

MED439  
KING SAUD UNIVERSITY

# Anatomy of the spine

Musculoskeletal Block - Lecture 3

## Objective:

- ✓ Distinguish and describe the cervical, thoracic, lumbar, sacral and coccygeal vertebrae.
- ✓ Describe the vertebral curvatures.
- ✓ Describe the movement which occur in each region of the vertebral column.
- ✓ List the structures which connect 2 adjacent vertebrae together.
- ✓ List and identify the ligaments of the intervertebral joints.

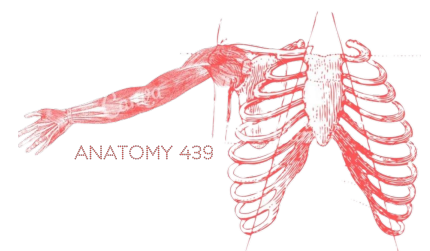
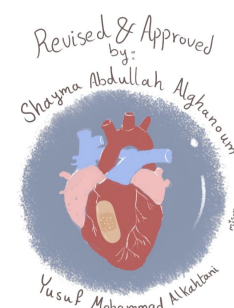
Color index:

**Important**

In male's slides only

In female's slides only

Extra information, explanation



[Editing file](#)



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# Spine or Vertebral Column:

The **vertebral column** extends from the skull to the pelvis.

It surrounds and protects the **spinal cord** and supports the whole body.

It is formed from **33** irregular vertebrae

It consists of **24 single vertebrae** and **2 bones**(Fused vertebrae):

**the 24 single bone:**(movable)

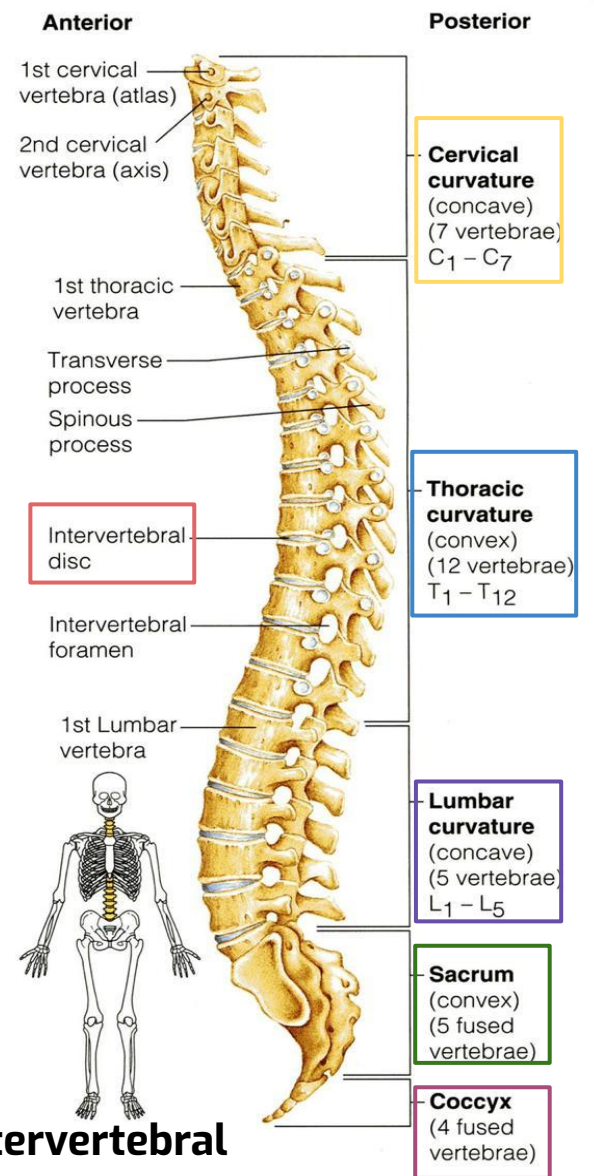
- 7 **Cervical** vertebrae (concave)
- 12 **Thoracic** vertebrae(convex)
- 5 **Lumbar** vertebrae.(concave)

**2 bones:** (immovable)

- **Sacrum** (5 fused vertebrae).(Convex)
- **Coccyx** (4 fused vertebrae).

• The single vertebrae are separated by pads of flexible **fibrocartilage** \*secondary cartilaginous joint\* called the **intervertebral disc**.

- The **intervertebral discs** cushion the vertebrae and absorb shocks.
- The **discs and S-shaped curvatures** of the vertebral column work together to **prevent shock** to the head when we walk or run.
- They also make the body trunk flexible.



## We have 2 spinal curvatures:

### 1-Primary curvature

present **at** birth

**Thoracic**  
**Sacral** regions

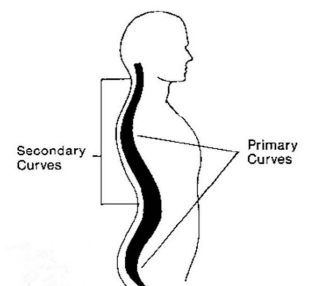
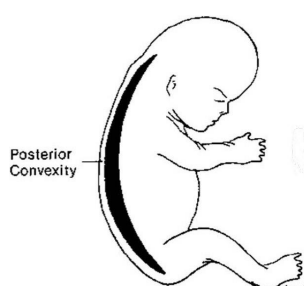
Concave **forward**

### 2-Secondary curvature

present **after** birth

**Cervical** (when the baby begins to hold his head (6th month))  
**Lumbar** (when the baby begins to walk when he's around 1 year old).

Convex **forward**



# Typical Vertebra:

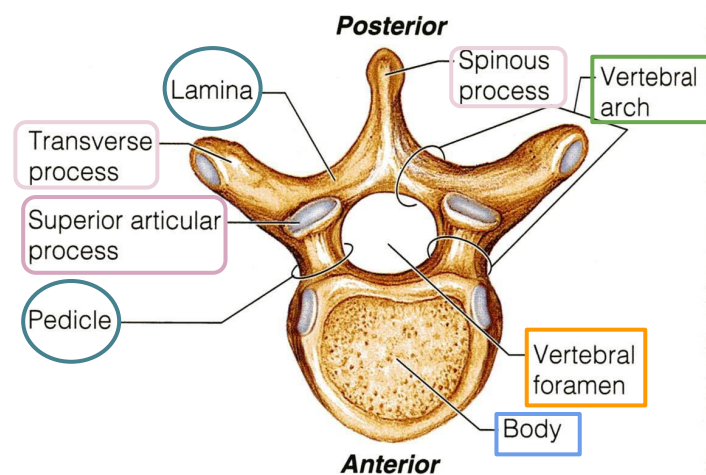
**Body** or Centrum: disc-like, weight-bearing part that lies anteriorly

**Vertebral Arch:** Formed from fusion of 2 **pedicles** and 2 **laminae**

**Any vertebra is made up of:**

**Vertebral foramen:** lies between the body and the arch

spinal cord passes through the vertebral foramen



## The vertebral arch carries 7 process:

2 transverse processes:

lateral projections from the arch

2 superior articular processes:

paired projections lateral to the vertebral foramen

2 inferior articular processes:

paired projections lateral to the vertebral foramen

1 spinous process:

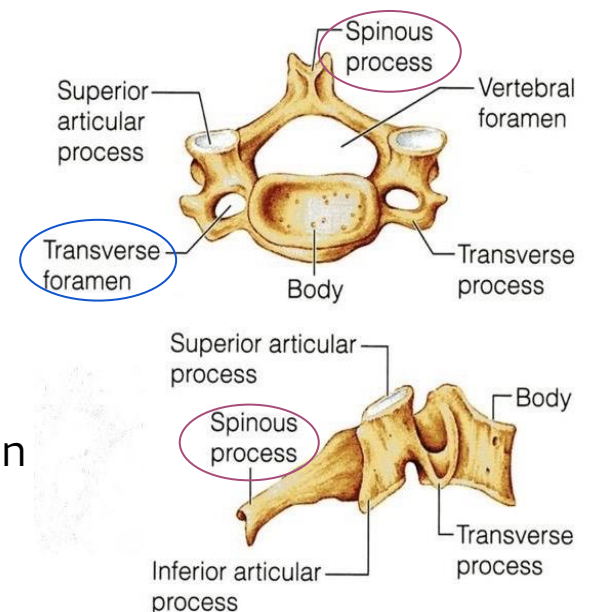
single projection arising from the posterior aspect of the vertebral arch.

forms joints between vertebrae

## Typical Cervical Vertebra:

### The "typical" Cervical vertebrae (C3 to C6):

- they're the smallest, lightest vertebrae, and their **spinous processes** are short and bifid (divided).
- The transverse processes of the cervical vertebrae contain **foramina** \*called foramen transversarium\* through which the vertebral arteries pass on their way to the brain above.
  - Their transverse foramen is enlarged because of the the cervical enlargement in the spinal cord.
  - Transverse foramina is a special feature for Cervical vertebrae





# Atypical Cervical Vertebra:

## Atlas & Axis & C7 or Cervical prominens:

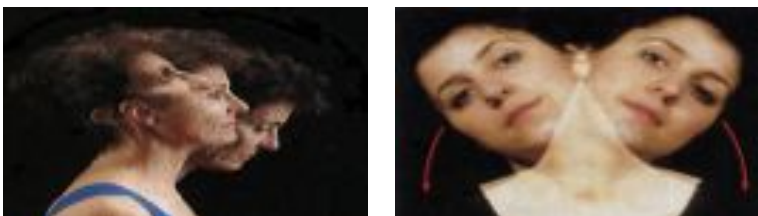
- The 7 Cervical vertebrae (identified as C1 to C7) form the neck region of the spine.
  - The first two vertebrae (**atlas** and **axis**) are different ? because they perform functions not shared by the other cervical vertebra
- What are the atypical cervical vertebrae? C1(Atlas),C2 (Axis) and C7.

### Atlas (C1):

- **has no body** and is formed of **2 lateral masses**.
- contain **kidney** shaped facets superiorly.

- The **facets** forms a joint with the occipital condyles of the skull forming the **atlanto-occipital joint**

The **atlanto-occipital** joint allows flexion, extension, and lateral flexion movements (saying yes). **no rotation**

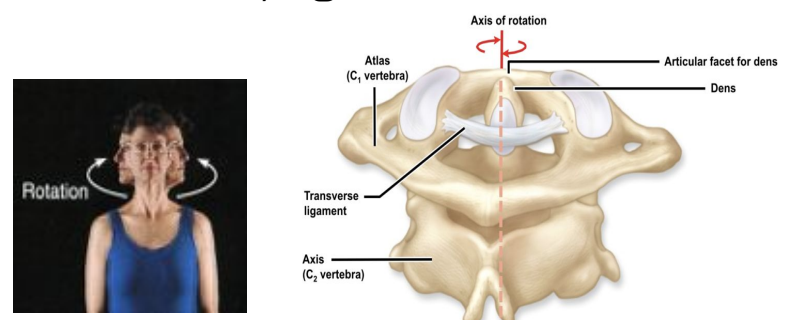


### Axis (C2):

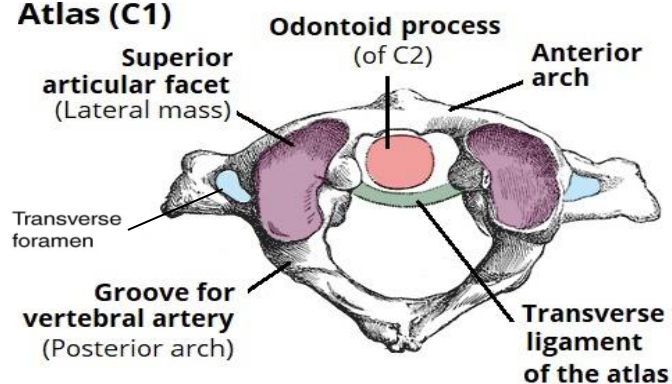
It has a large upright process called **odontoid process** or **dens** that acts as a pivot for the rotation of the atlas and the skull.

Forms a joint with the atlas called **atlanto-axial joint**  
The joint between C1 and C2 allows rotation of the head from side to side.

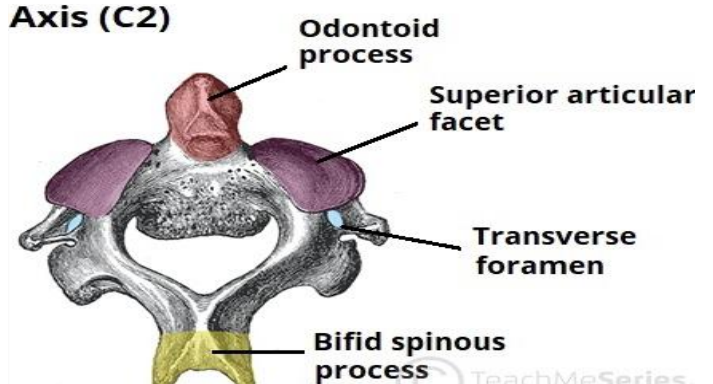
The **atlantoaxial** joint allows rotational movement (saying no)



### Atlas (C1)

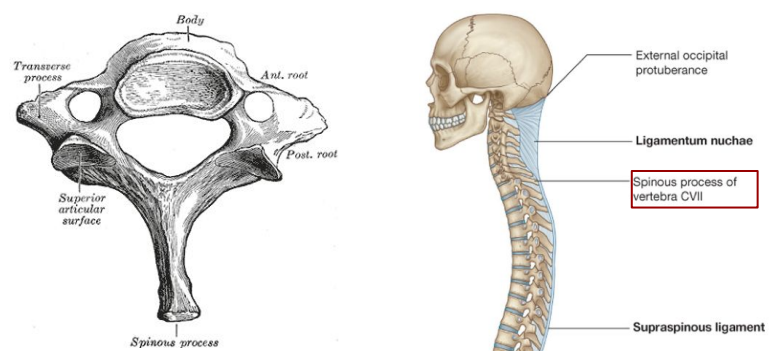


### Axis (C2)



## C7 or Cervical prominens:

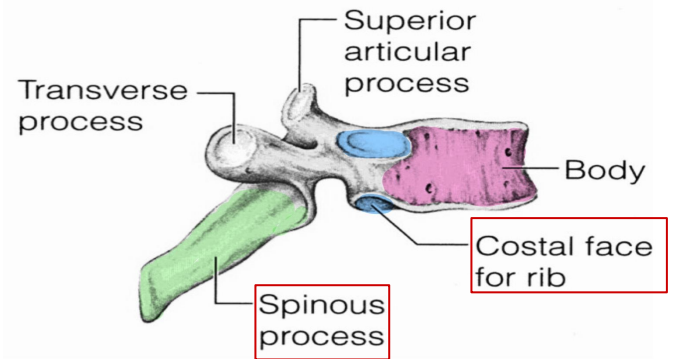
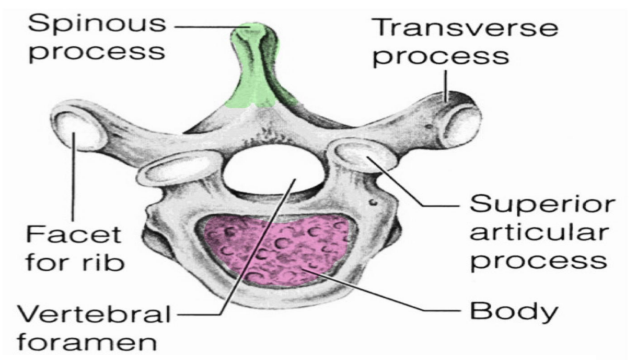
- **Longest** spinous process which is **NOT** bifid
- It's the 1st spine to be felt subcutaneously in the root of back of the neck.



# Thoracic and Lumbar Vertebrae

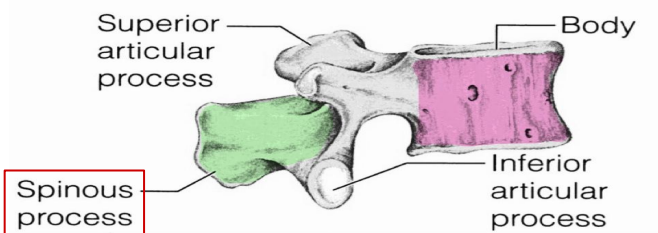
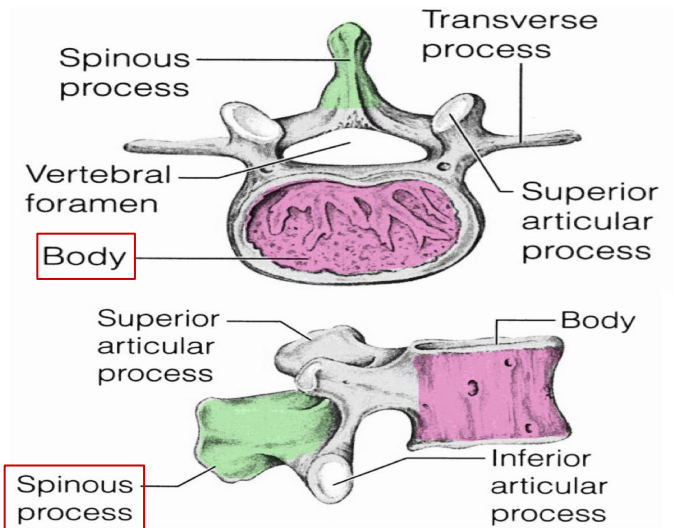
## Thoracic

- The 12 thoracic vertebrae (T<sub>1</sub>-T<sub>12</sub>) are almost typical, T2-T9 are typical while T1 and from T10 to T12 are atypical.
- They are larger than the cervical vertebrae.
- Their vertebral foramen or canal is small and circular.
- The **body** is somewhat heart-shaped and has two **costal demifacets**/semifacetes (articulating surfaces) on each side, which receive the heads of the ribs.
- The **spinous process** is long and hooks sharply downward (tapered downward).

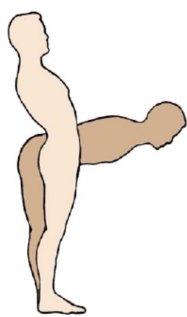


## Lumbar

- The 5 lumbar vertebrae (L<sub>1</sub>-L<sub>5</sub>) have massive, block like bulky **bodies**.
- They have short, hatchet-shaped (flat and broad) **spinous processes**.
- They are the most solid of all of vertebrae.



## Movement of the Thoracolumbar Spine



Flexion/Extension



Lateral Flexion/Side Bending



Rotation

**Extensive** in the lumbar regions/spine  
**Restricted** in the thoracic region/spine

**Extensive** in thoracic region/spine  
**least Extensive** in the lumbar region/spine

Why?

Because in the thoracic region, the ribs, the costal cartilages, and the sternum severely restrict the range of movement.

# Sacral and Coccyx Vertebrae

## Sacrum

- The sacrum is formed by fusion of 5 vertebrae.
- Superiorly it articulates with L5
- Inferiorly it connects with the coccyx.

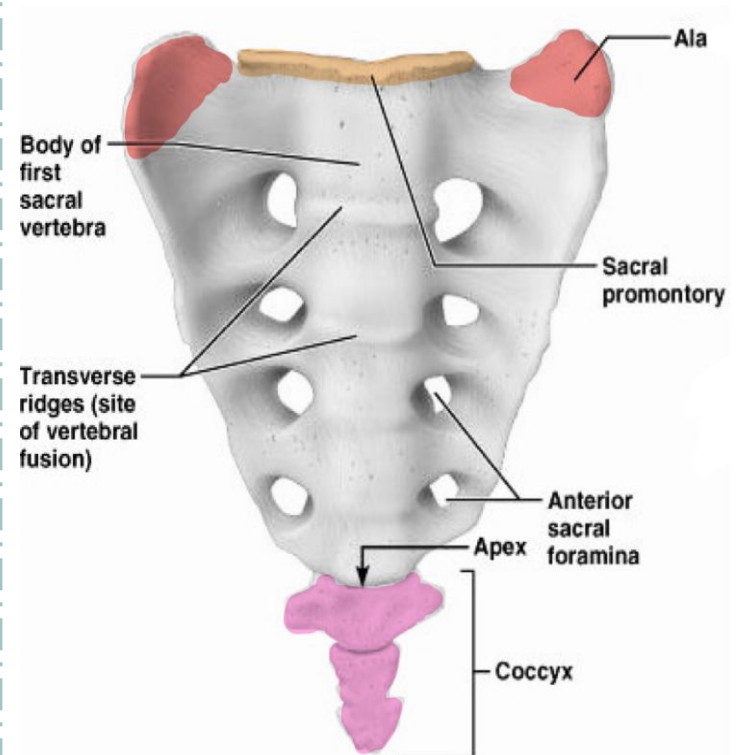
### Anteriorly:

- **Sacral promontory** is the anterior and upper margin of the first sacral vertebra.
- The wing like **ala** articulate laterally with the hip bones, forming the sacroiliac joints.
- The sacrum forms the posterior wall of the pelvic cavity.

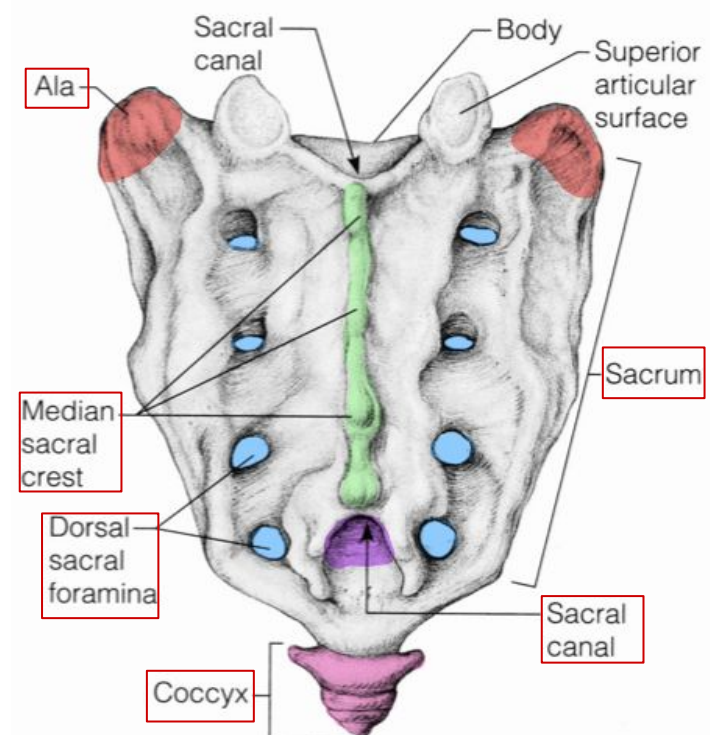
### Posteriorly:

It has a rough surface

- Its dorsal midline surface is roughened by the **median sacral crest**, the fused spinous processes of the sacral vertebrae.
- This is flanked laterally by the dorsal **sacral foramina**.
- The vertebral canal continues inside the sacrum as the sacral canal.
- The canal opens inferiorly in what is called **sacral hiatus** (hiatus=opening).



Anterior View



Posterior View

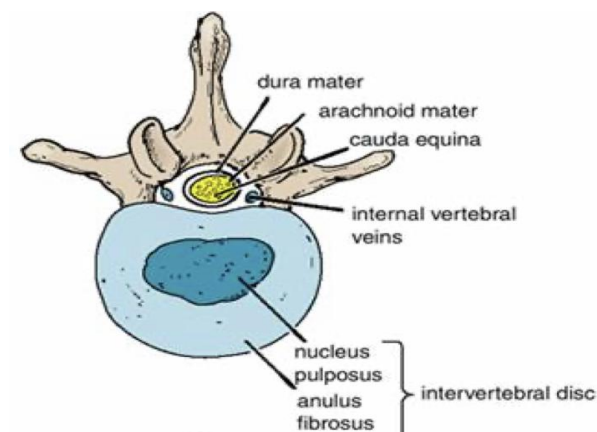
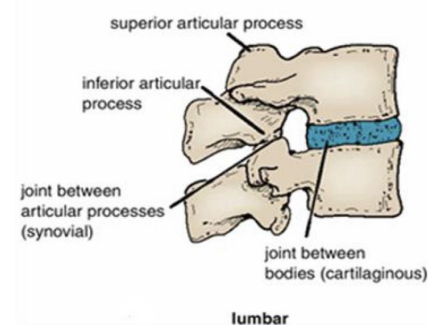
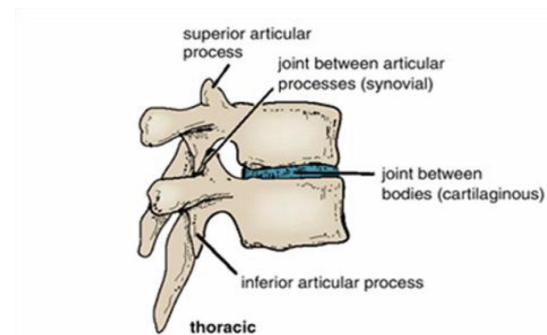
## Coccyx

- The **coccyx** is formed from the fusion of 4 tiny, irregularly shaped vertebrae.



# Joints between two Vertebral Bodies

- It is a secondary cartilaginous joint. (Remember cartilaginous joint were of two type primary and secondary)
- The upper and lower surfaces of the bodies of 2 adjacent vertebrae are covered by thin plates of **hyaline cartilage**.
- Sandwiched between the plates of hyaline cartilage is an intervertebral disc of **fibrocartilage**.
- The intervertebral discs forms about **one fourth** of the whole length of the vertebral column.
- They are **thickest** in the cervical and lumbar regions, where the movements of the vertebral column are greatest.



Each disc is formed of :

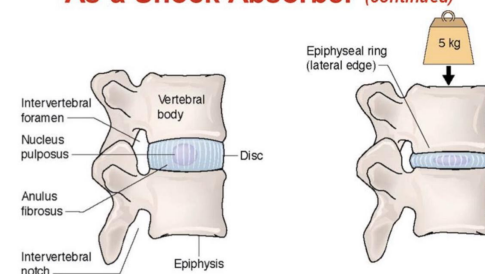
1. **Peripheral part**, called the **annulus fibrosus**, composed of fibrocartilage.
  2. **Central part**, the **nucleus pulposus**, a mass of gelatinous material which is made up of mostly **water**, Small number of **collagen fiber** & few **cartilage cells**.
- No discs are found between **C1 & OCCIPITAL CONDYLES** or **C1 & C2** or in the sacrum or coccyx.

Allows the vertebrae to move forward and backward (flexion and extension of vertebral column)

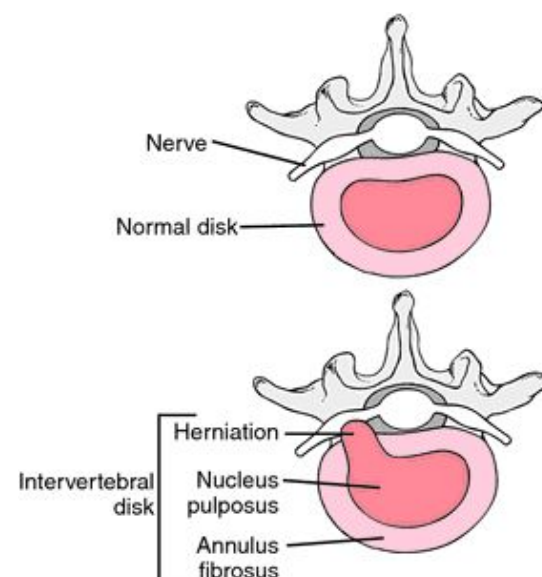
**Intervertebral discs functions**

Serves as shock absorbers when the load on it **suddenly increase** (like when you jump)

## The Intervertebral Disc As a Shock Absorber (continued)

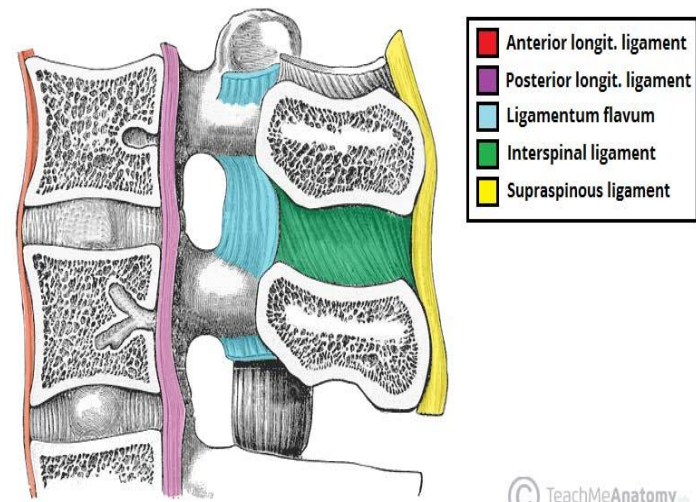


Sometimes, the **annulus fibrosus ruptures**, allowing the **nucleus pulposus** to **herniate and protrude** into the **vertebral canal**, where it may press on the spinal nerve roots, or the spinal nerve, or even spinal cord itself. (Herniation of the disk)



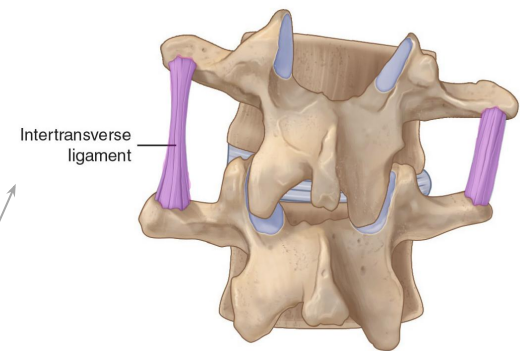
# Ligaments

- The **anterior** and **posterior longitudinal ligaments** run as continuous bands along the anterior & posterior surfaces of the vertebral bodies.
- These ligaments hold the vertebrae firmly together but at the same time **permit a small amount of movement** to take place.

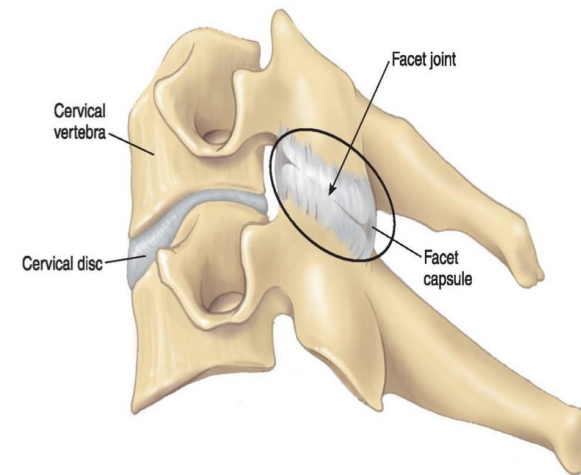


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<b>Interspinous ligament</b>	connects two adjacent <u>spines</u> .
<b>ligamentum flavum</b>	connects the <u>laminae</u> of adjacent vertebrae.
<b>Supraspinous ligament</b>	Connect the <u>tips</u> of adjacent spines.
<b>Intertransverse ligament</b>	Connects 2 adjacent <u>transverse</u> processes

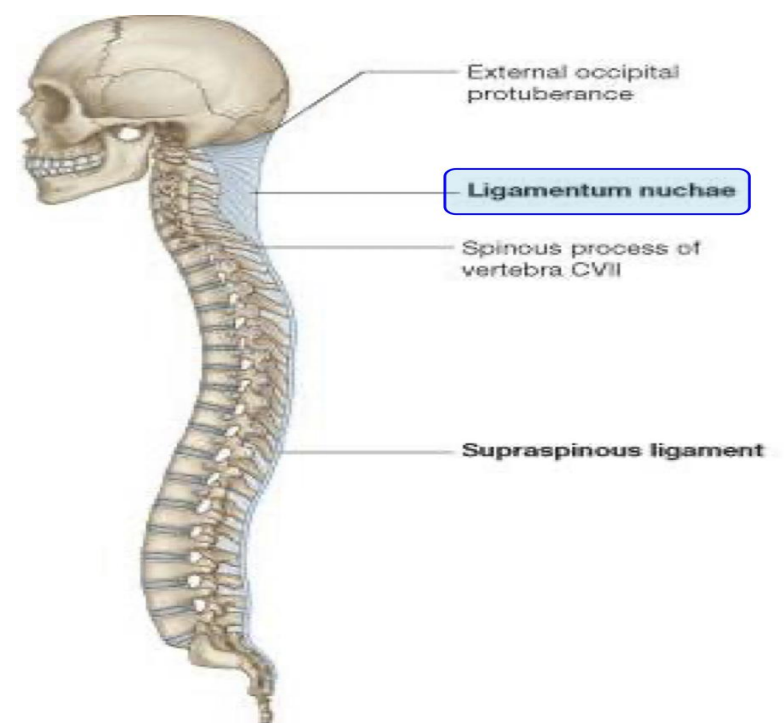


- The joints between two vertebral arches consist of synovial joints between the **superior and inferior articular processes** of 2 adjacent vertebrae.
- The articular facets are covered with **hyaline cartilage**, and the joints are surrounded by a fibrous capsule.



## ligamentum nuchae

- In the cervical region, the **Supraspinous** and **Interspinous ligaments** are thickened to form the strong ligamentum nuchae.
- It extends from the external occipital protuberance of the skull to the spine of the seventh cervical vertebra.
- Its anterior border is strongly attached to the cervical spines in between.





## Cervical vs Thoracic vs Lumbar Vertebrae

**Cervical vertebrae** are the seven individual vertebrae located in the neck region, immediately below the skull.

**Thoracic vertebrae** are the twelve vertebrae which allow attachment sites for all ribs.

**Lumbar vertebrae** consist of five cylindrical bones that make the spine in the lower back of the body.

### Number of Vertebrae

Seven

Twelve

Five

### Abbreviations

C1 – C7

T1 – T12

L1 - L5

### Size

Smallest among three types

Larger than cervical, but smaller than lumbar vertebrae

Largest among cervical, thoracic and lumbar vertebrae

### Weight

Lightest vertebrae in the vertebral column

Heavier than cervical vertebrae, but lighter than lumbar vertebrae

Heaviest vertebrae

### Transverse Foramina

Have two transverse foramina in the transverse processes

Lack transverse foramina in the transverse processes

Lack transverse foramina in the transverse processes

### Facets

Have two prominent facets

Have small facets

Do not have facets on either side of the body

### Spinous Process

Have slender and bifid spinous processes

Have long and fairly thick overlapping spinous processes

Have short and blunt spinous processes

### Articular Facets for Ribs

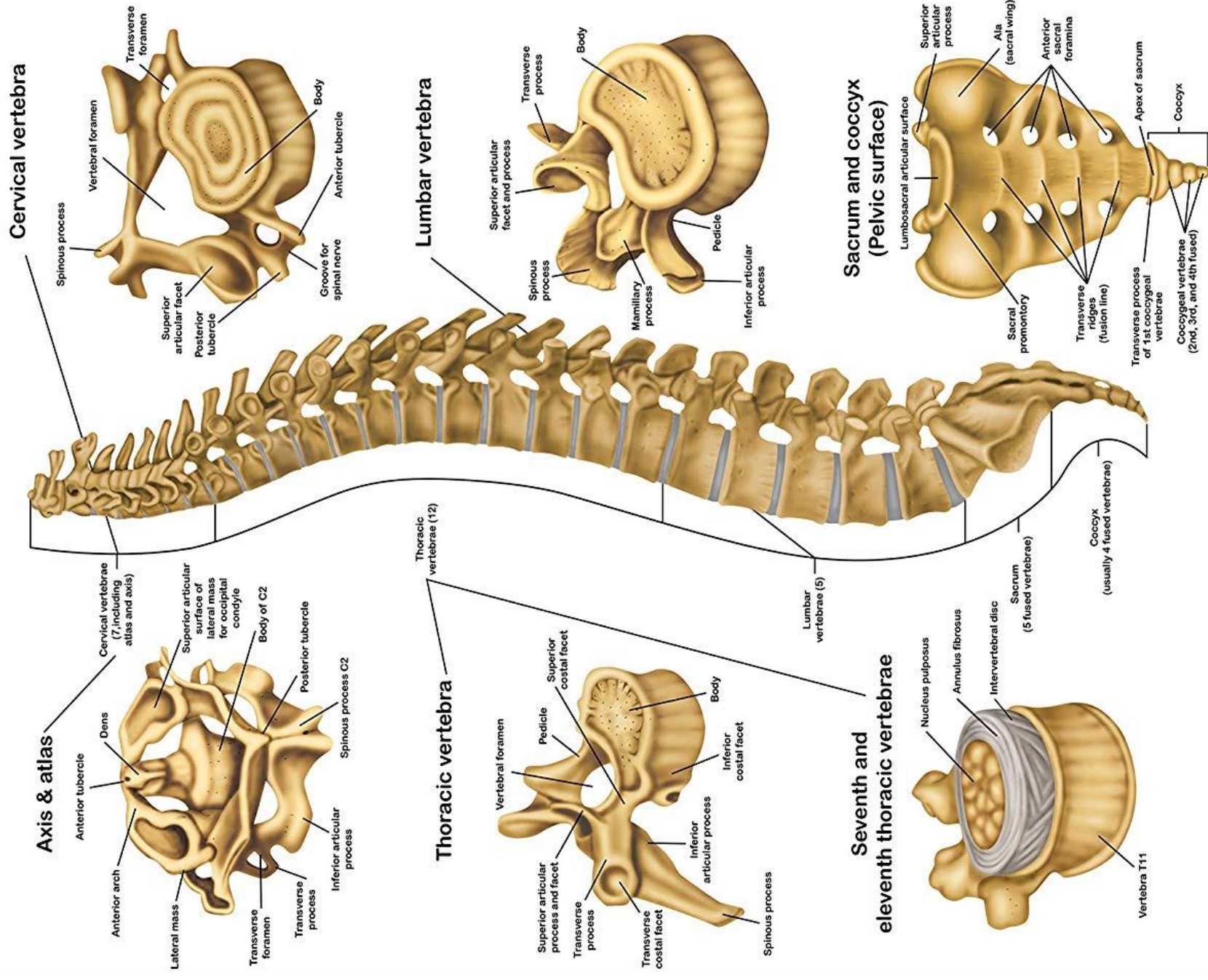
Absent

Present

Absent

# The Vertebral Column

The spine is made up of 33 vertebrae, which form a strong yet flexible housing for the spinal cord.



# MCOs

Q1: Which one of the following head movements contributes in the atlantoaxial joint?

- A.flexion
- B.extension
- C.lateral flexion
- D.lateral rotation

Q2: Which of the following ligaments contributes in the ligamentum nuchae?

- A.ligamentum flavum
- B.intertransverse ligament
- C.supraspinous ligament
- D.anterior longitudinal ligament

Q3: In which vertebral region the extensive rotation of the spine occurs?

- A.cervical
- B.thoracic
- C.lumbar
- D.sacral.

Q4: To which spine the ligamentum nuchae is attached?

- A.T12
- B.C5
- C.C7
- D.S1

Q5: The lateral flexion of the spine is extensive in which of the following?

- A.Thoracic region
- B.Lumbar region
- C.Sacral region
- D.Both A&B

Q6: What is the structure that articulate with the hip bones, forming the sacroiliac joints?

- A.Median sacral crest
- B.Sacral hiatus
- C.Sacral promontory
- D.Ala

Q7: Which joint allows you to say: "Yes"?

- A.Atlanto-occipital joint
- B.Atlantoaxial joint
- C.Atlantic synovial joint
- D.Axial synovial joint

Q8: What are the typical cervical vertebrae?

- A.C1 and C2
- B.C3 to C6
- C.C7
- D.Both A and c

Q9: Which of the following Cervical spine can be felt subcutaneously?

- A.C1 and C2
- B.C3 to C6
- C.C7
- D.Both A and c

Q10: bodies of 2 adjacent vertebrae are covered by thin plates of?

- A.Fibrocartilage
- B.Hyaline cartilage
- C.Elastic cartilage
- D.annulus fibrosus

Q11: Supraspinous and Interspinous ligaments in the cervical are thickened to form?

- A.Interspinous ligament
- B.ligamentum flavum
- C.ligamentum nuchae
- D.Intertransverse ligament

Q12: the intervertebral disc are thickest in the?

- A.cervical
- B.lumbar
- C.thoracic
- D.Both A and B

1)D  
2)C  
3)B  
4)C  
5)B  
6)D  
7)A  
8)B  
9)C  
10)B  
11)C  
12)D

# SAOs

**Q1:** What are the structures that connects the bodies of vertebrae.

**Q2:** During flexion and extension of the spine, what restricts the movement of the thoracic region.

**Q3:** what are the vertebral arch processes.


**Q4:** What is the difference between the movement of Atlanto-Occipital Joints and Atlanto-Axial Joints?

**Q5:** Mention 5 ligaments and give a description for each one of them.

1)Intervertebral disc, Anterior longitudinal ligament, Posterior longitudinal ligament  
2)The ribs, costal Cartilages, and the sternum.  
3) 2 of transverse processes , 2 of superior articular processes , 2 of inferior articular processes , 1 of spinous process  
4)The atlanto-occipital joint allows flexion, extension, and lateral flexion movements (saying yes)  
The atlantoaxial joint allows rotational movement (saying no)  
5) 1-Interspinoous ligament: connects two adjacent spines  
2-ligamentum flavum: connects the laminae of adjacent vertebrae  
3-Supraspinous ligament: Connect the tips of adjacent spines  
4-Interspinous ligament : connects 2 adjacent transverse processes.  
5- anterior and posterior longitudinal ligaments: hold the vertebrae firmly together but at the same time permit a small amount of movement

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