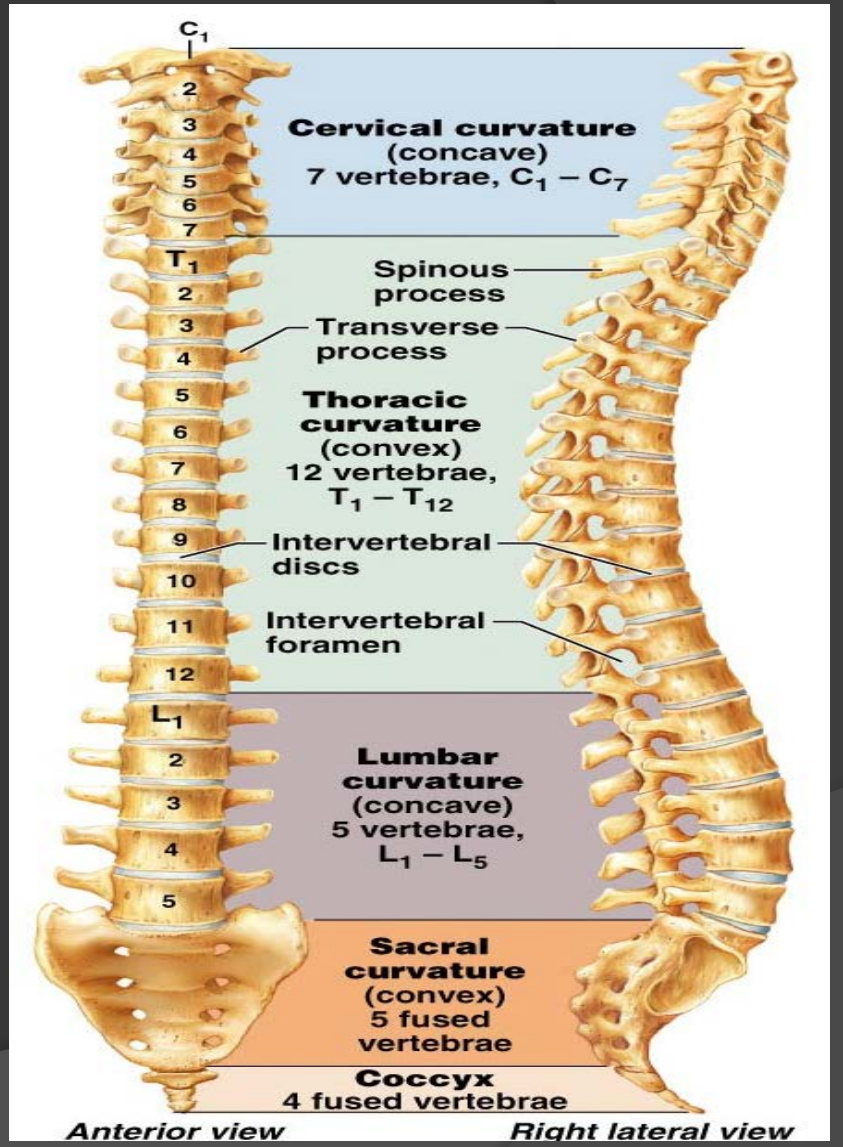
VERTEBRAL COLUMN

Dr.Poonam Kalavadiya
MPT (Cardio Pulmonary)

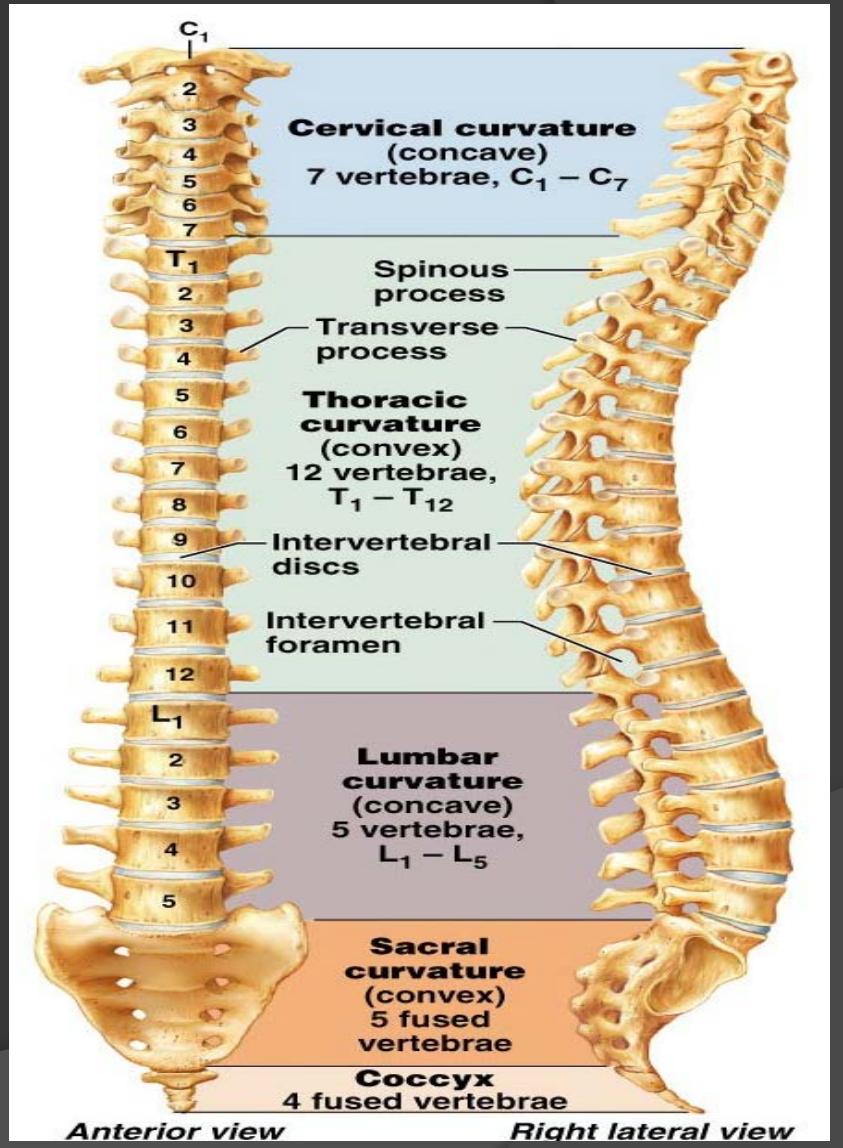
introduction

- It is a complex structure.
- Provides protection for spinal Cord.
- Also provide mobility and stability of the trunk and the extremities.

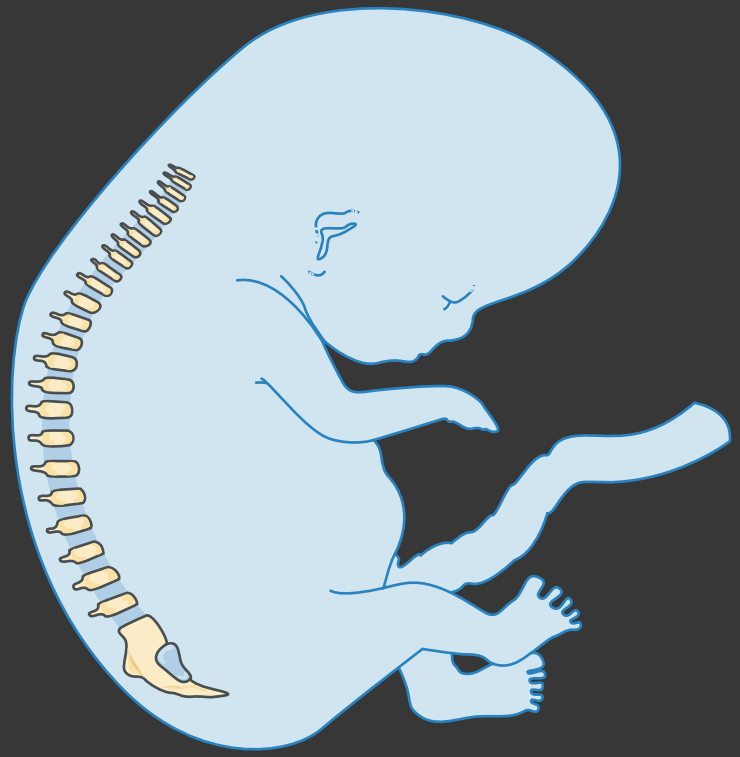


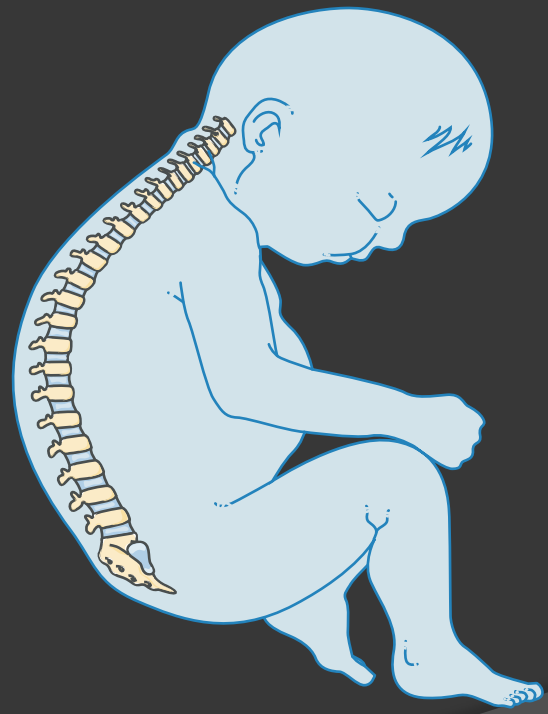
structure

- Vertebral column composed of 33 vertebrae and 23 intervertebral disks.
- And divided in to five regions.



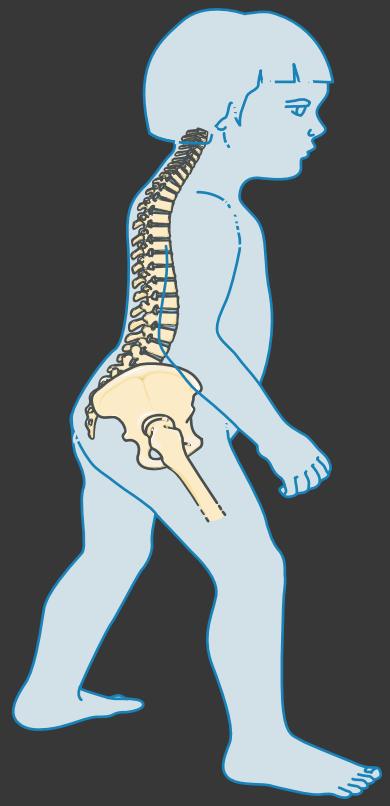
During fetal life

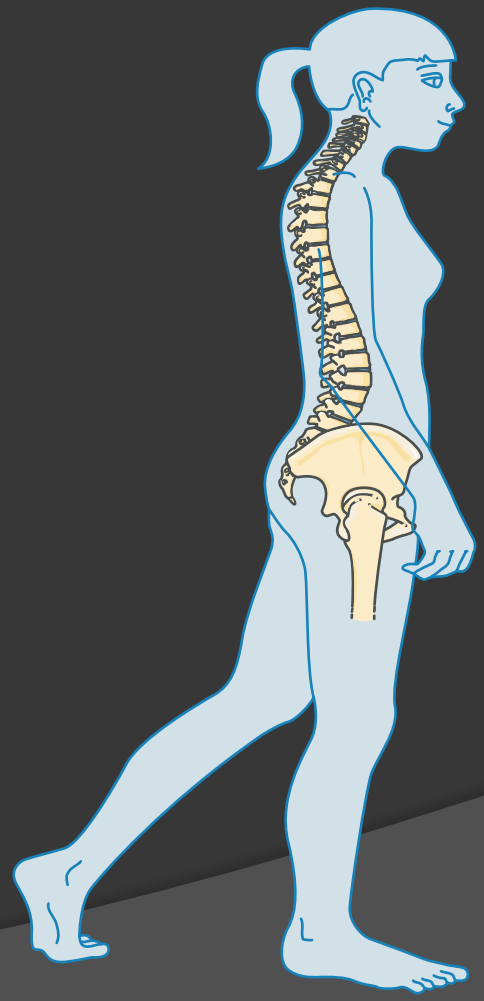




- The two curves (thoracic and sacral) that retain the original posterior convexity throughout life are called **primary curves** or **kyphotic curves**.
- And the two curves (cervical and lumbar) that show a reversal of the original posterior convexity are called **secondary** or **lordotic curves**.

- The secondary or lordotic curves develop as a result of the accommodation of the skeleton to the upright posture.



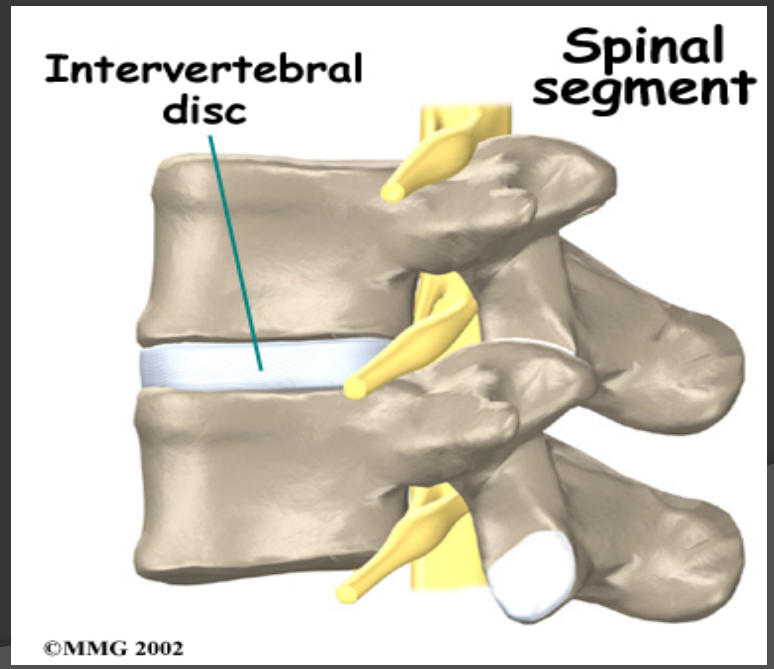


ADVANTAGE OF CURVES

- A curved vertebral column provides significant advantage over a straight rod in that it is able to resist much higher compressive loads.
- According to kapandji, a spinal column with the normal lumbar, thoracic, and cervical curves has a 10-fold ability to resist axial compression in comparison with a straight rod.

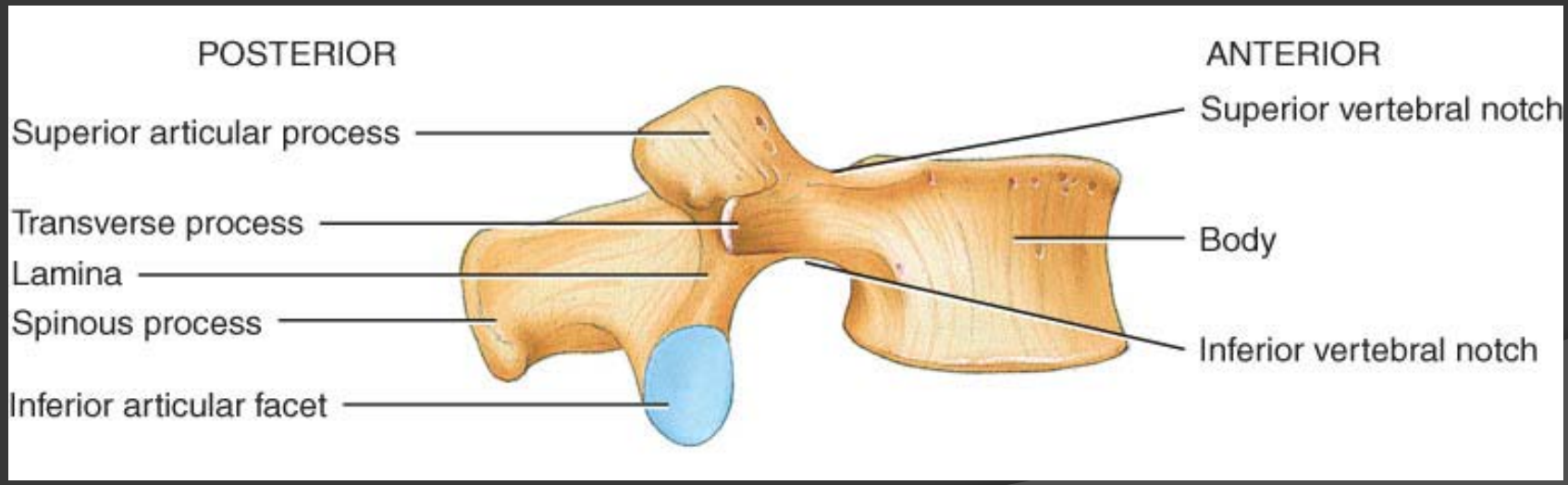
The mobile segment

- A smallest functional unit in a spine.
- One mobile segment=two adjacent vertebrae, the intervening intervertebral disk and all the soft tissue around.



A typical vertebra

- There are two major parts
  1)anterior - vertebral body
  2)posterior - neural arch

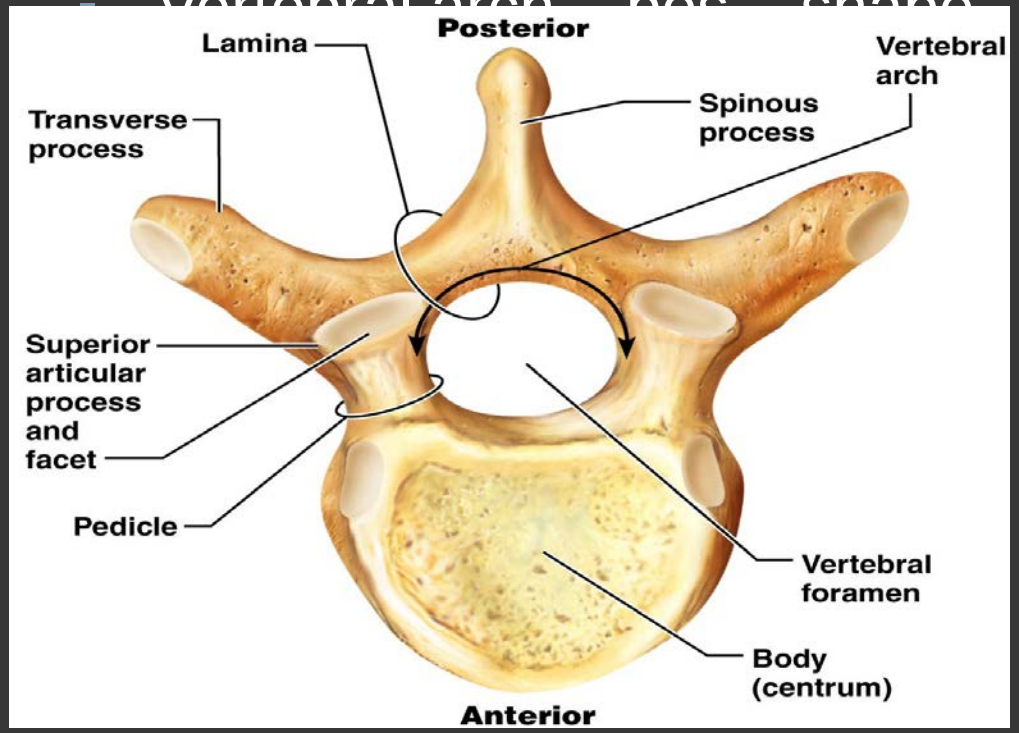


1)Vertebral body

- Is designed to be the weight-bearing structure of the spinal column.
- It is not a solid block of bone but a shell of a cortical bone surrounding by a cancellous cavity.
- The cortical shell is reinforced by trabeculae in the cancellous bone, which provide resistance to compressive forces.

Structure of the Typical Vertebra

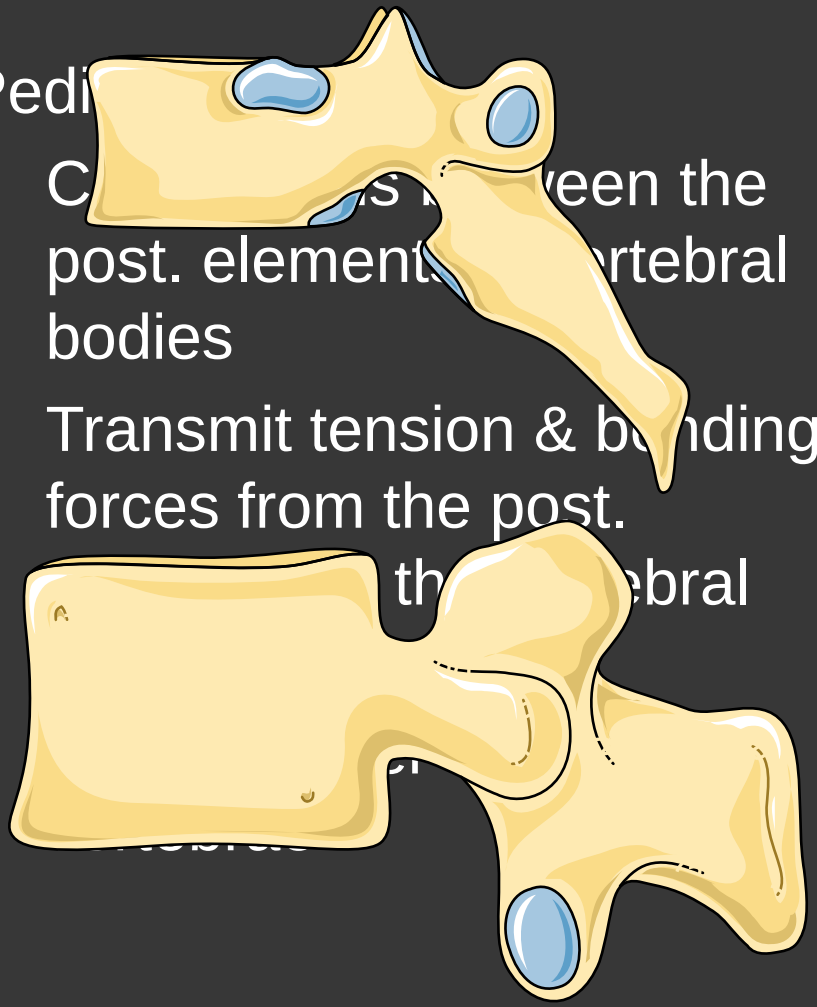
- Vertebral body – ant
- Vertebral arch – pos – shape



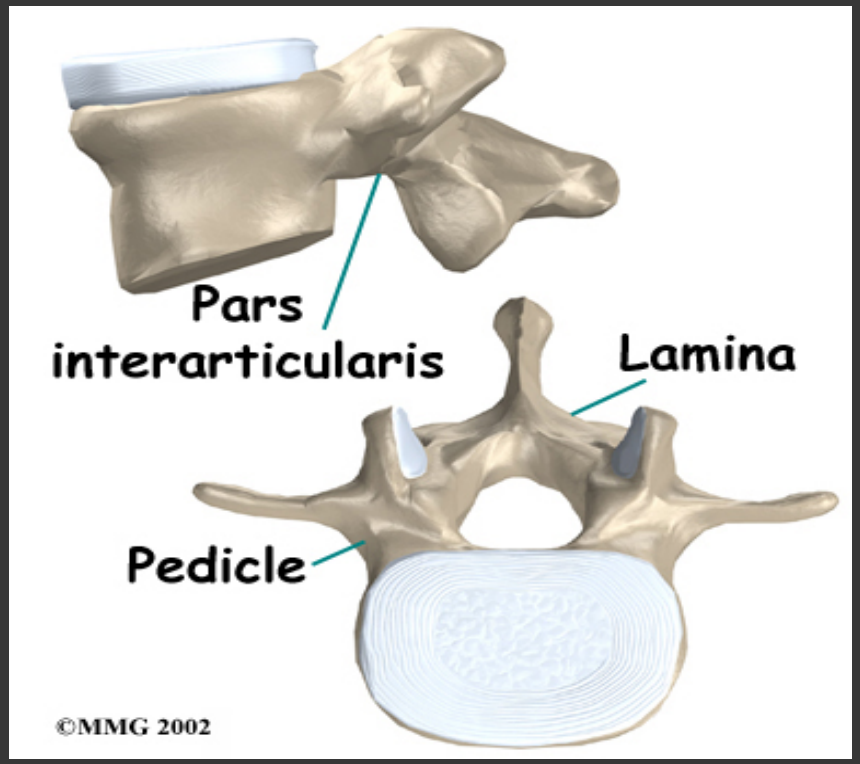
Structure of the Typical Vertebra

Pedi

- C een the post. element rtebral bodies
- Transmit tension & b nding forces from the post. th ebral
-

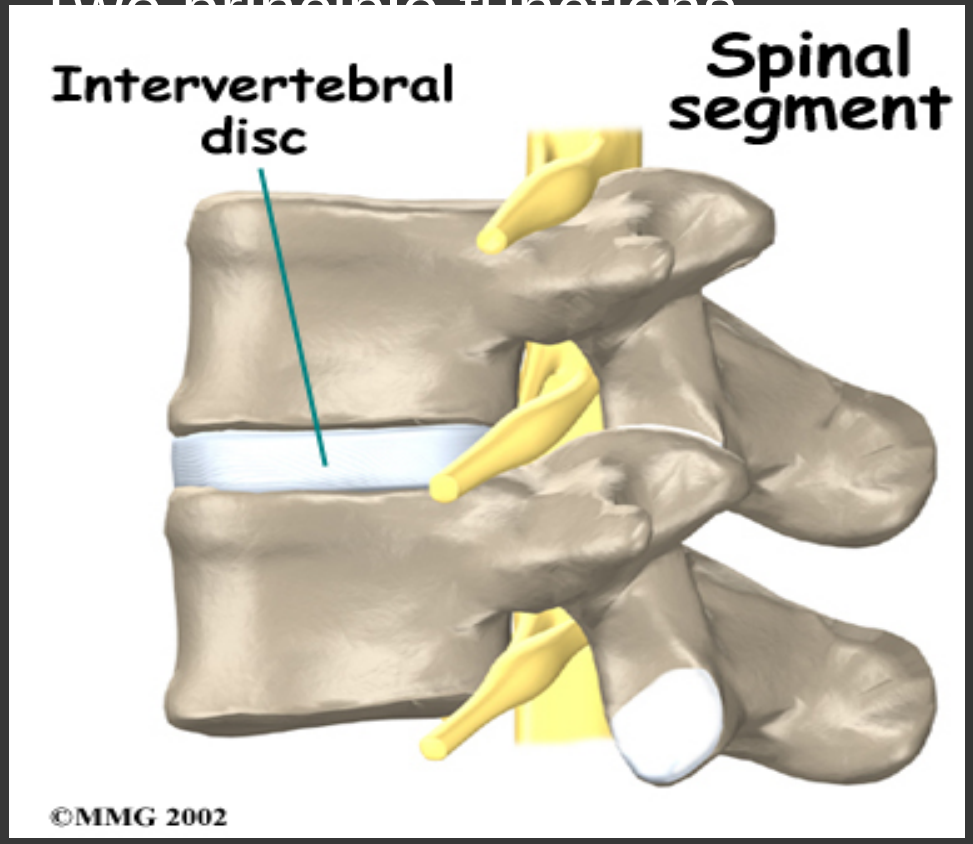


Structure of the Typical Vertebra

- Laminae – serve as a roof –
- 

INTERVERTEBRAL DISC

- Two principle functions



INTERVERTEBRAL DISC

- Disc thickness varies with disc position in the vertebral column
- Lumbar region – 9mm
- Thoracic region – 5mm
- Cervical region – 3mm
- The greater the ratio – greater the mobility

INTERVERTEBRAL DISC

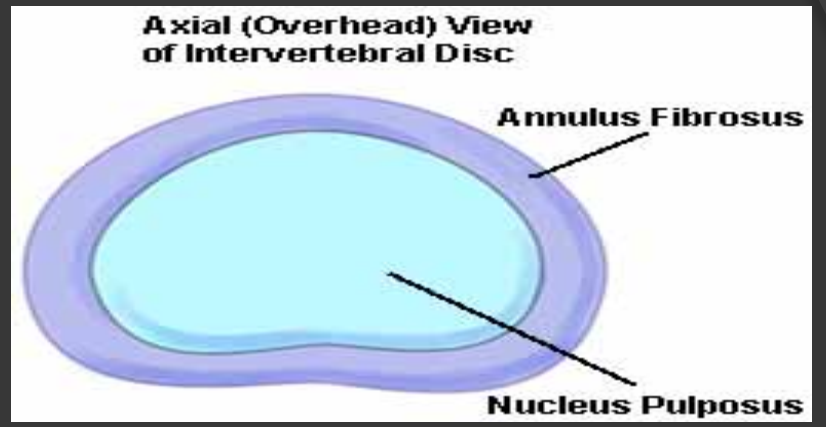
- The ratio of disc thickness to the height of the vertebral body
- Cervical column – 2/5
- Lumbar column – 1/3
- Thoracic column – 1/5

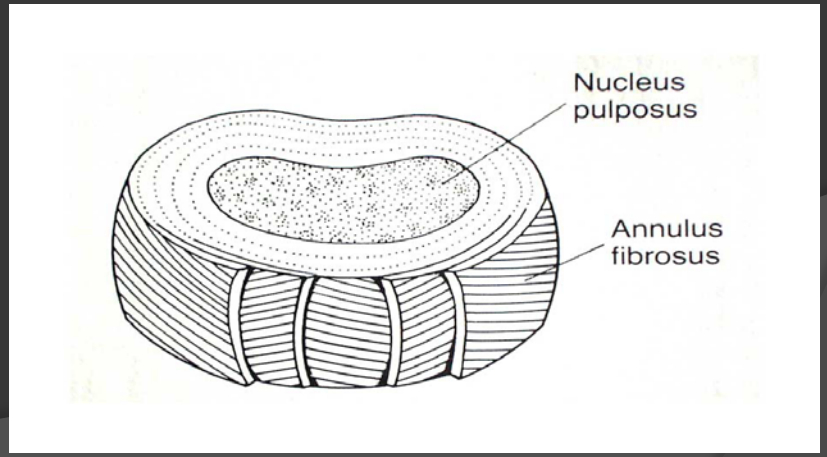
INTERVERTEBRAL DISC

- Consists of 3 Parts

1. Nucleus Pulposus
2. Annulus fibrosus
3. Vertebral end plate

- All 3 structures are composed of water, collagen and PGs. however the relative propotion of each vary.



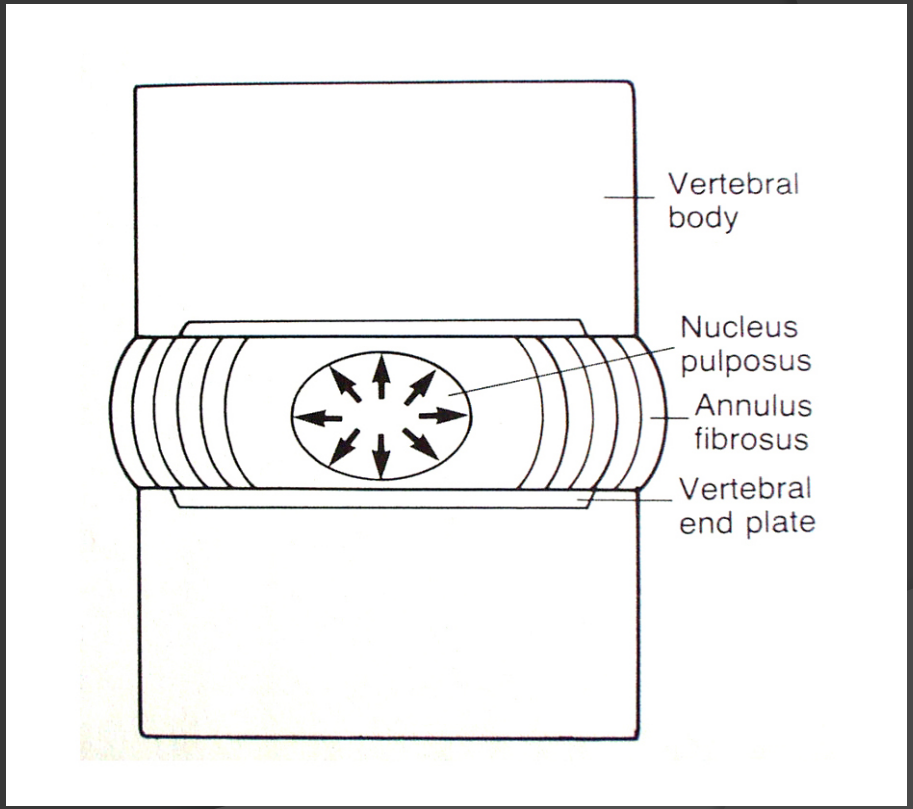


Nucleus Pulposus

- Has more water 70% - 90% and PGs & remainder 15% consists of collagen, elastin, proteolytic enzymes
- PG are macro-molecules
  - Attract and retain water
  - Hydrophilic gel–like matter
    - Resists compression
- Amount of water
  - Activity related
  - Varies throughout the day

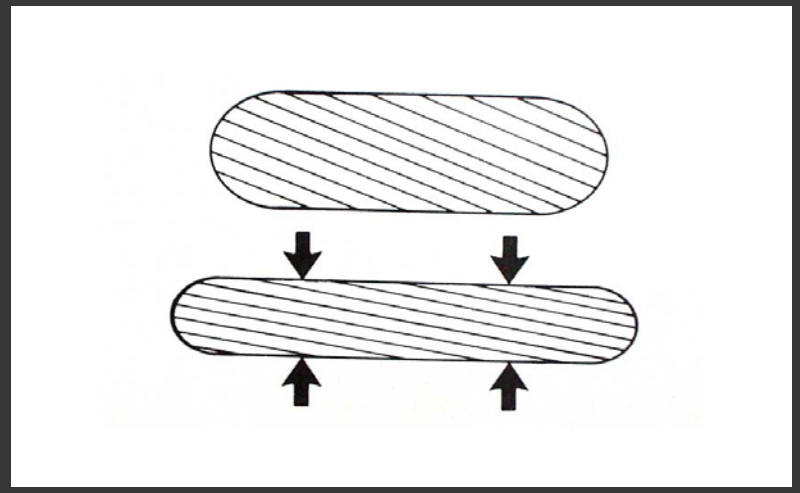
Theory of weight bearing

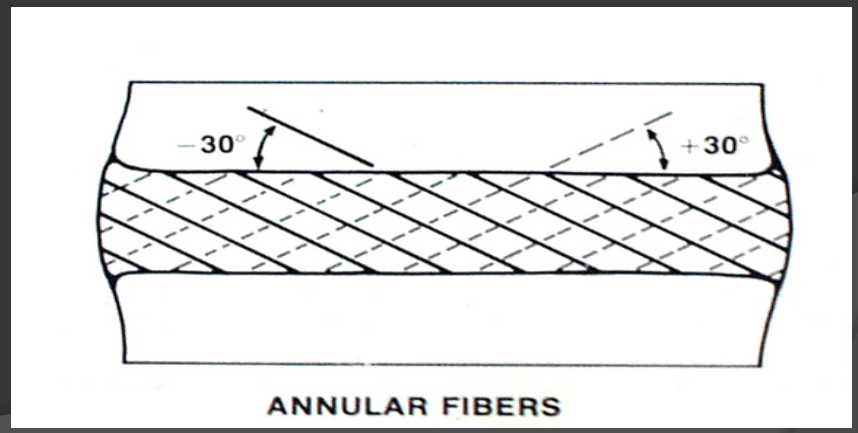
- Nucleus pulpous imbibes water
- Develops internal pressure
- Pressure exerted in all directions
  - Lateral forces
    - Against annulus
  - Superiorly and inferiorly directed forces
    - Against end plates
  - Increases stiffness
    - Of end plate and annulus fibrosus



Anulus Fibrosus

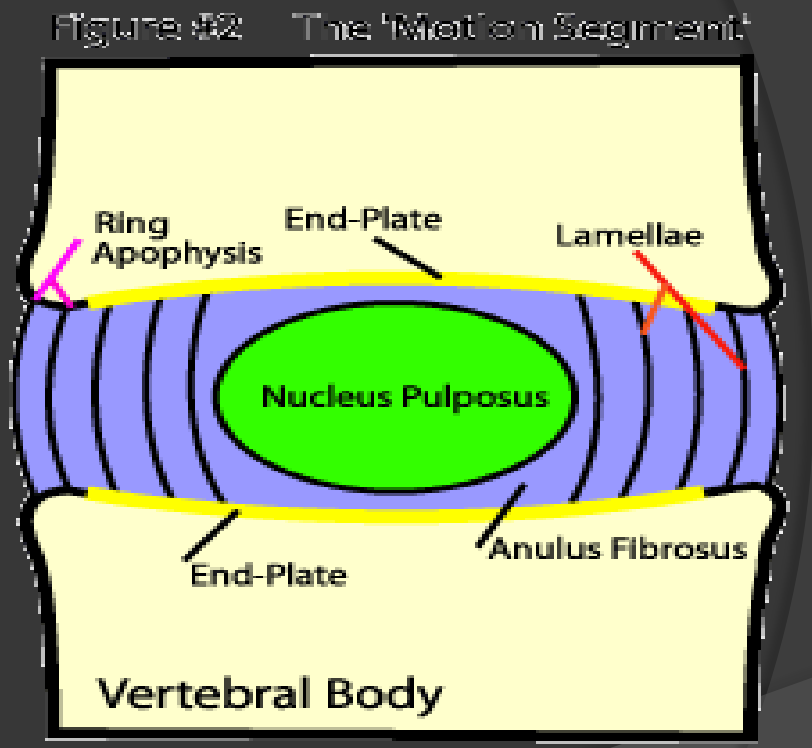
- Strong radial tire–like structure
- Series of lamellae
- Concentric sheets of collagen fibers
  - Connected to end plates
  - Orientated at various angles
  - Under compression
    - Become horizontal
- Encloses nucleus pulposus





Vertebral End Plates

- Layers of cartilage 0.6 – 1mm thick cover the vertebral bodies
- It cover the entire nucleus pulposus but not the anulus fibrosus
- It consists of both hyaline & fibrocartilage
- The vertebral end plate is strongly attached to the vertebral body, which is why it is considered to be a component of the disk rather than the vertebral body.



Disk innervation

- Disks are innervated in the outer one third to one half of the fibers of the anulus fibrosus.
- Cervical and lumbar – vertebral and sinuvertebral nerves.

Disc Nutrition

- Avascular structure of the human body
- Nutrients for the disc found within the tiny capillary beds of the metaphyseal arteries that are in the subchondral bone, just above the vertebral plates
- It supply the outer surface of the anulus fibrosus
- Remaining of the disc receives its nutrition through diffusion process

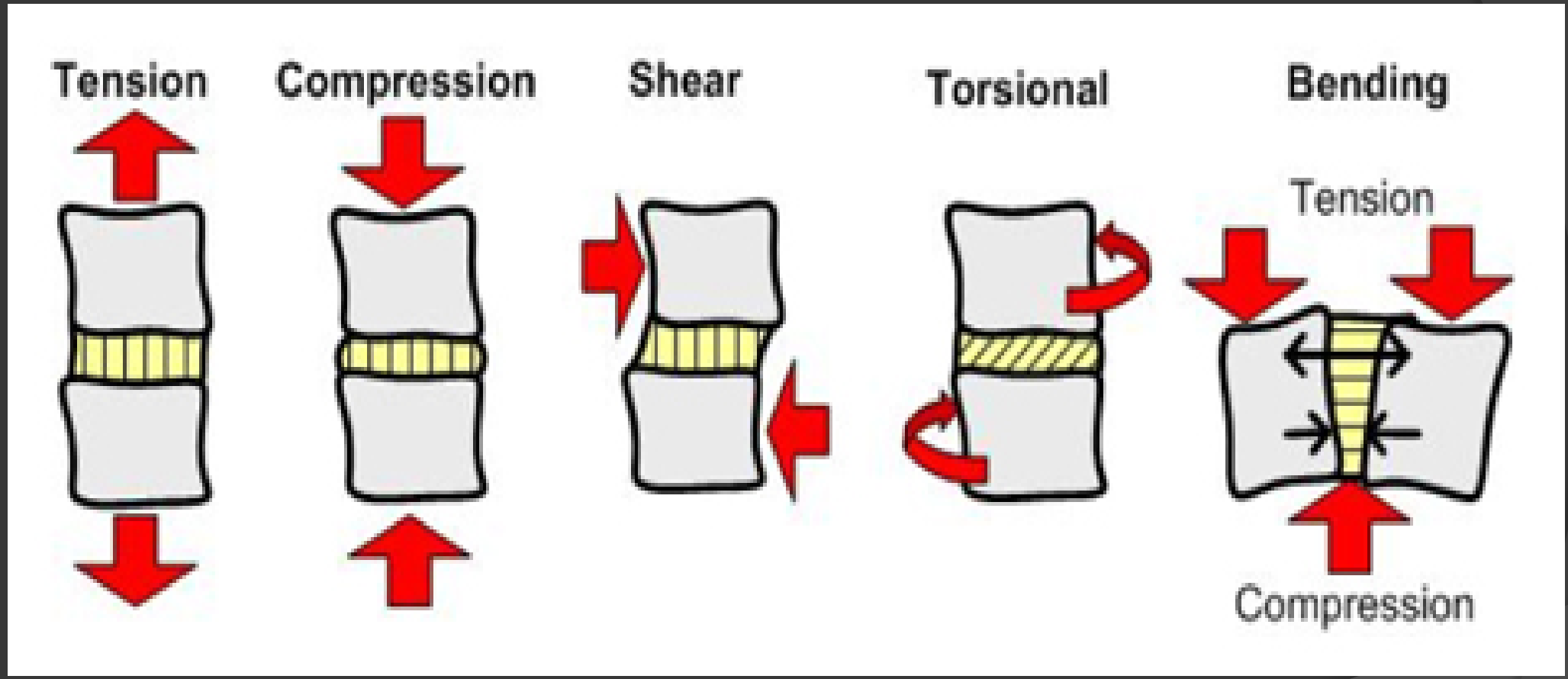
Articulations

- Two types

1. Cartilaginous – between the vertebral bodies – also called as INTERBODY JOINTS
2. Diarthrodial joints or synovial – between the zygapophyseal facets located on the superior articular process of one vertebra & zygapophyseal facets located on the inferior articular process of an adjacent vertebra

Movements at the Interbody joints

- Gliding – Frontal Plane
- Distraction & Compression – Vertically
- Anterior – Posterior translation – Sagittal plane
- Rotation – Side to side rotation - Frontal plane
- Rotation – transverse plane
- Anterior – posterior tilting – sagittal plane


Tension
Compression
Shear
Torsional
Bending
Tension
Compression

Zygapophyseal articulations

- They are diartrodial joints and have regional variations in structure.
- These accessory structures appear to be of several types, but most are classified as either adipose tissue pads or fibro adipose meniscoids.
- The structures are most likely involved in protecting articular surfaces that are exposed during flexion and extension of vertebral column.