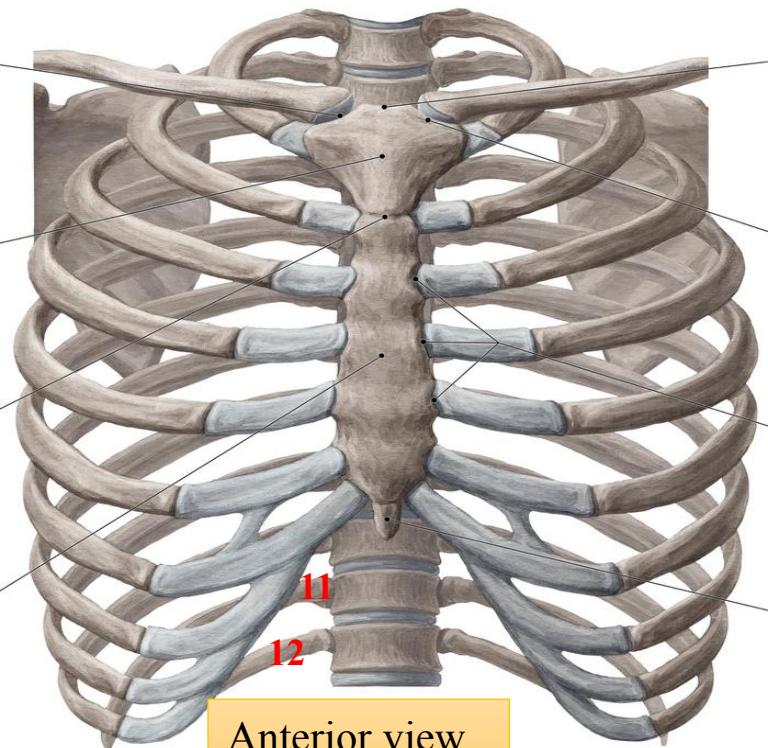
False ribs (8th – 10th)

Do not join the sternum directly but are connected to the 7th rib by the cartilage of the rib above them

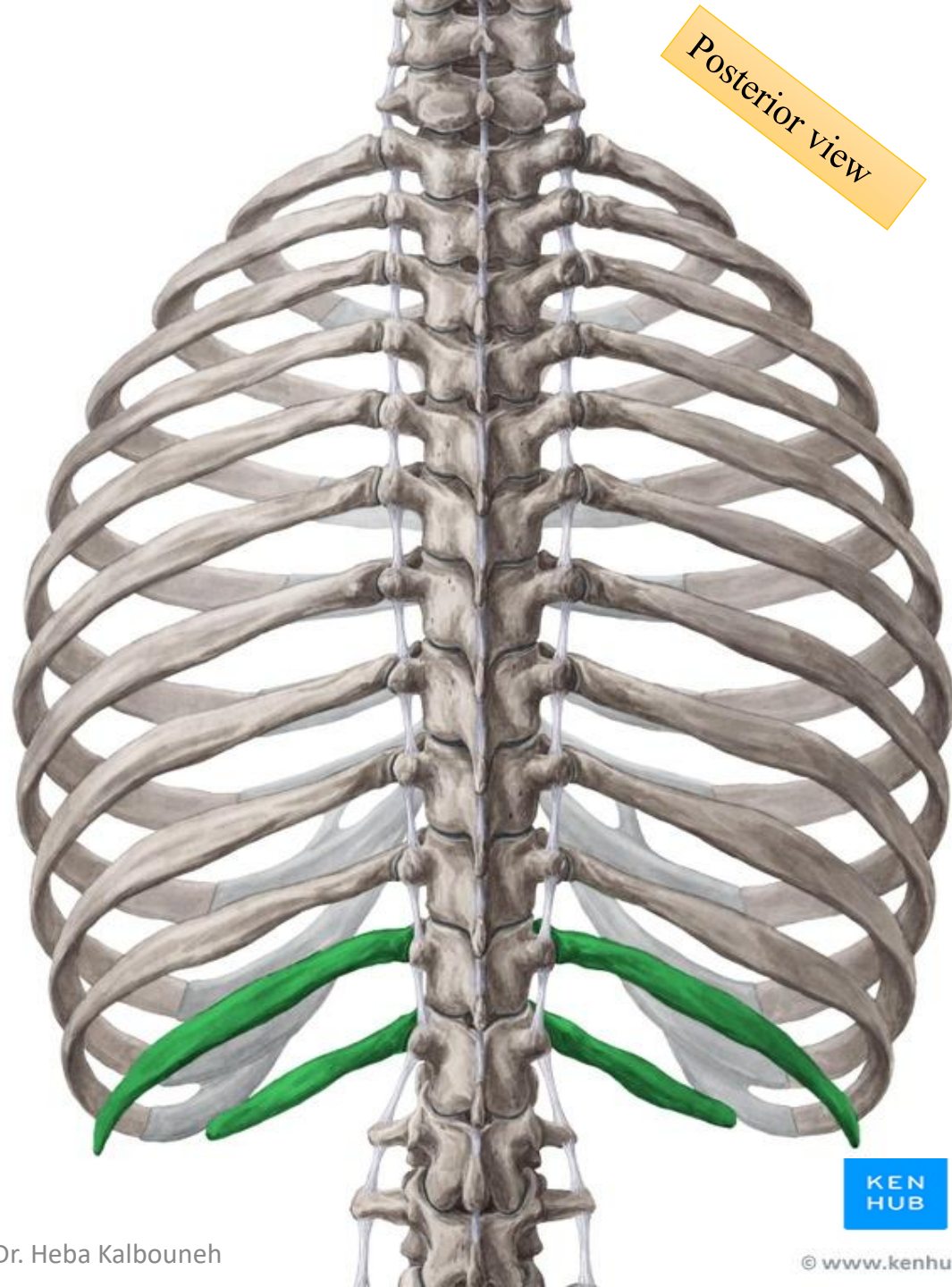


Floating ribs (11th & 12th)

Are half the size of the others and do not reach to the front of the body



Anterior view



Posterior view

Features of typical rib

1. Head: has two facets for articulation with the numerically corresponding vertebral body and that of the vertebra immediately above.

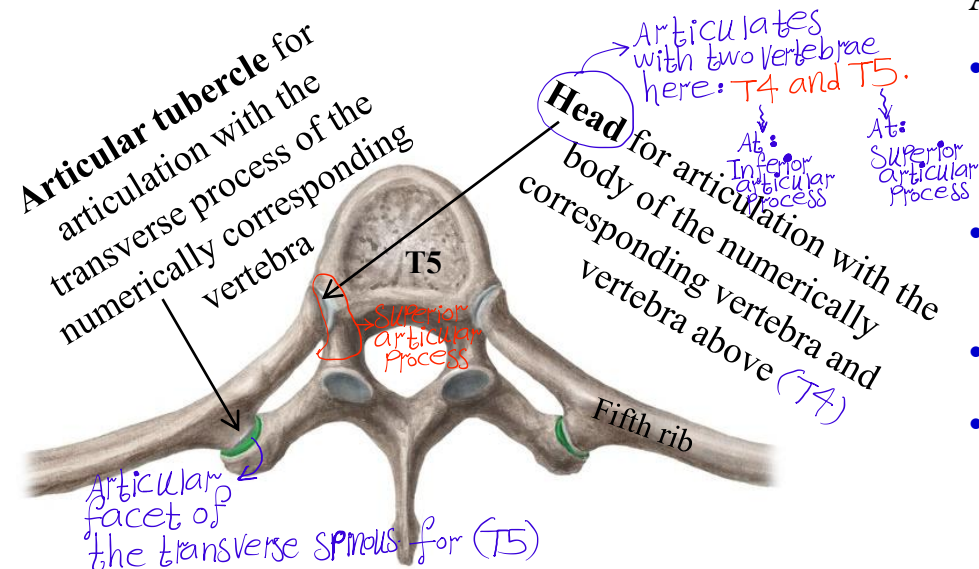
2. Neck: is a constricted portion situated between the head and the tubercle.

3. Tubercle: is a prominence on the outer surface of the rib at the junction of the neck with the shaft. It has a facet for articulation with the transverse process of the numerically corresponding vertebra (articular & non articular parts)

4. Angle: where the shaft of the rib bends sharply forward.

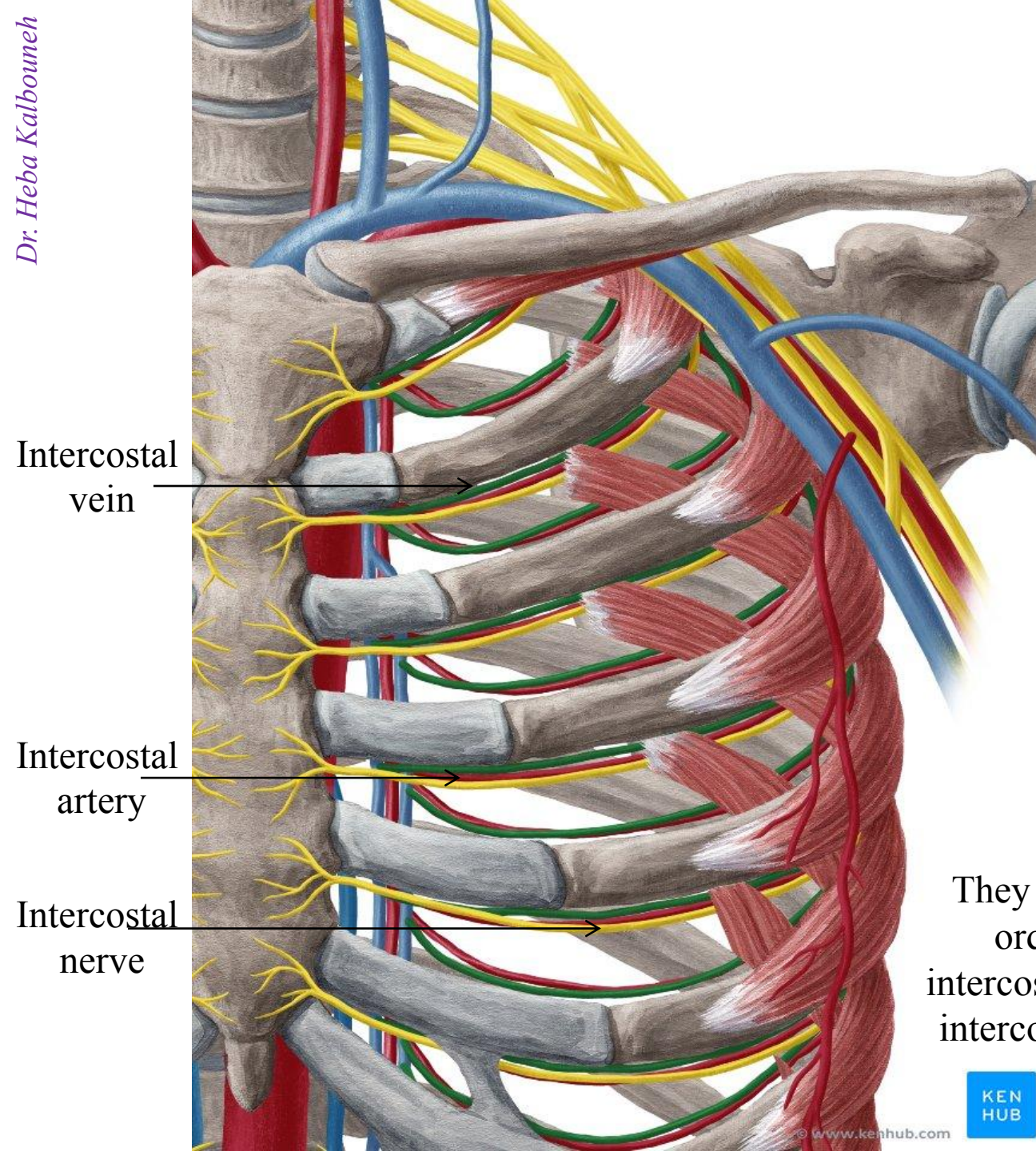
5. Shaft (Body): is thin and flattened and twisted on its long axis.

3rd – 9th ribs are considered typical

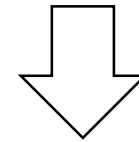


Atypical ribs

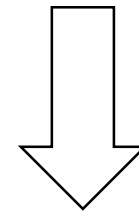
- 1st rib:** Flat, shortest, broadest, one facet on the head, scalene tubercle & grooves for subclavian vein and artery.
- 2nd rib:** Rough tuberosity for serratus anterior muscle.
- 10th rib:** One facet on the head.
- 11th & 12th:** One facet on the head & no neck or tubercle



A typical rib has a smooth superior border and a sharp, thin inferior border.



The inferior border of the rib contains a groove called the **costal groove**. The costal groove protects the neurovascular bundle.



They are arranged in the following order from above downward: intercostal vein, intercostal artery, and intercostal nerve (mnemonic: **VAN**).

Each head has two articular facets (demifacets) separated by a wedge of bone, One facet articulates with the numerically corresponding vertebrae, and the other articulates with the vertebrae above.

Demi-facet
(for head of rib)

نصف
Demi-facet
(for head of rib)

Costal facet of
transverse process
(for tubercle of rib)

* Note: Demi-facets are found only at the thoracic Vertebrae.

Note: Fifth right rib as it articulates with the vertebral column posteriorly and the sternum anteriorly. Note that the rib head articulates with the vertebral body of its own number and that of the vertebra immediately above

Head of rib

Each rib has two
: Superior & inferior
borders.

Each rib has two
: anterior & posterior
surfaces.

1st rib

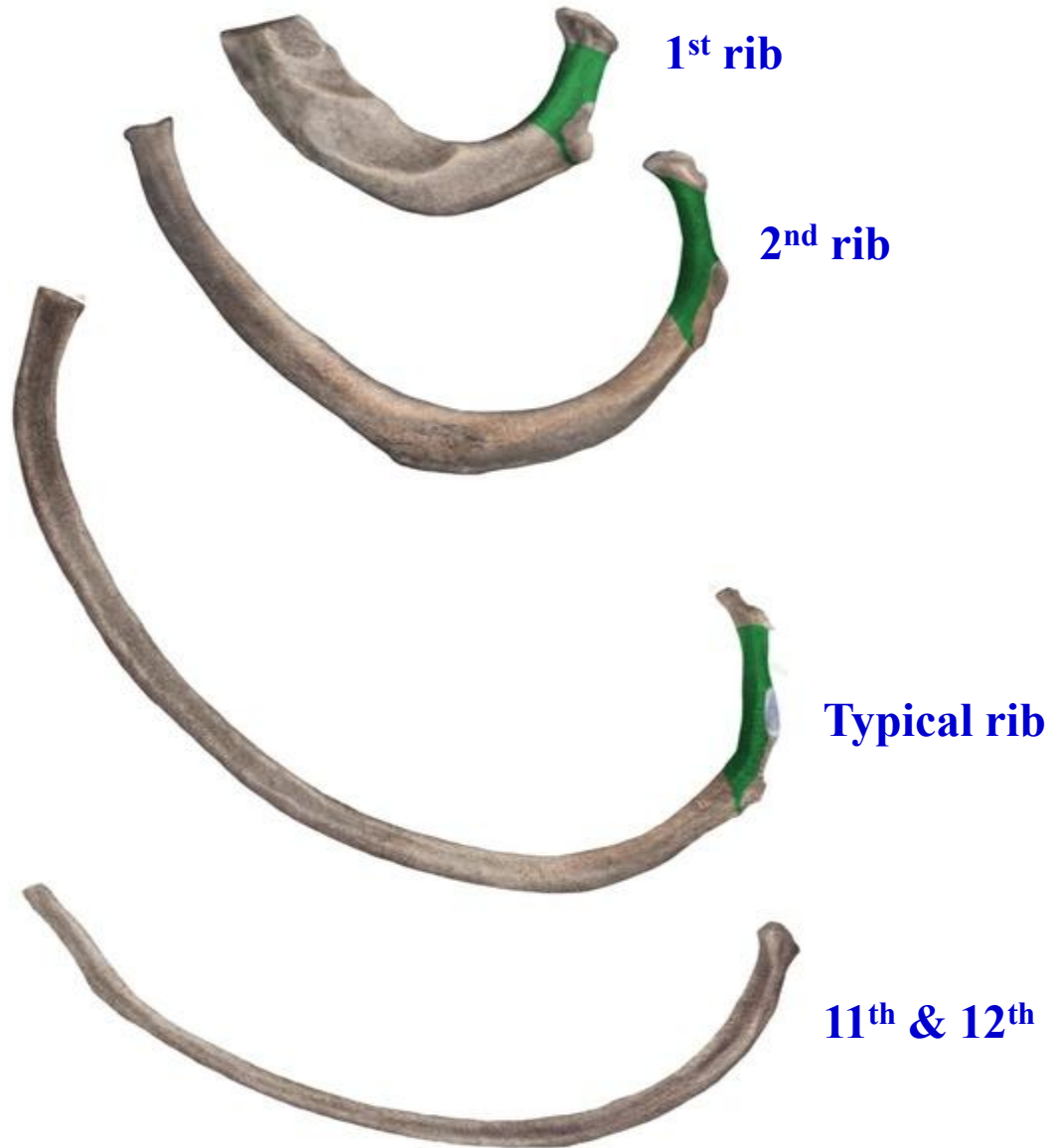
2nd rib

Typical rib

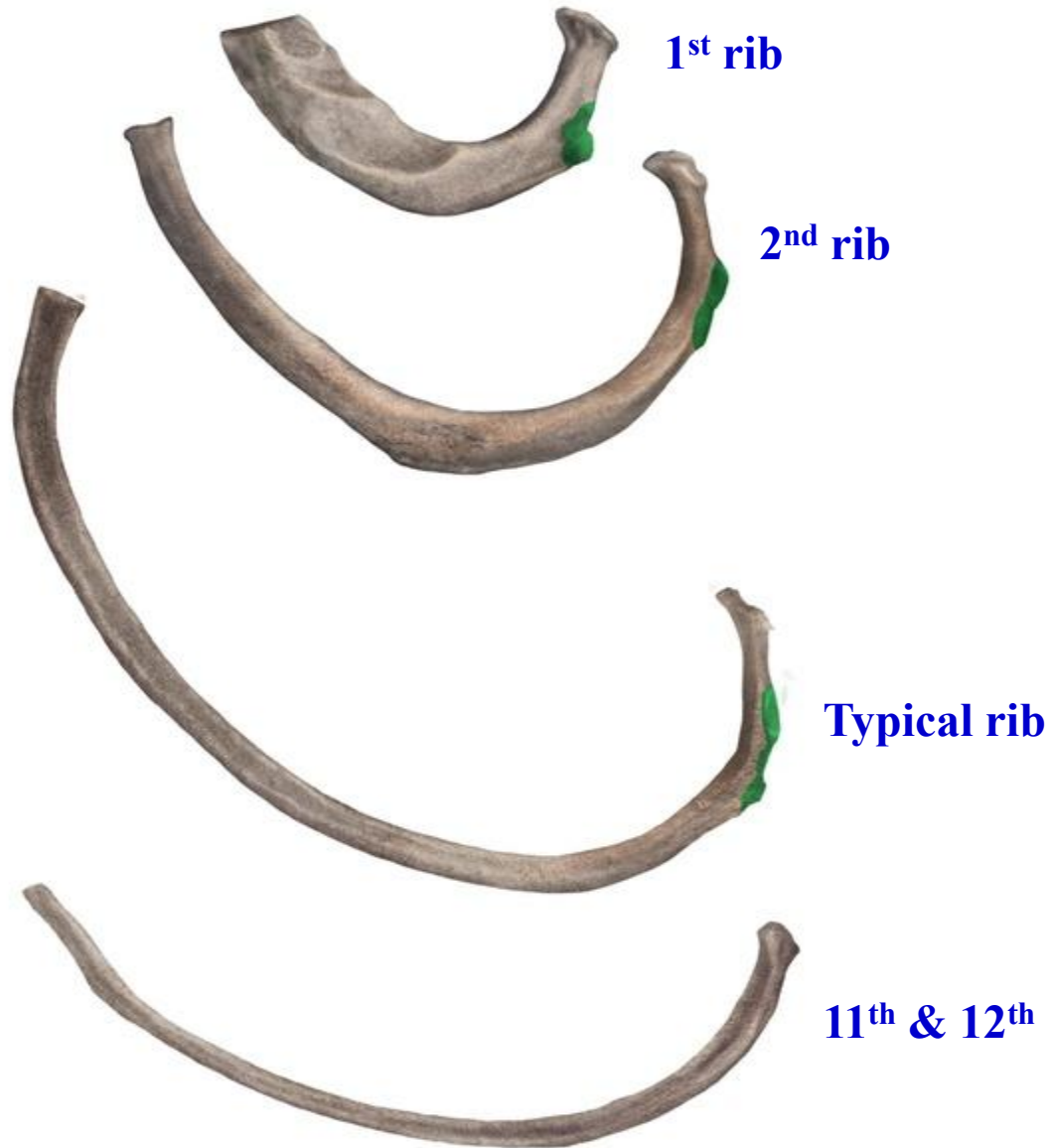
11th & 12th



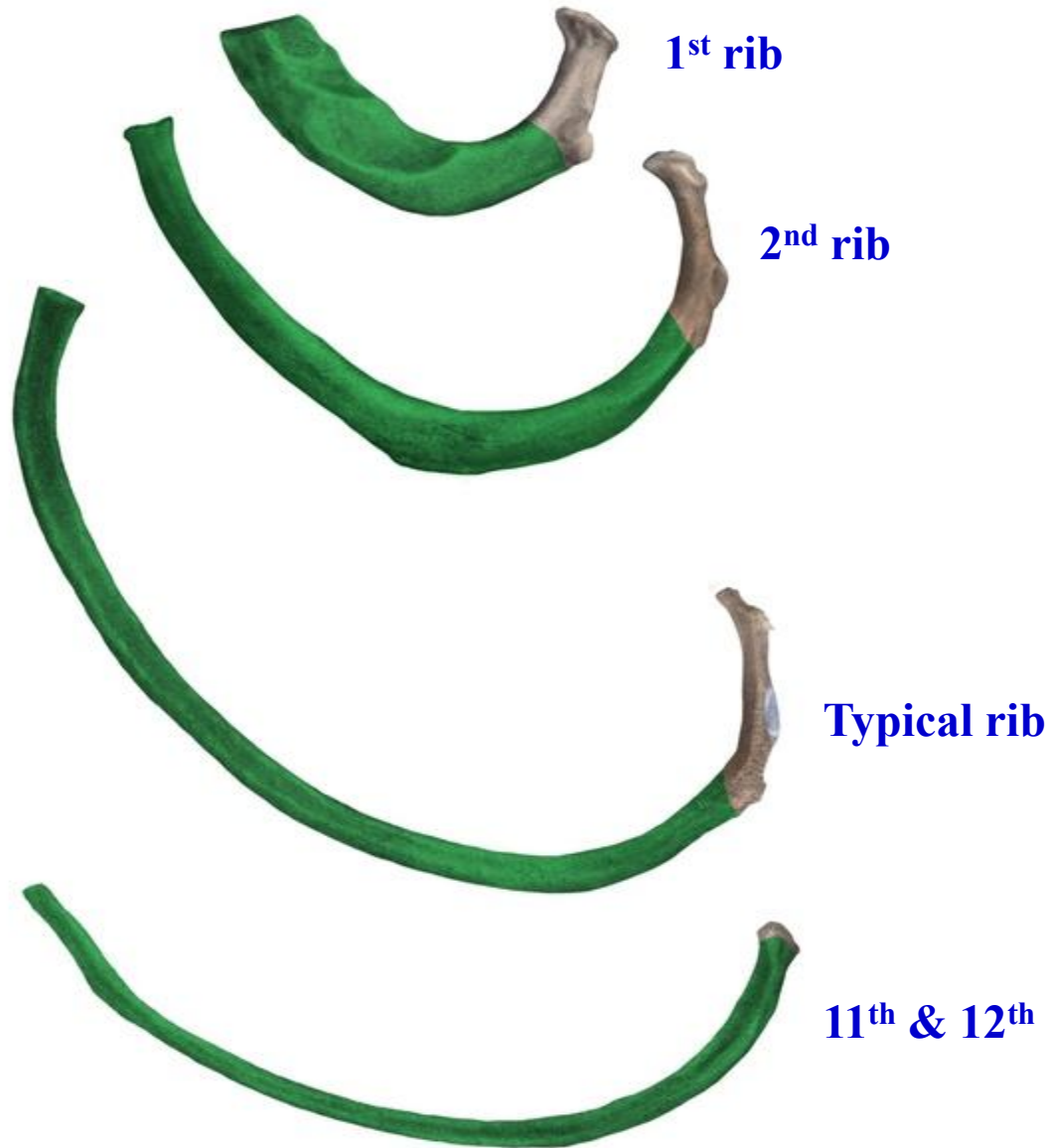
Neck of rib



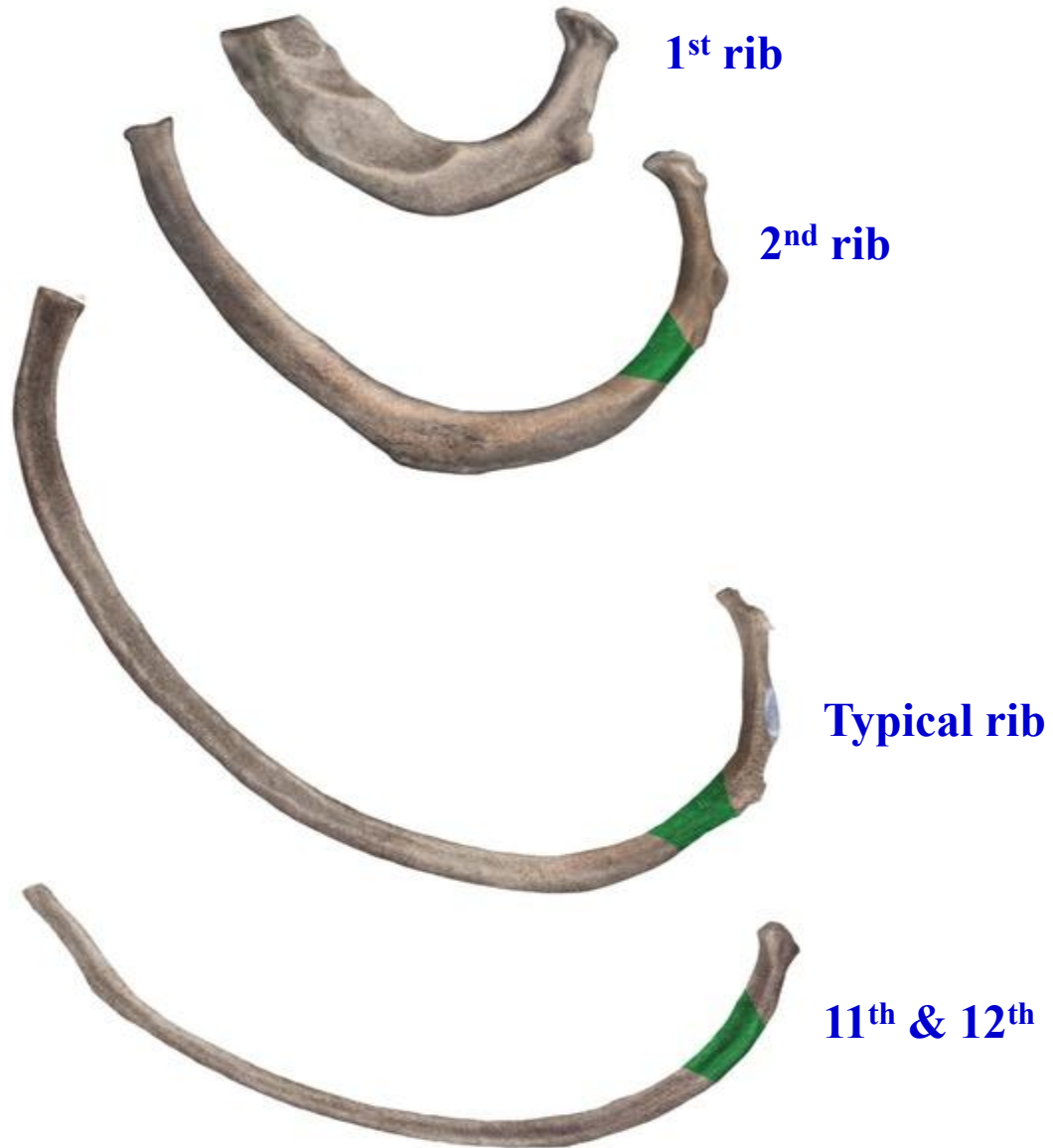
Tubercle of rib



Body of rib



Angle of rib



1st rib

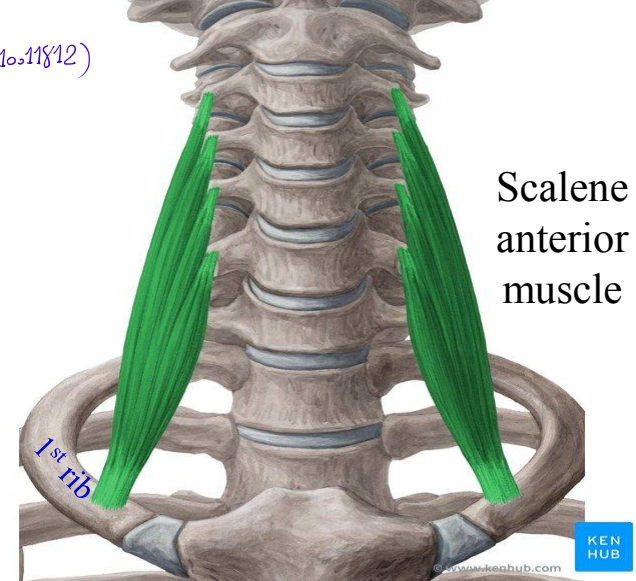
Groove for subclavian vein

Scalene tubercle of first rib

One facet on the head

~ makes one articulation (like: 10, 11 & 12) with (T1).

The brachial plexus is a network of nerves that originates from the spinal cord in the neck and extends into the upper limb. It controls the motor and sensory functions of the upper limb.



Scalene anterior muscle

Groove for subclavian artery

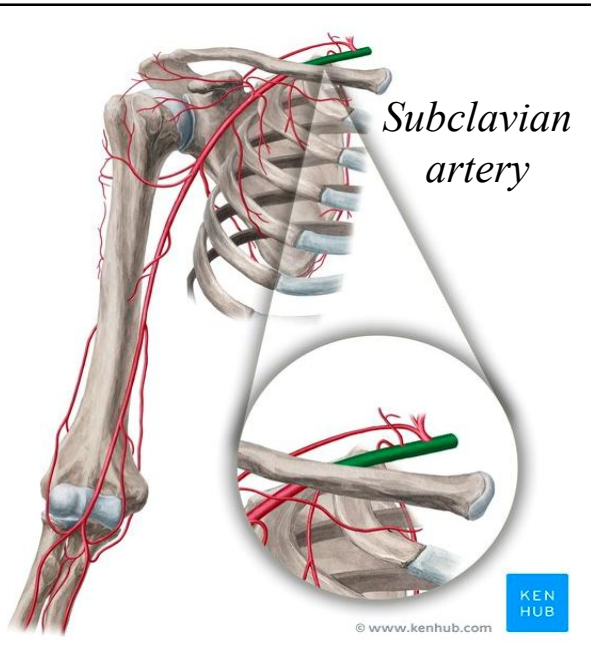
Atypical rib

The first rib is important clinically because of its close relationship to the lower nerves of the brachial plexus and the main vessels to the arm, namely, the subclavian artery and vein. The scalenus anterior muscle is attached to its 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.

Dr. Heba Kalbouneh

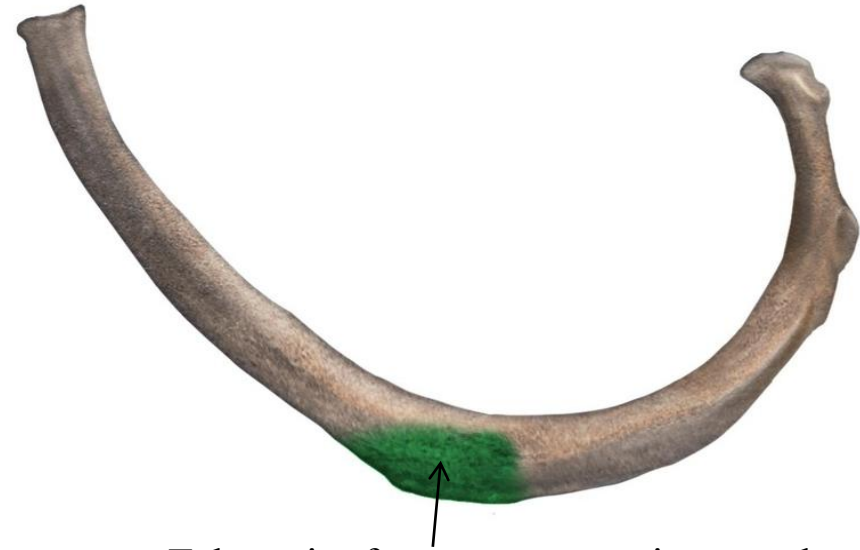
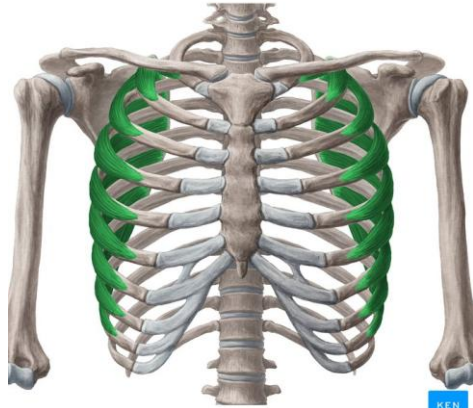
Subclavian artery



Clinical application: A cervical rib (i.e., an extra rib that forms above the first rib, extending from the seventh cervical vertebra) occurs in about 0.5% of humans.

Usually asymptomatic, but it can lead to issues such as pain, weakness, or numbness in the arm due to compression of nearby nerves and blood vessels, a condition known as thoracic outlet syndrome.

*Serratus anterior
muscle*



Tuberosity for serratus anterior muscle

One facet on the head &
no neck or tubercle



Joints of the Thoracic Wall

Summary ☺

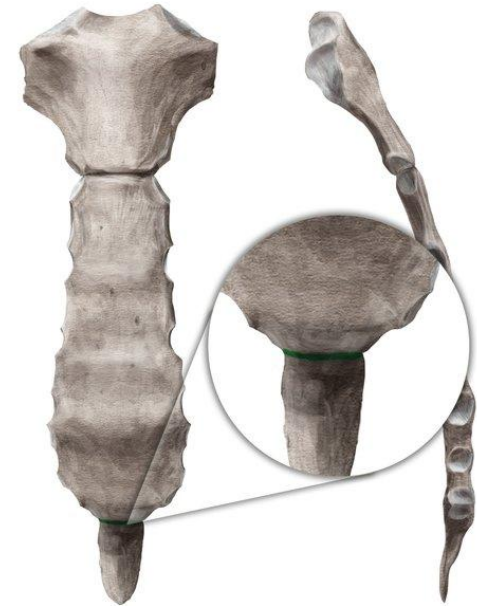
Joints of the Sternum

- ✓ The **manubriosternal joint** is a cartilaginous joint between the manubrium and the body of the sternum. A small amount of angular movement is possible during respiration.
- ✓ The **xiphisternal joint** is a cartilaginous joint between the xiphoid process (cartilage) and the body of the sternum. The xiphoid process usually fuses with the body of the sternum during middle age.

Manubriosternal joint



Xiphisternal joint



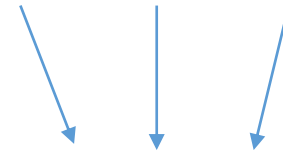
Costovertebral joints

1- Joints of the Heads of the Ribs (Costocorporeal joints)

The first rib and the three lowest 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.

2- Joints of the Tubercles of the Ribs (Costotransverse joints)

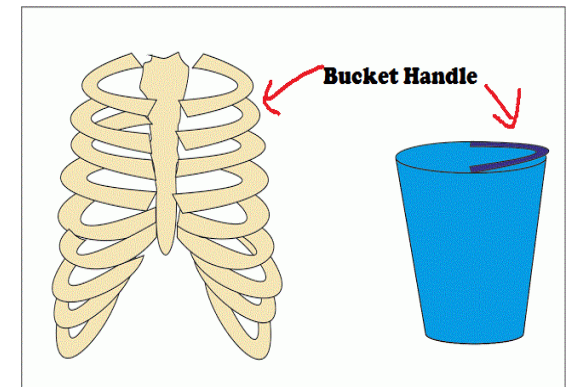
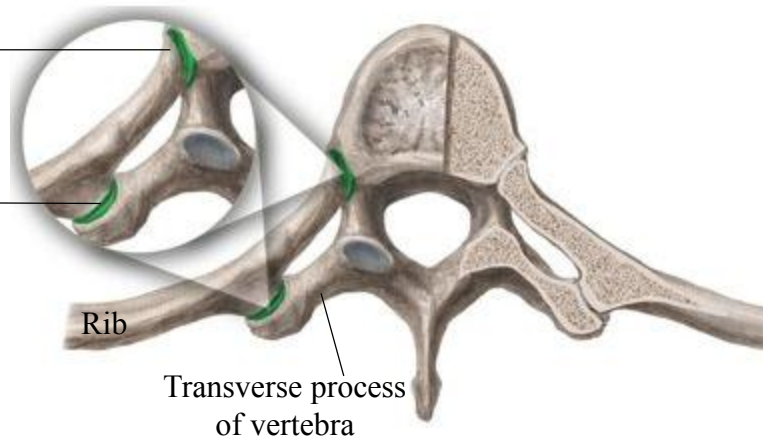
The tubercle of a rib articulates by means of a synovial joint with the transverse process of the corresponding vertebra.



(This joint is absent on the 11th and 12th ribs.)

Joint of the head
of the rib

Joint of the
tubercle of the rib



The movements on these joints are called 'pump-handle' or 'bucket-handle' movements, and are limited to a small degree of gliding and rotation of the rib head. The function of these movements is to enable lifting of the ribs upwards and outwards during breathing. The end result is the increase of the lateral diameter of the thorax and subsequent expansion of the lung as the air is being inhaled.

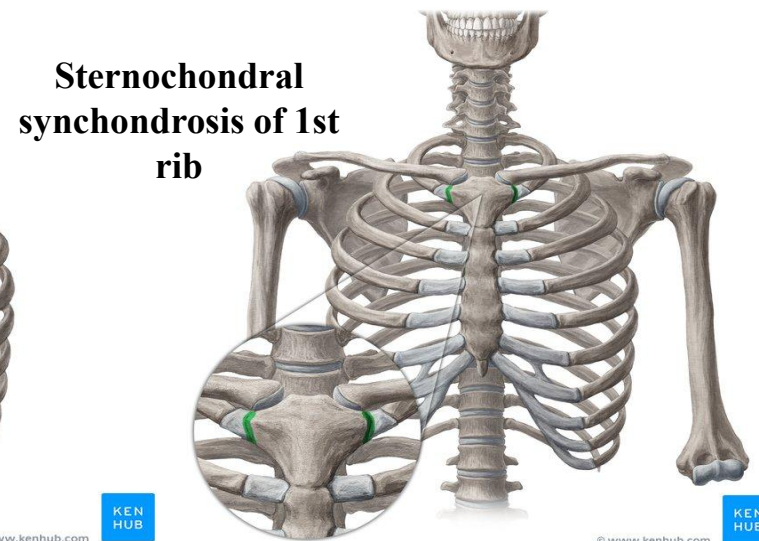
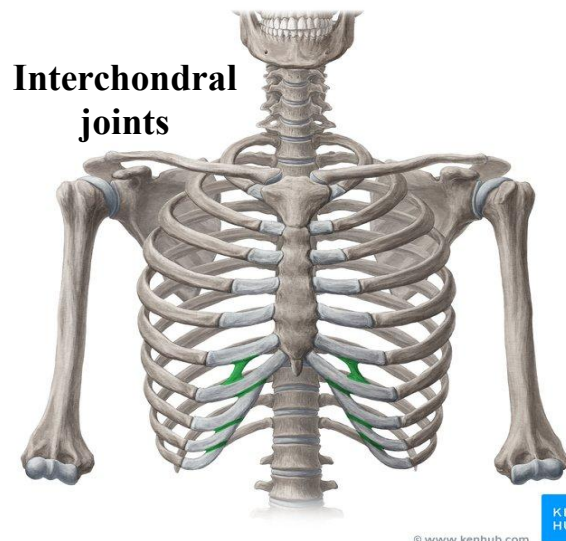
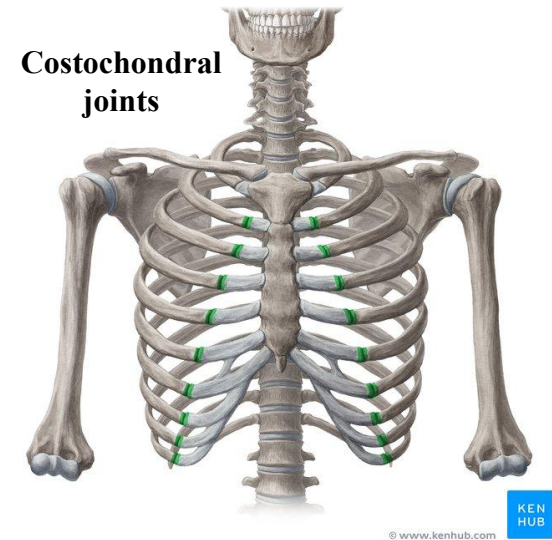
Joints of the Costal Cartilages with the Sternum

- 1- The first costal cartilages articulate with the manubrium, by cartilaginous joints that permit no movement (**Sternochondral synchondrosis of 1st rib**).
- 2- The 2nd to the 7th costal cartilages articulate with the lateral border of the sternum by synovial joints (**Sternochondral joints**).
- 3- The 6th, 7th, 8th, 9th, and 10th costal cartilages articulate with one another along their borders by small synovial joints (**Interchondral joints**).

Note: The cartilages of the 11th and 12th ribs are embedded in the abdominal musculature.

Joints of the Ribs and Costal Cartilages (Costochondral joints)

These joints are cartilaginous joints. No movement is possible.



The hyoid bone

- ✓ Is a U-shaped bone.
- ✓ The bone has a central body (forming the center of the “U”) with two smaller protruding structures on the superior surface (lesser horns) and two larger bony protrusions from the body (greater horns).

Unlike other bony structures, the hyoid bone does not directly articulate with other bones. Instead, it is connected to neighbouring bones by muscular and ligamentous attachments.

Muscles that insert on the upper surface of the bone are known as **suprahyoid muscles**, while those attached to the lower surface are **infrahyoid muscles**.

