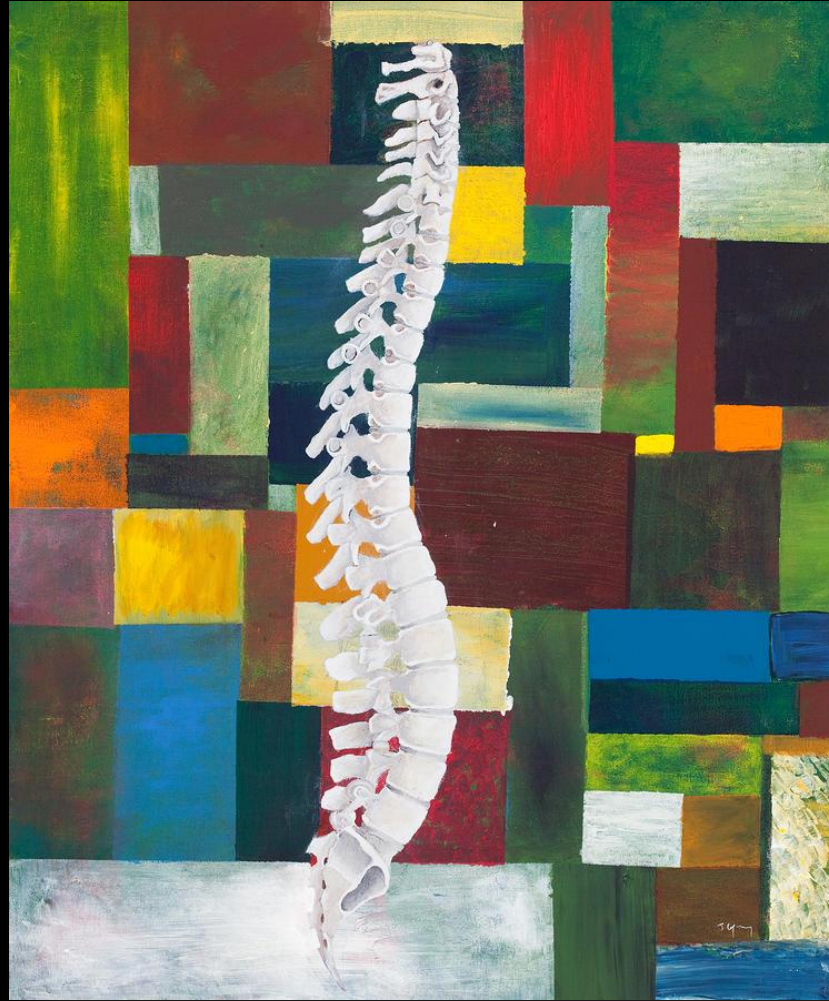


JOINTS OF THE VERTEBRAL COLUMN



Spine by Sara Young

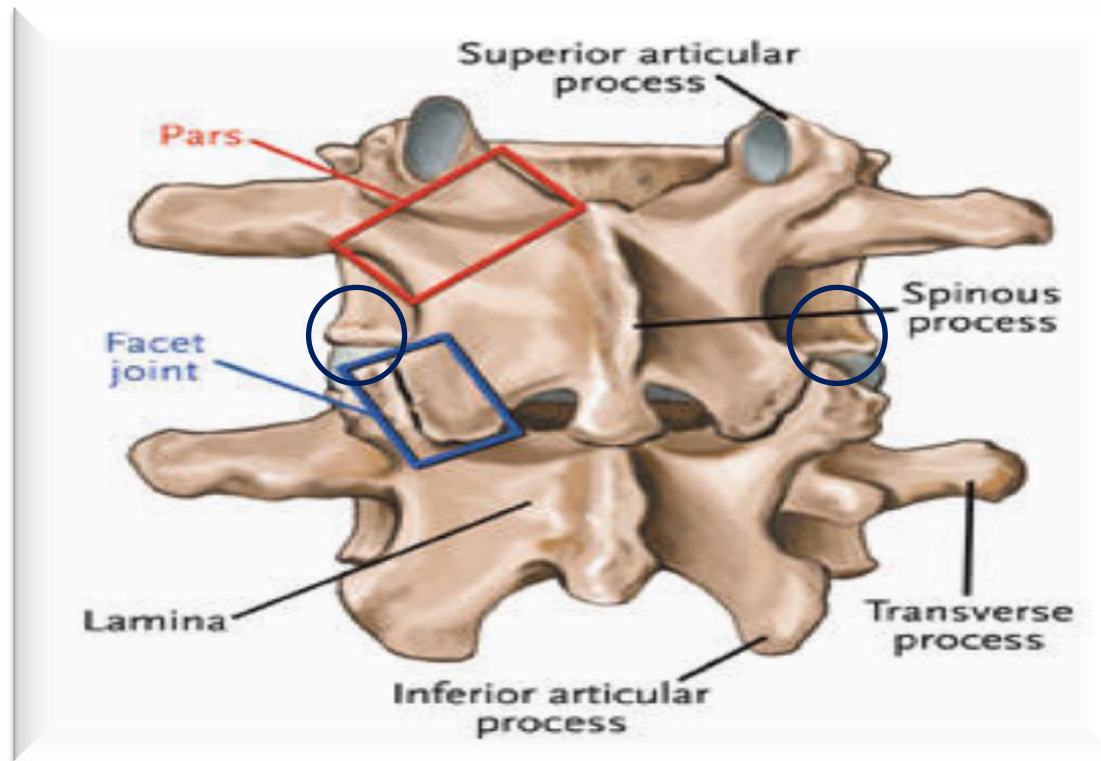
JOINTS OF THE VERTEBRAL COLUMN



Symphyses between **vertebral bodies** $n=2$ 1 above, 1 below

Synovial joints *between* **articular processes** $n=4$ 2 above, 2 below

a total of **6** joints between two vertebrae



- 1) Craniovertebral (atlanto-axial and atlanto-occipital) joints
- 2) Costovertebral joints
- 3) Sacroiliac joints**

JOINTS OF THE VERTEBRAL BODIES



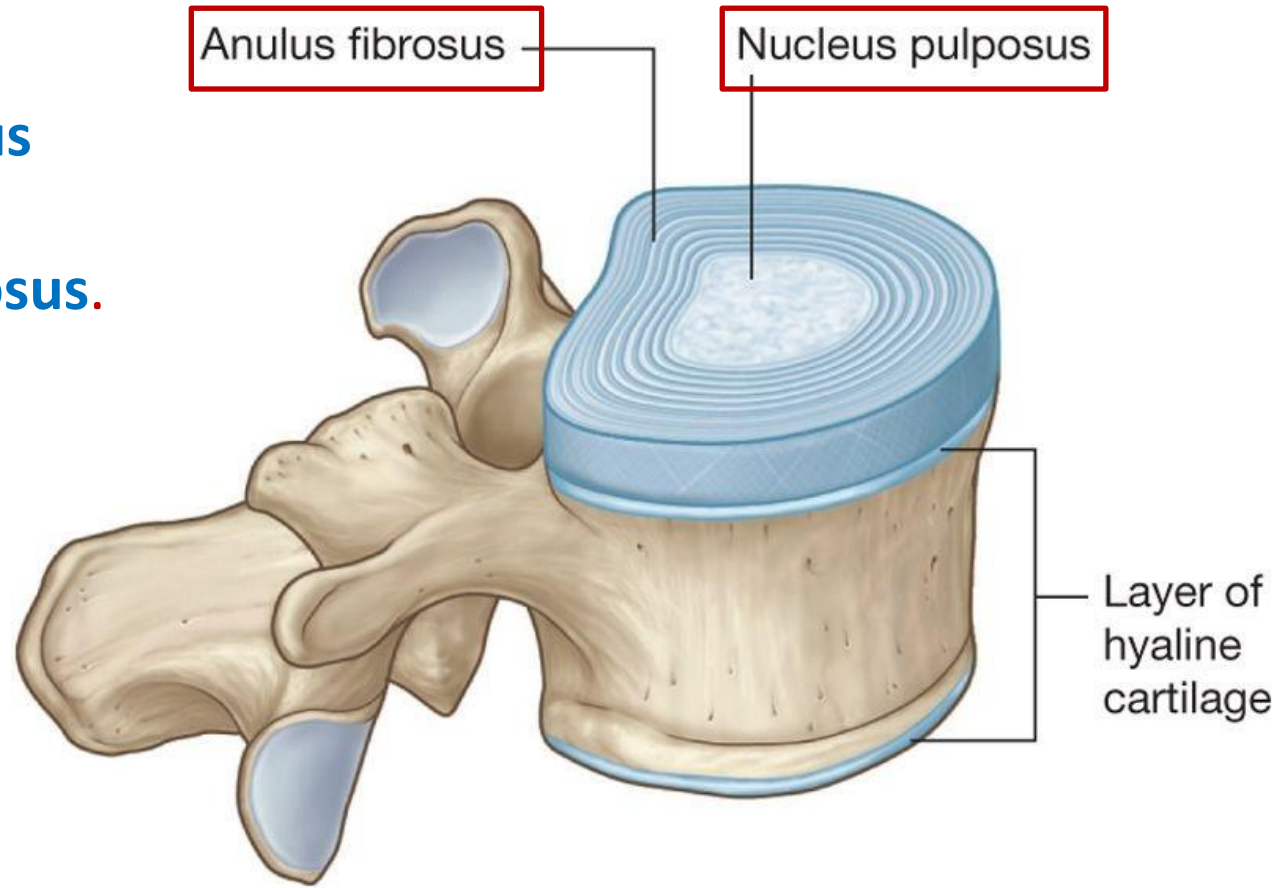
Joint type: symphyses (secondary cartilaginous joints)

designed for weight-bearing and strength

A layer of **hyaline cartilage** on each vertebral body

An **intervertebral disc** between these layers

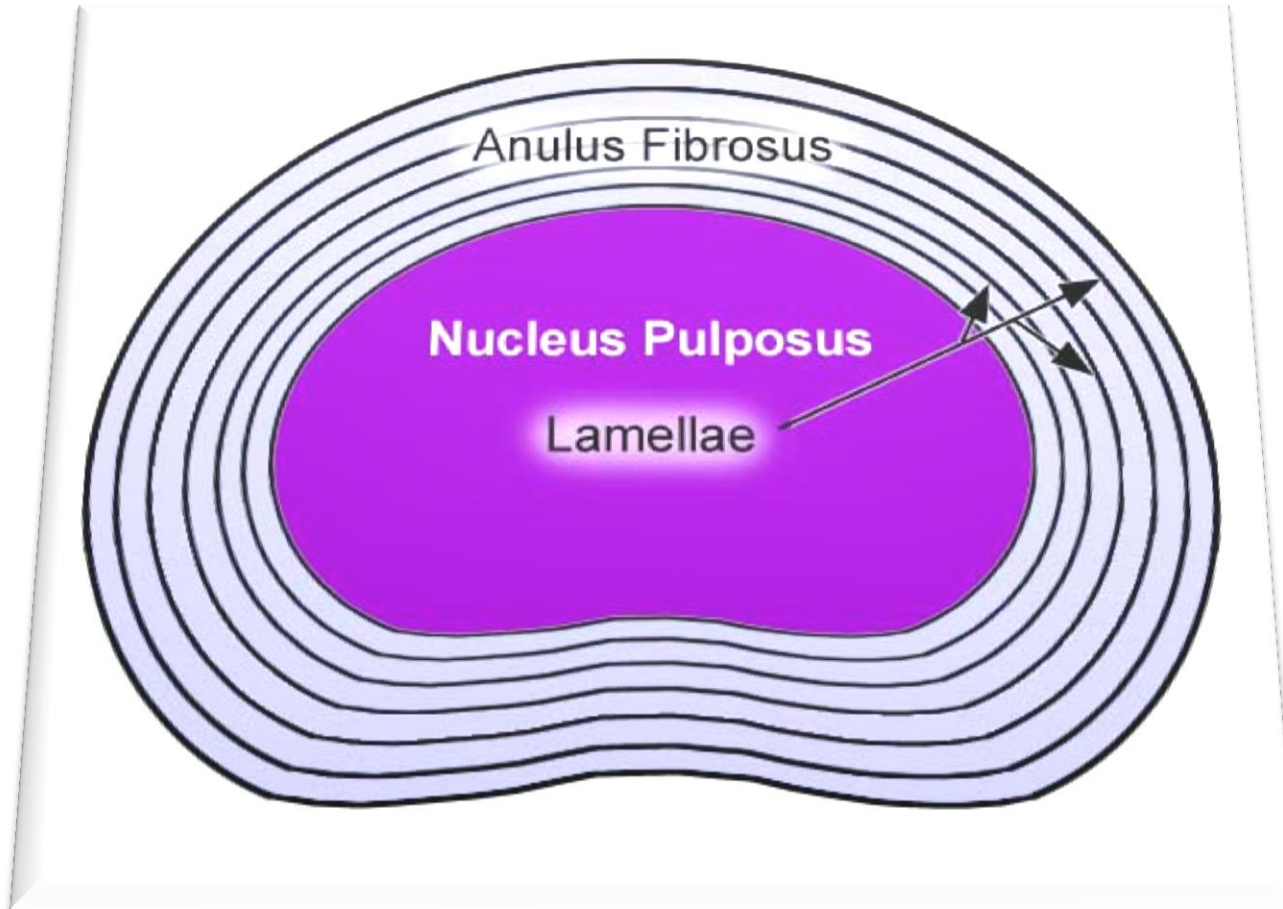
an outer **anulus fibrosus**
surrounds
a central **nucleus pulposus**.



Anulus fibrosus



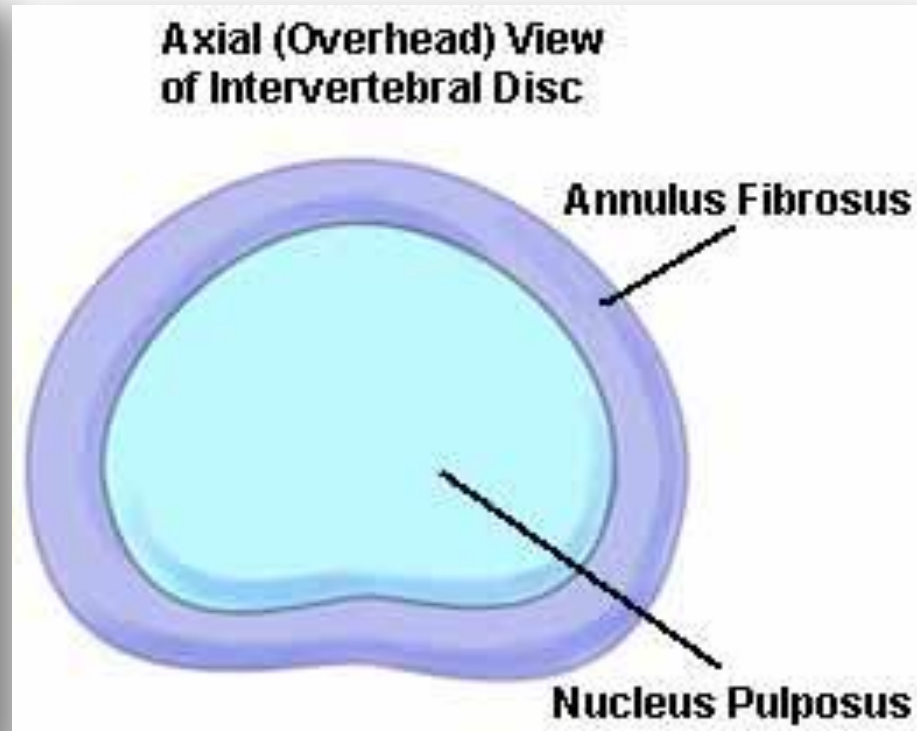
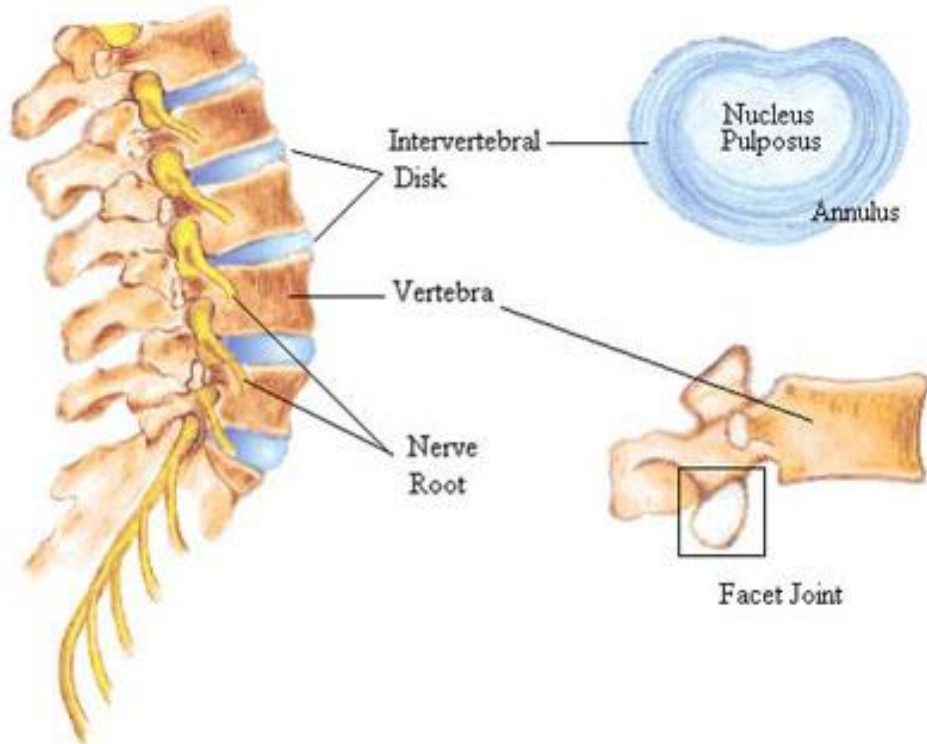
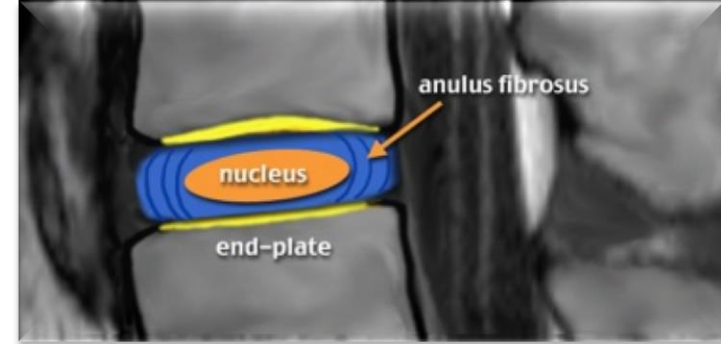
- an outer ring of collagen *surrounding*
- a wider zone of fibrocartilage arranged in a lamellar configuration.



Nucleus pulposus

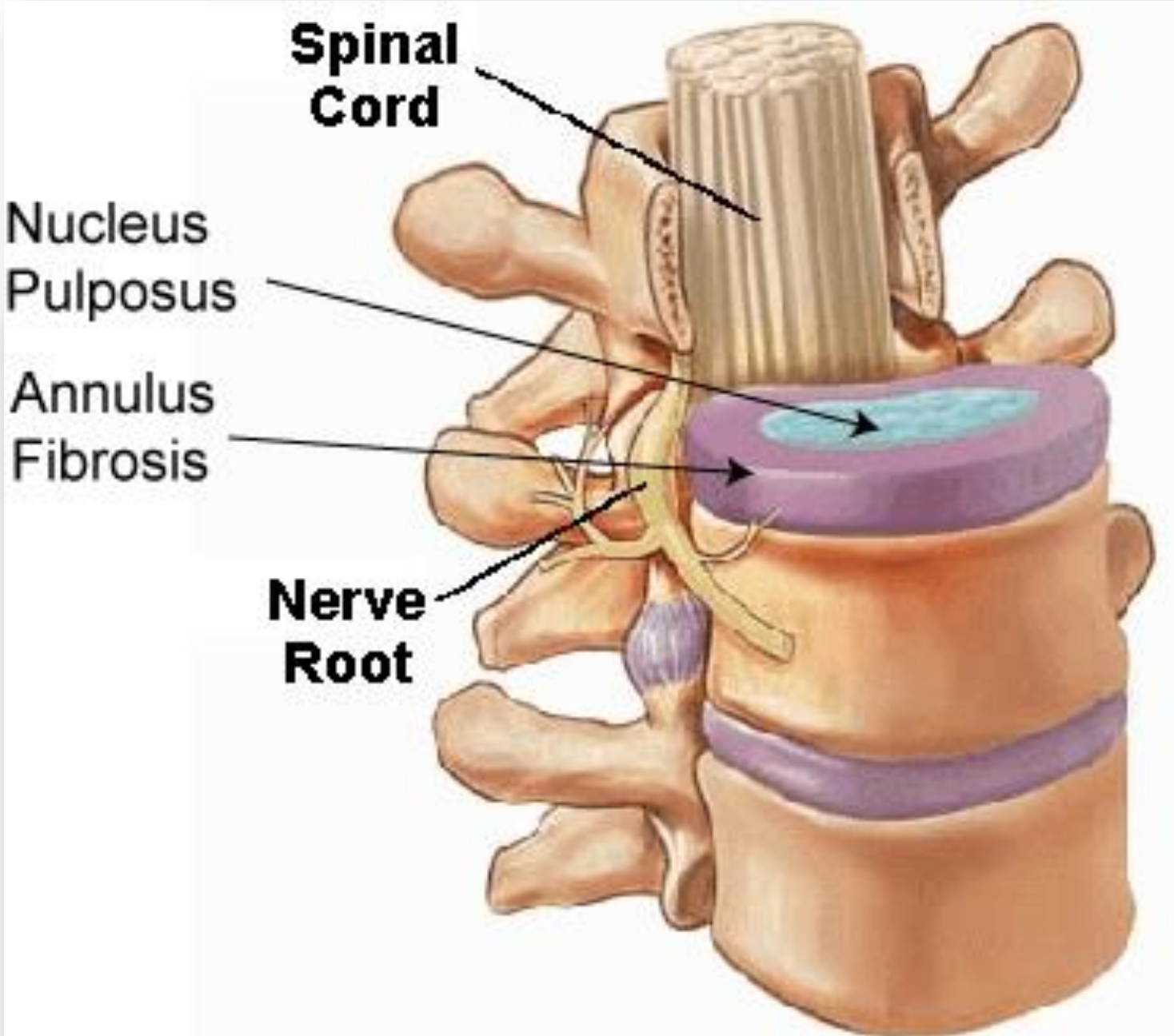
L. pulpa, fleshy

- core of the intervertebral disc
- fills the center of the intervertebral disc
- gelatinous
- absorbs compression forces between vertebrae.



semifluid nature responsible for much of the flexibility & resilience of the intervertebral disc and of the vertebral column as a whole

INTERVERTEBRAL DISCS



odies
umn
tebral foramen.
.

INTERVERTEBRAL DISCS

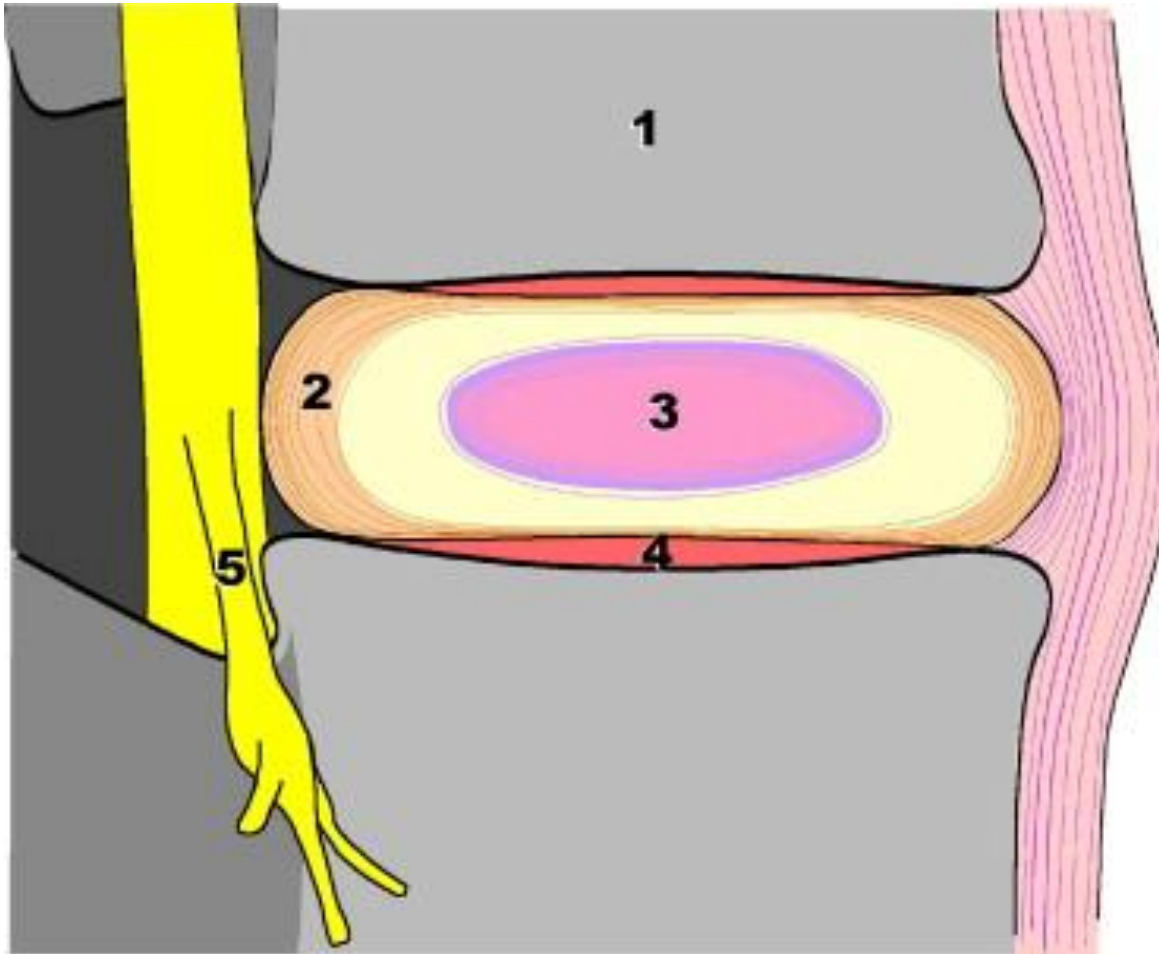


Diagram of sagittal section of vertebral body and disc showing relationship of endplate and longitudinal ligament to the disc and the vertebrae.

1, vertebral body; 2, annulus fibrosus; 3, nucleus pulposus; 4, endplate; 5, spinal nerve root

INTERVERTEBRAL DISCS



■ No intervertebral disc between C1 and C2 vertebrae

■ Most inferior functional disc between L5 and S1 vertebrae



anterior arch of the atlas (C1)

dens (odontoid peg around which atlas rotates) of axis (C2)

posterior arch of the atlas (C1)

soft palate (roof of the mouth)

root of the tongue

transverse process

intervertebral disc

superior articular process

superior articular process

zygapophyseal (facet) joint

spinous process of C7 2nd-7th:

bodies of 2nd to 7th cervical vertebrae

INTERVERTEBRAL DISCS



Thickness of the discs  vertebral column descends

The range (amount) of movement **relative thickness to body**

greatest @ **cervical & lumbar regions**, movements of vertebral column greatest
thickness most uniform in the thoracic region

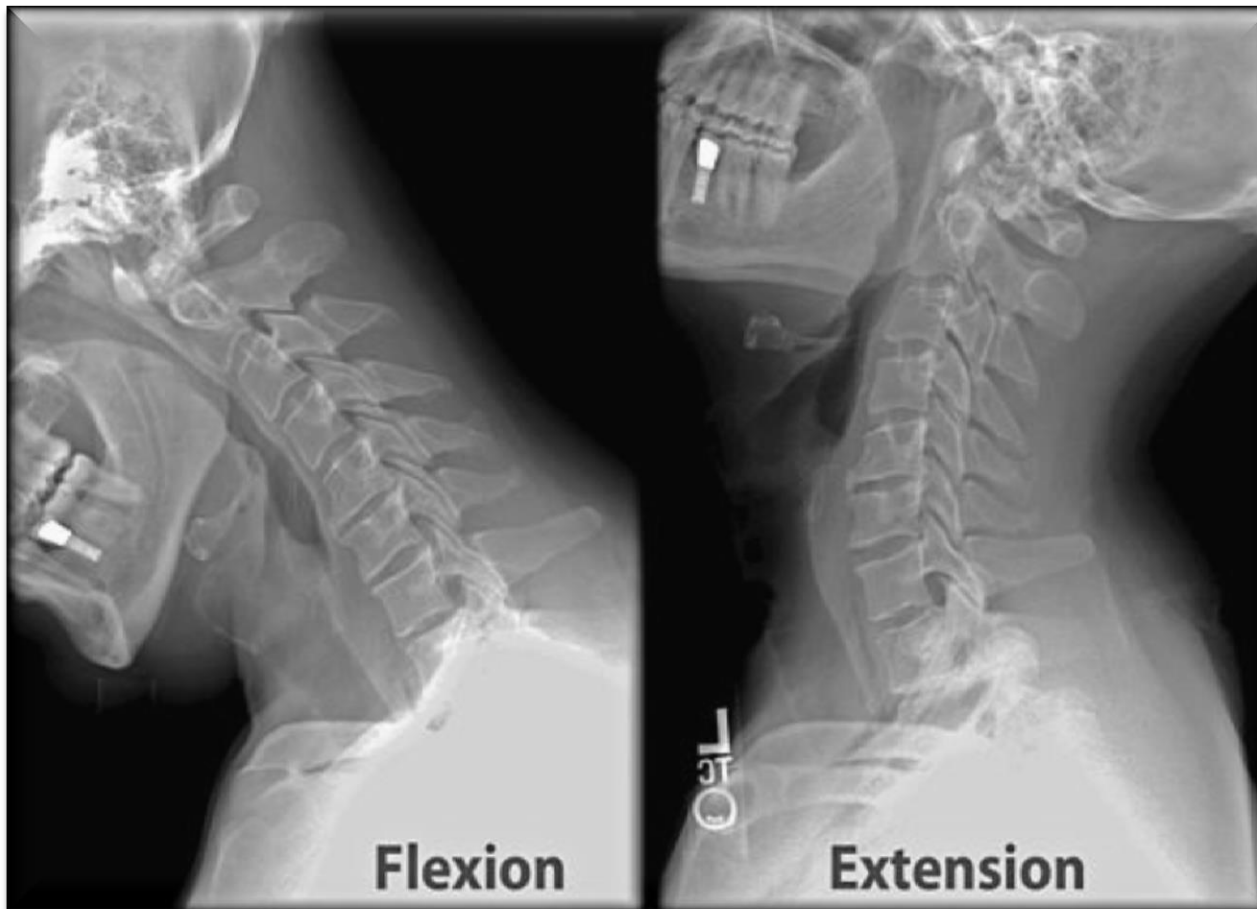


FUNCTIONS OF INTERVERTEBRAL DISCS



Thanks to the semifluid nature

One vertebra rock forward or backward on another during flexion & extension



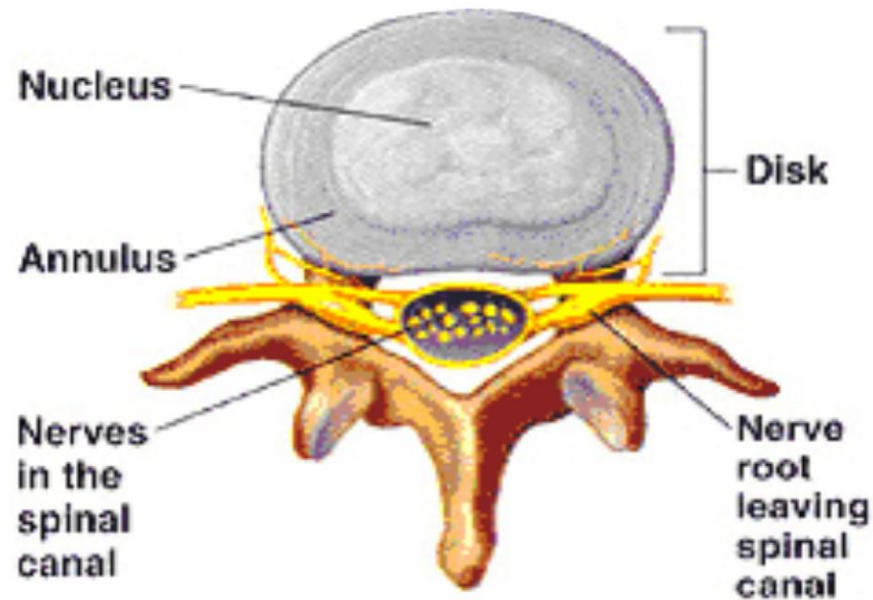
INTERVERTEBRAL DISCS BY AGING



⊕ Water content of the nucleus pulposus

⊕ Collagen fibers of the annulus degenerate.

Thin & less elastic discs
Nucleus & annulus not distinguishable



JOINTS OF THE VERTEBRAL ARCHES

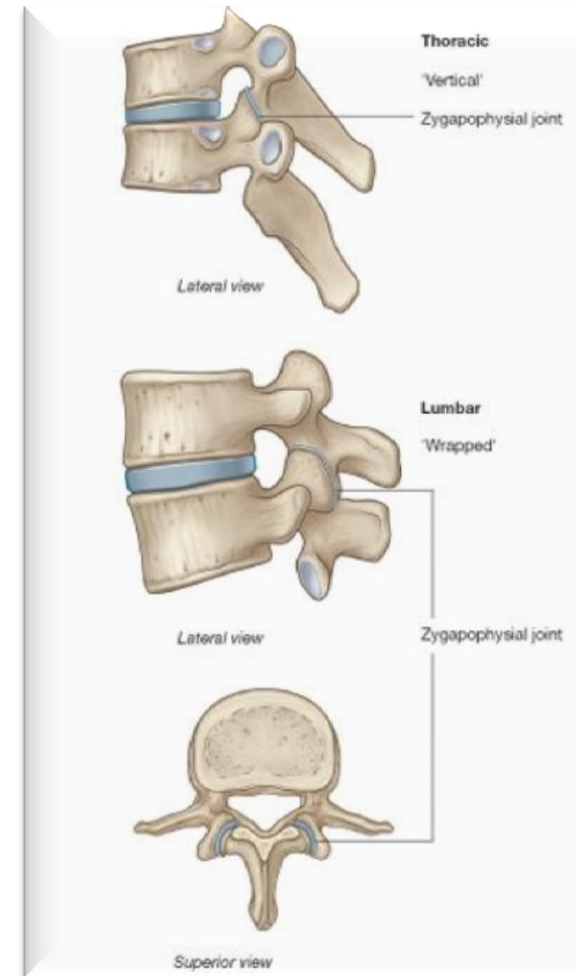
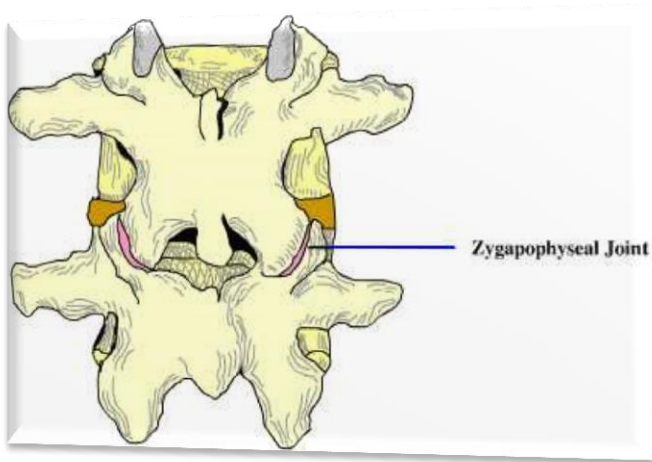


ZYGAPOPHYSIAL JOINTS, FACET JOINTS

plane synovial joints

between superior & inferior articular processes of adjacent vertebrae.

@ cervical region articular capsule especially thin
wide range of movement

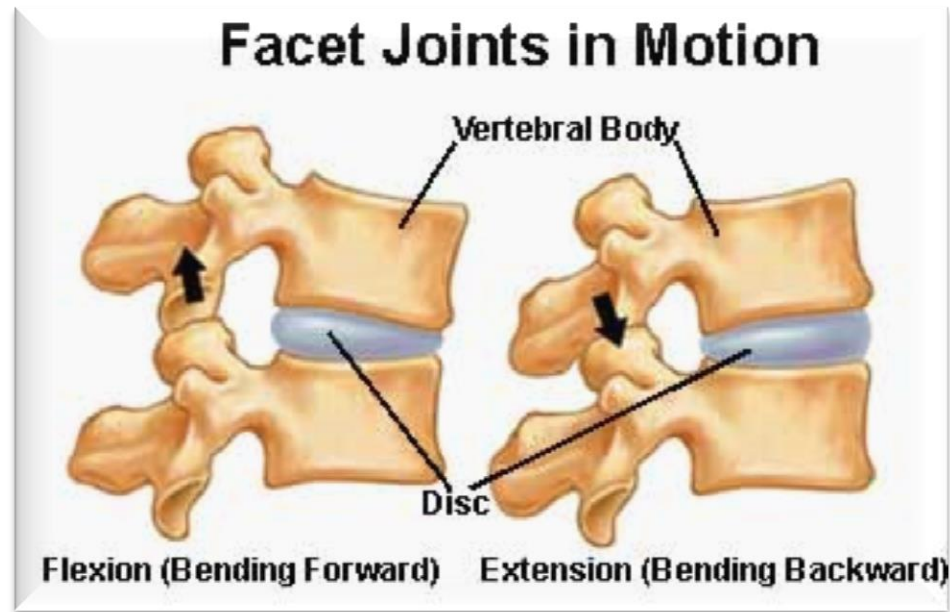


JOINTS OF THE VERTEBRAL ARCHES



ZYGAPOPHYSIAL JOINTS, FACET JOINTS

- permit gliding movements between articular processes
- **shape & disposition of the articular surfaces** determine the types of movement possible.



Accessory ligaments unite the laminae, transverse processes, and spinous processes and help stabilize the joints.

UNCOVERTEBRAL (LUSCHKA'S) JOINTS



Uncinate process

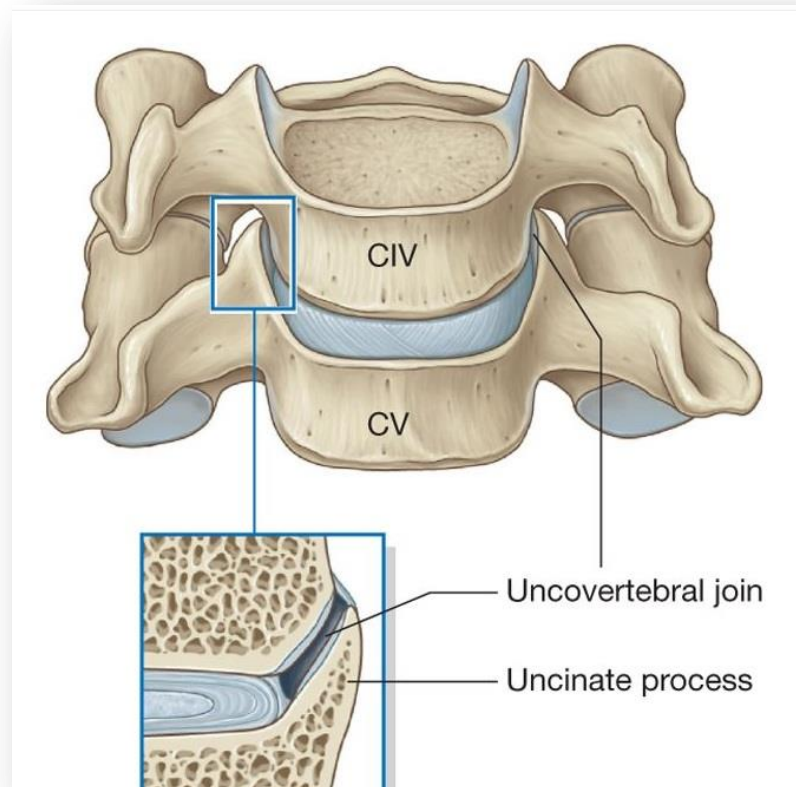
elevations @ lateral margins of the upper surface

Articulation with the body of the vertebra above

commonly between unci of the bodies of C3 or 4-C6 or 7 vertebrae

@ the lateral & posterolateral margins of the intervertebral discs

synovial joints or degenerative spaces (clefts) in the discs occupied by extracellular

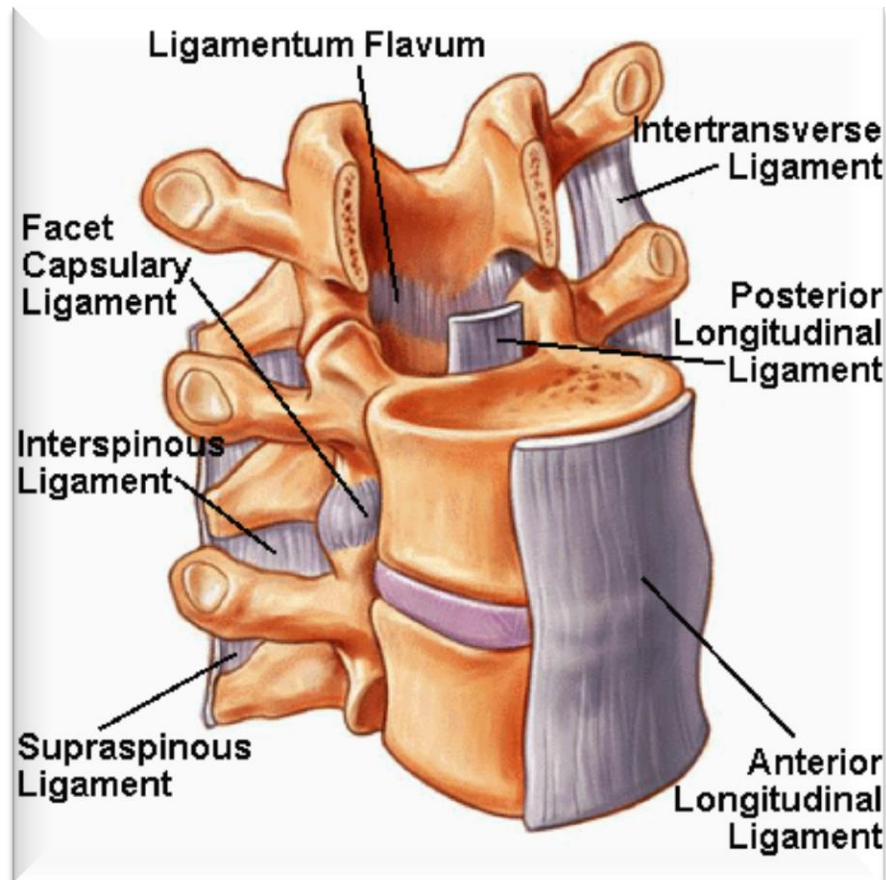


LIGAMENTS OF THE VERTEBRAL COLUMN



Joints between vertebrae
reinforced & supported by numerous ligaments

pass between vertebral bodies
interconnect components of vertebral arches.



LIGAMENTS OF THE VERTEBRAL COLUMN



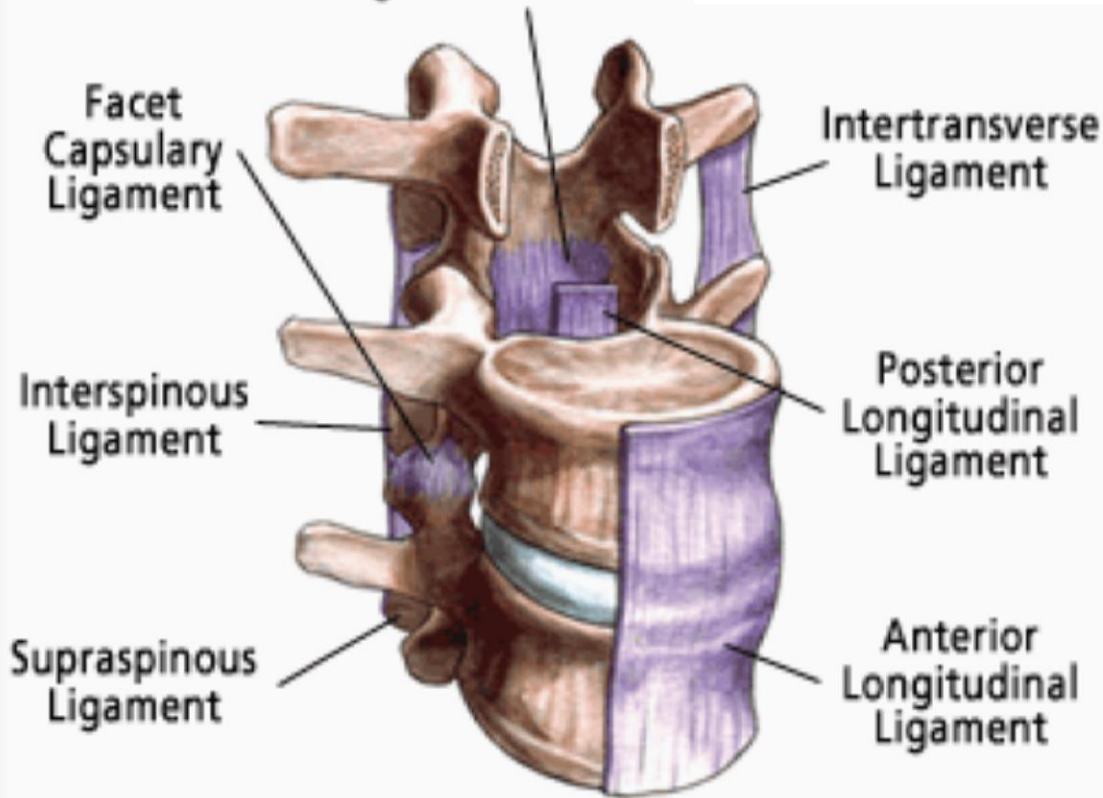
Anterior & posterior longitudinal ligaments

Ligamenta flava

Supraspinous ligament & ligamentum nuchae

Interspinous ligaments

Ligamentum Flavum between two laminae



Posterior longitudinal ligament



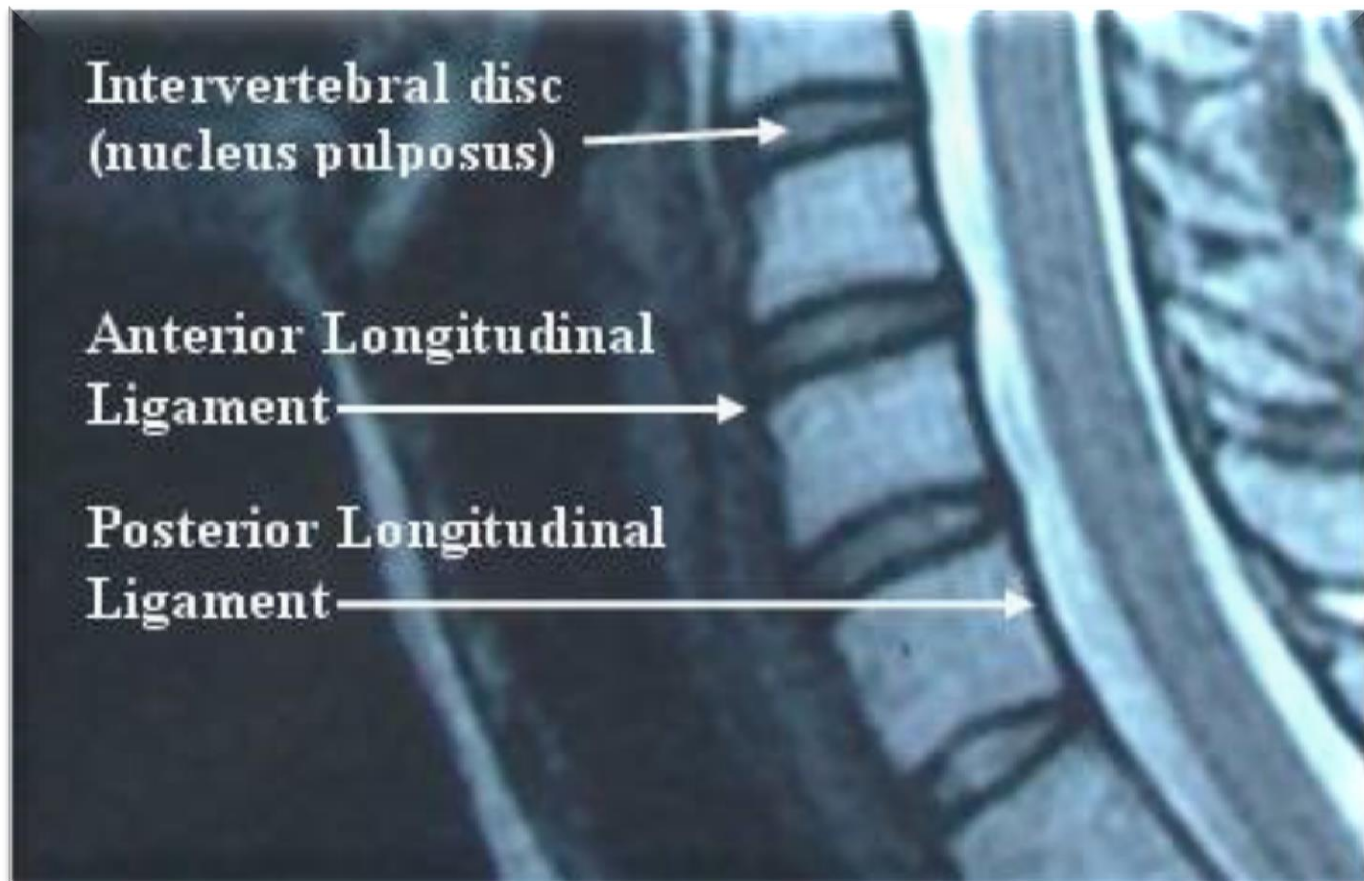
Anterior longitudinal ligament

- From base of the skull to anterior surface of sacrum
- Along its length attached to vertebral bodies and intervertebral discs

Posterior longitudinal ligament

Tectorial membrane

Posterior longitudinal ligament connecting axis to base of the skull



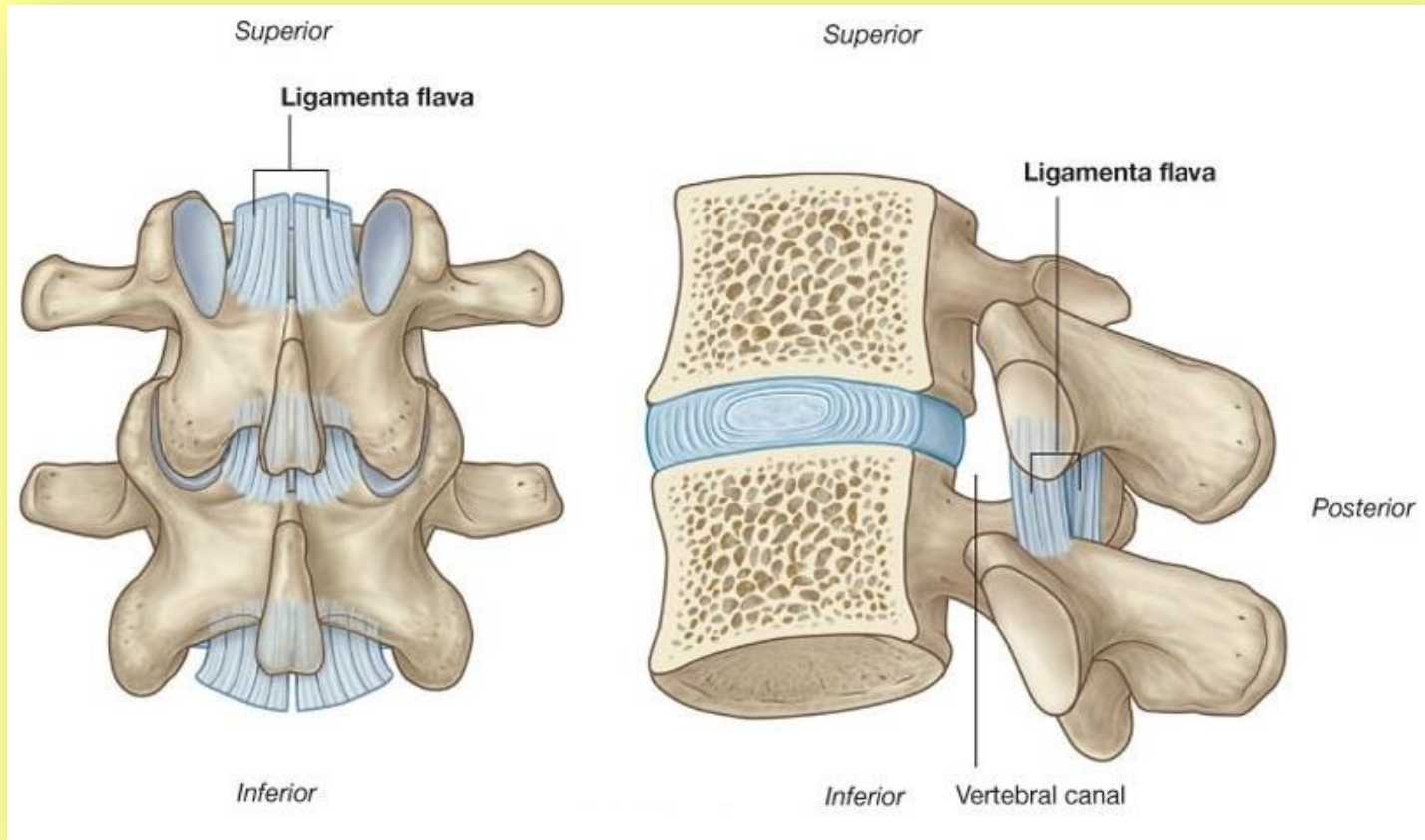
Ligamenta flava/Ligamentum flavum



Between

posterior surface of the **lamina** on the vertebra below
anterior surface of the **lamina** of the vertebra above

- resist separation of the laminae in flexion.
- assist in extension back to the anatomical position.

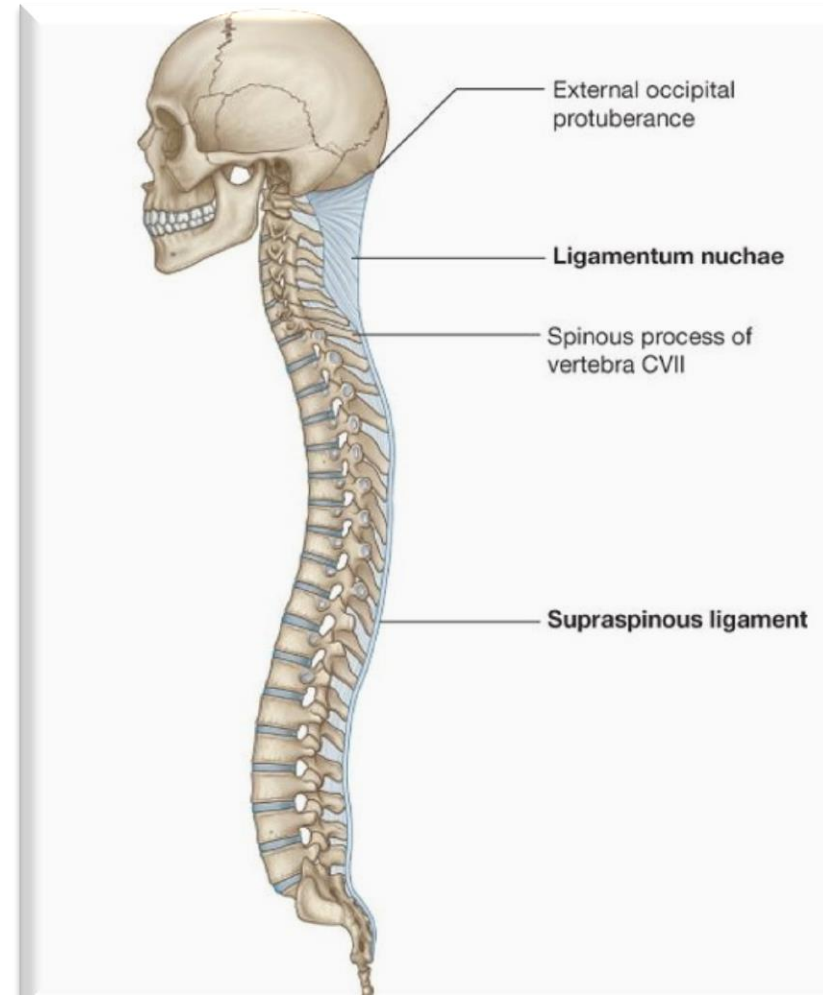


Supraspinous ligament

connects tips of the spinous processes
from vertebra C7 to the sacrum

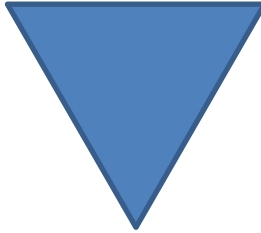


From vertebra C7 to the skull becomes structurally distinct
ligamentum nuchae



Ligamentum nuchae

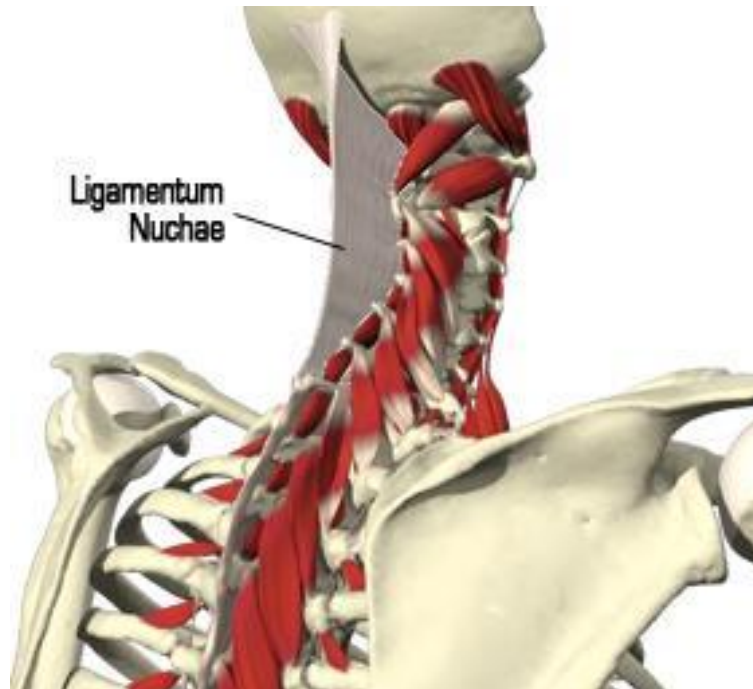
triangular, sheet-like structure in the median sagittal plane
External occipital protuberance to magnum



tip of spinous process of C7

deep side attached to

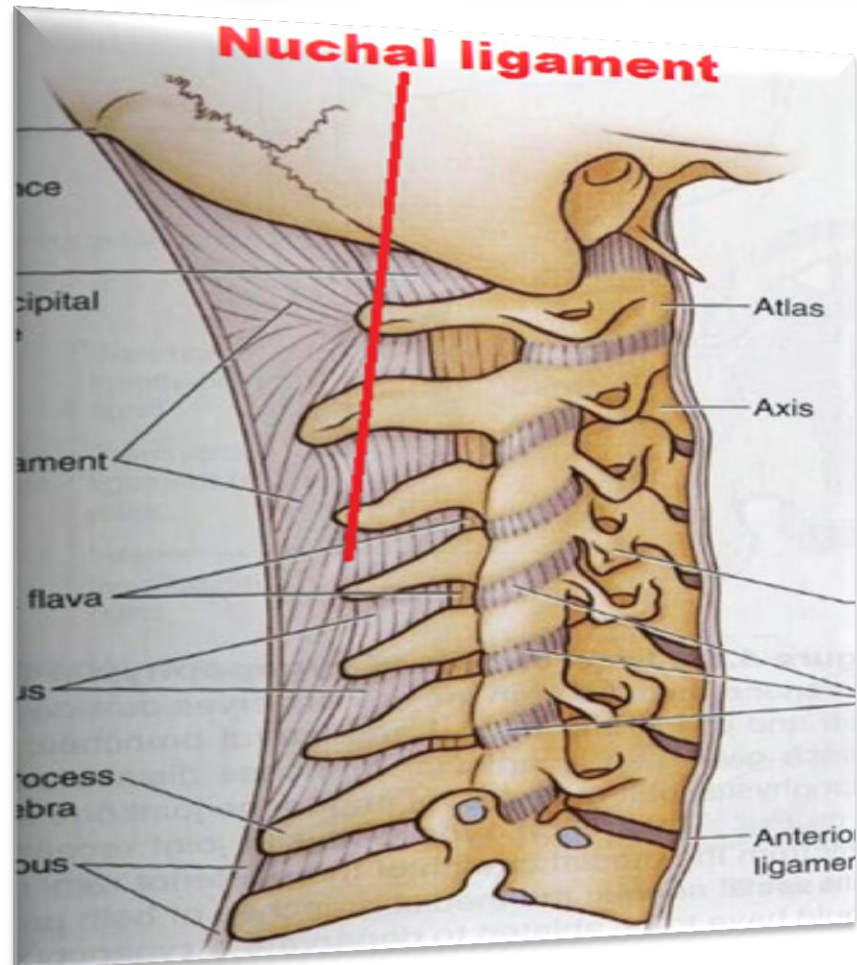
posterior tubercle of vertebra C1 & spinous processes of other cervical vertebrae.



Ligamentum nuchae



- supports the head.
- resists flexion .
- facilitates returning the head to the anatomical position.
- provide attachment for adjacent muscles broad lateral surfaces & posterior edge



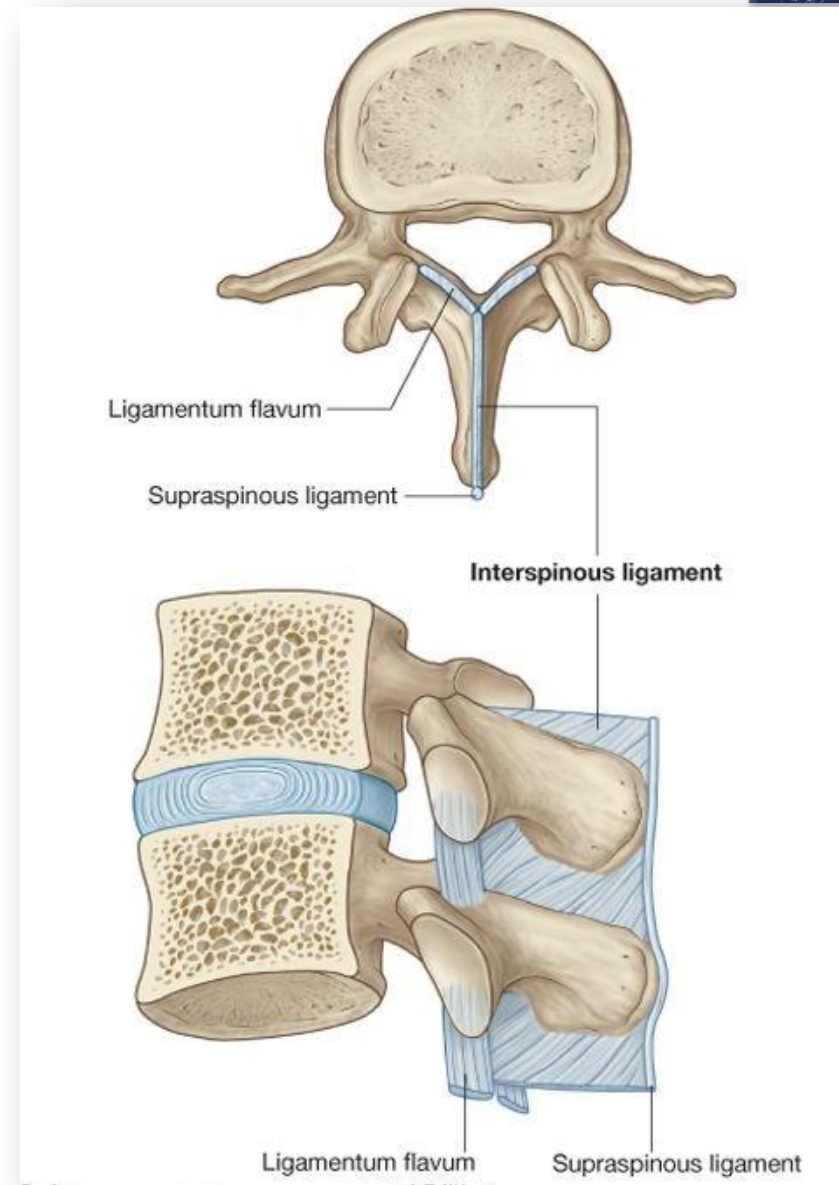
Interspinous ligaments



between adjacent vertebral spinous processes

from base to apex of each spinous process

blend with
supraspinous ligament posteriorly
ligamenta flava anteriorly
on each side



CRANIOVERTEBRAL JOINTS



atlanto-occipital joints

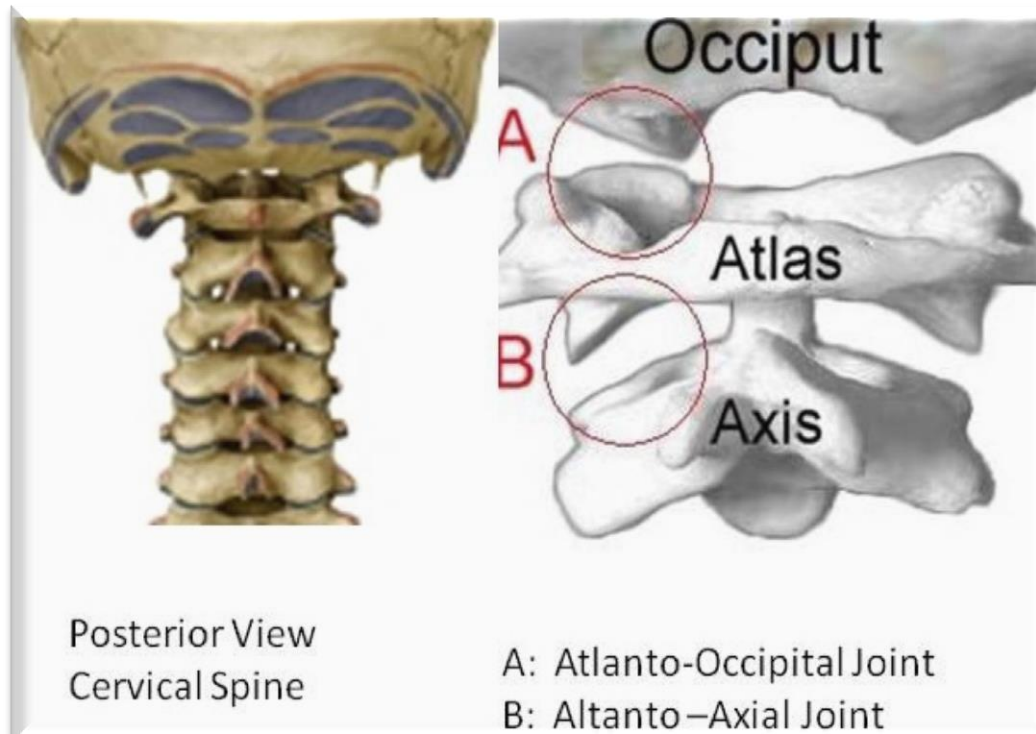
between atlas (C1) & occipital (condyle) bone

atlanto-axial joints

between atlas (C1) & axis (C2)

Synovial joints with no intervertebral discs

a wider range of movement than in the rest of the vertebral column.



ATLANTO-OCCIPITAL JOINTS



Superior articular surfaces of lateral masses

Occipital condyles

nodding of the head, “yes” movement
also sideways tilting of the head.

Main movement flexion, with a little lateral flexion and rotation.



LIGAMENTS OF ATLANTO-OCCIPITAL JOINTS



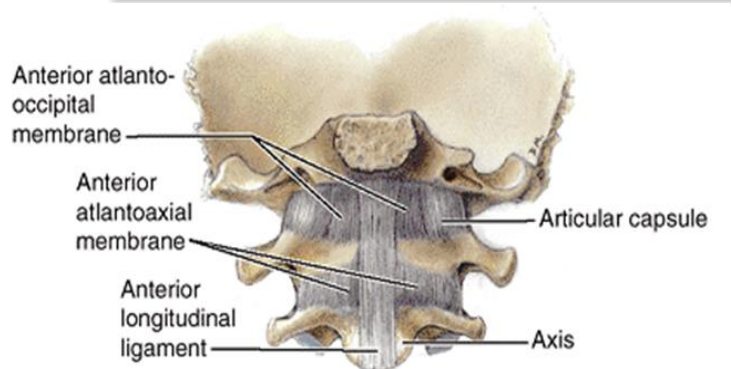
Anterior atlanto-occipital membrane (continuation of anterior long.lig.)

connects anterior arch of the atlas to anterior margin of the foramen magnum

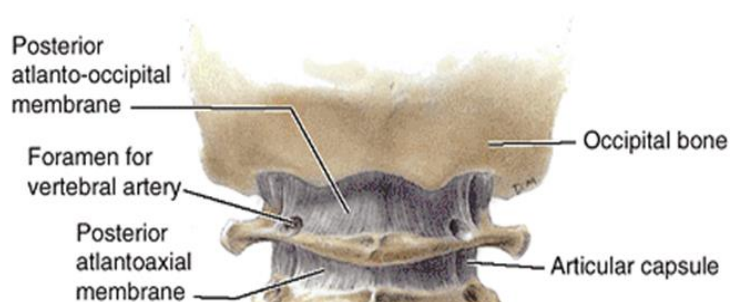
Posterior atlanto-occipital membrane (similar to the ligamentum flavum)

connects the posterior arch of the atlas to the posterior margin of the foramen magnum.

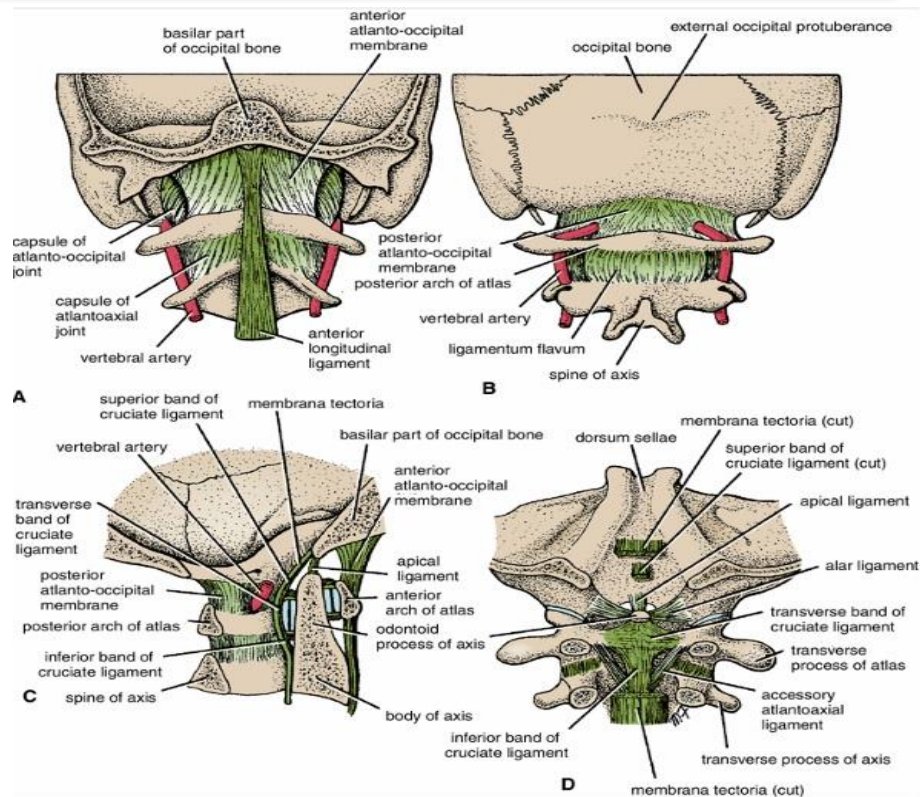
help prevent excessive movement of the atlanto-occipital joints



(A) Anterior view



(B) Posterior view



ATLANTO-AXIAL JOINTS

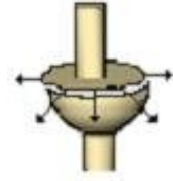


Right & left lateral atlantoaxial joints

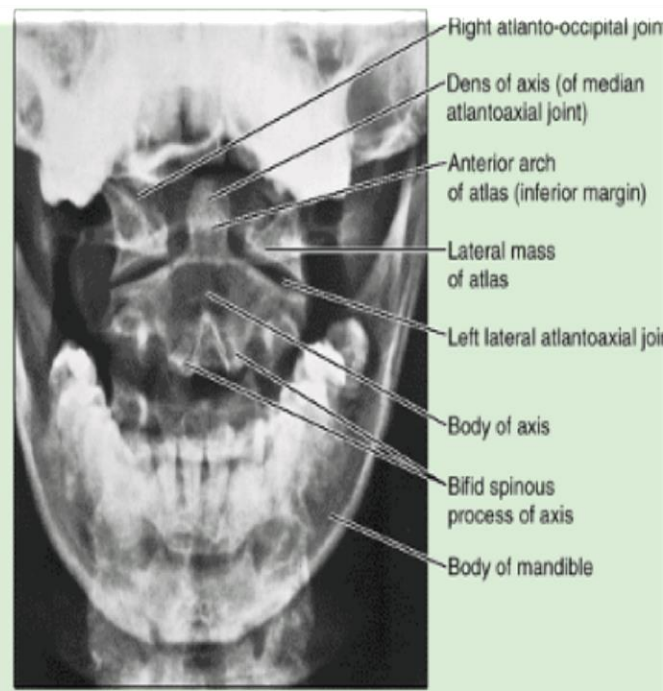
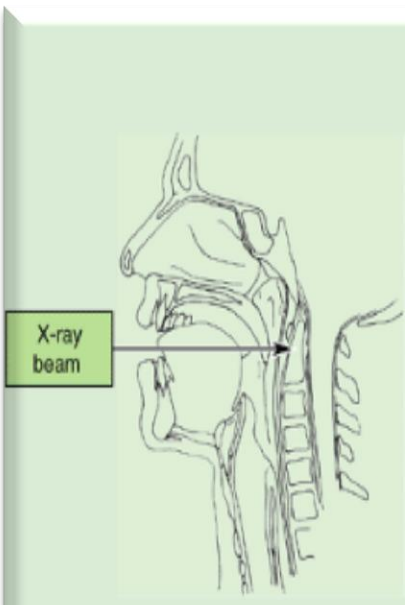
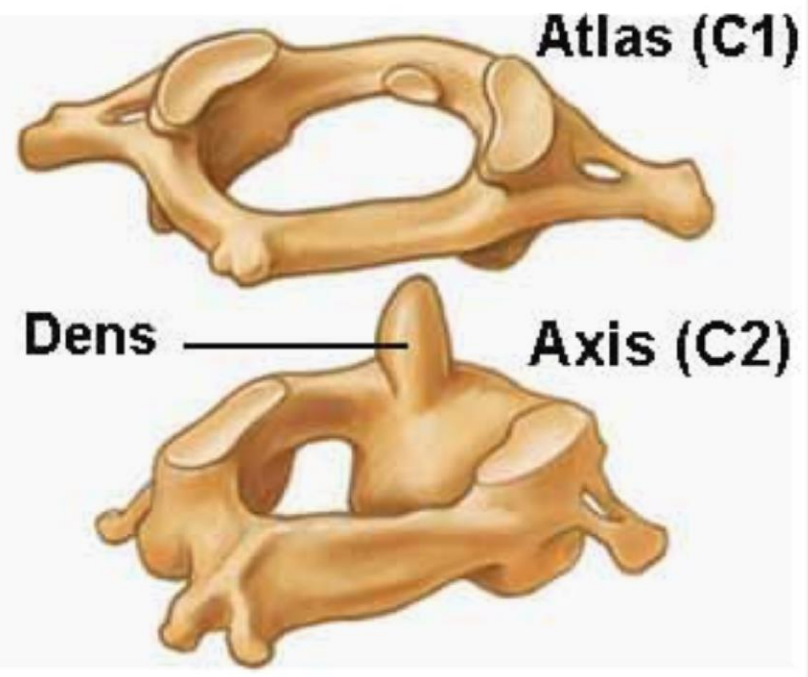
between inf. facets of lateral masses of C1 & superior facets of C2

Median atlantoaxial joint

between dens of axis & anterior arch of atlas



PLANE
IVOT



AP view

MOVEMENTS OF ATLANTO-AXIAL JOINTS



Cranium & atlas rotate on axis as a unit.

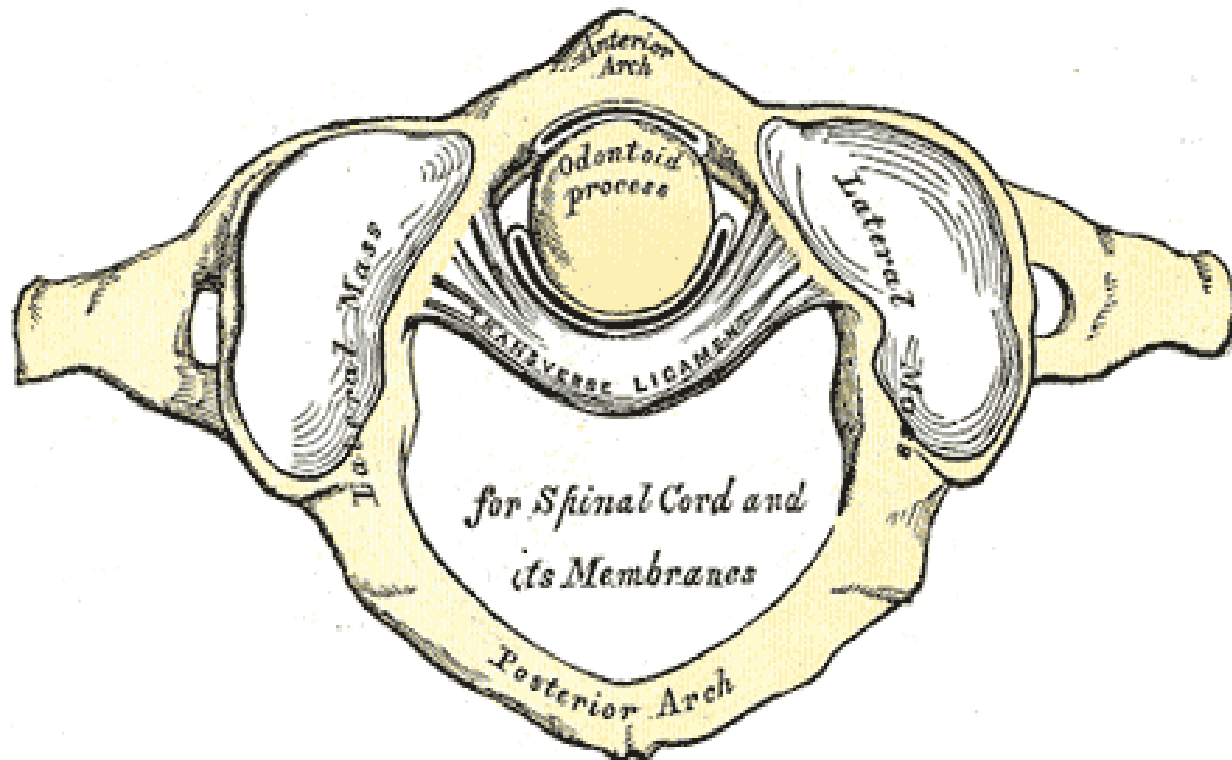
During rotation of the head

Dens/pivot held in a collar

- anteriorly **anterior arch of atlas**
- posteriorly **transverse ligament of atlas**

between tubercles on medial sides of lateral masses of atlas

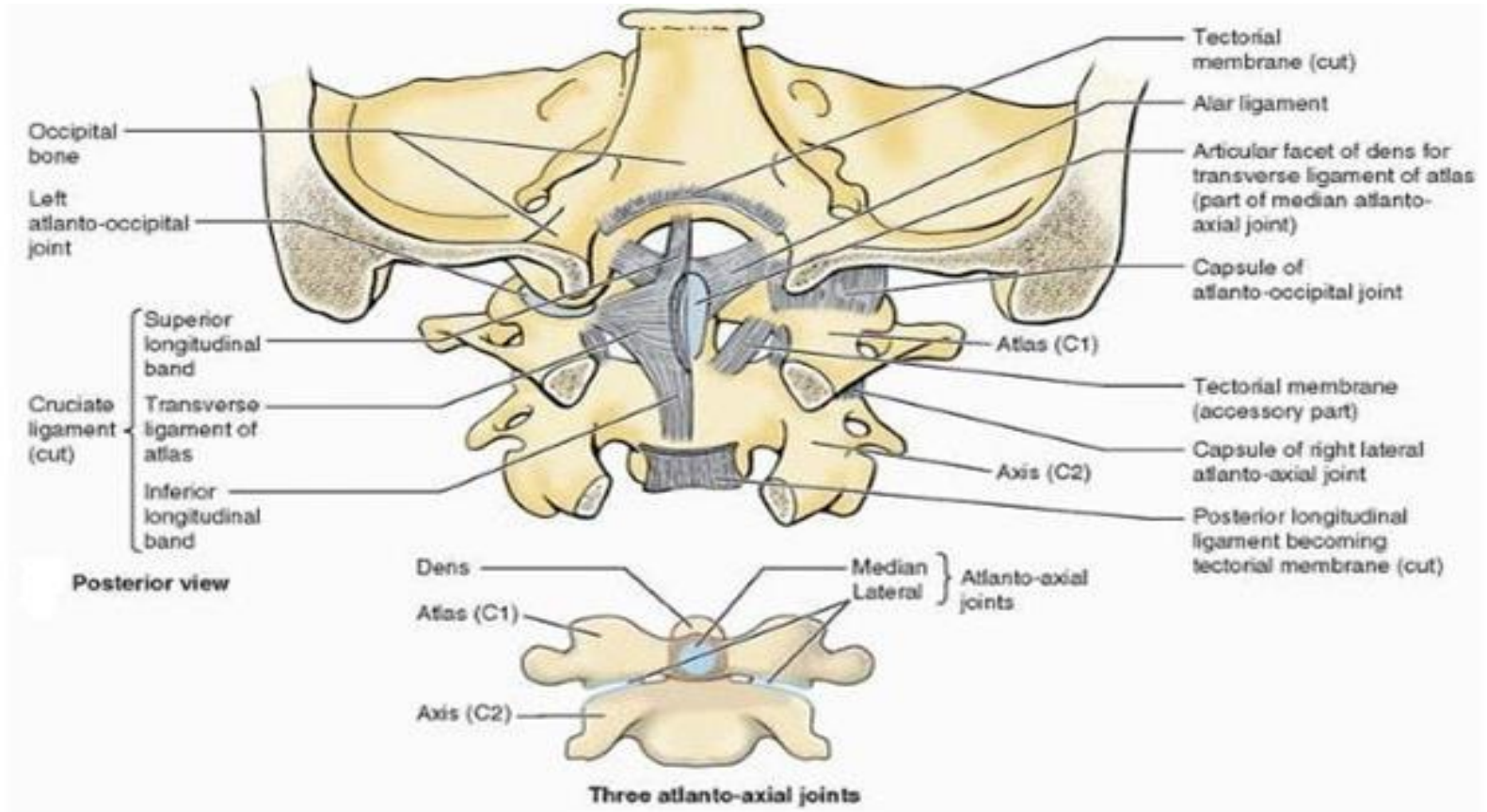
**HEAD TURNS
FROM
SIDE TO SIDE,
DISAPPROVAL
("NO" MOVEMENT).**



LIGAMENTS OF ATLANTO-AXIAL JOINTS



- Superior and inferior longitudinal bands
- Apical ligament
- Alar ligaments
- Cruciate ligament of the atlas
- Tectorial membrane (*Membrana tectoria*)



COSTOVERTEBRAL JOINTS



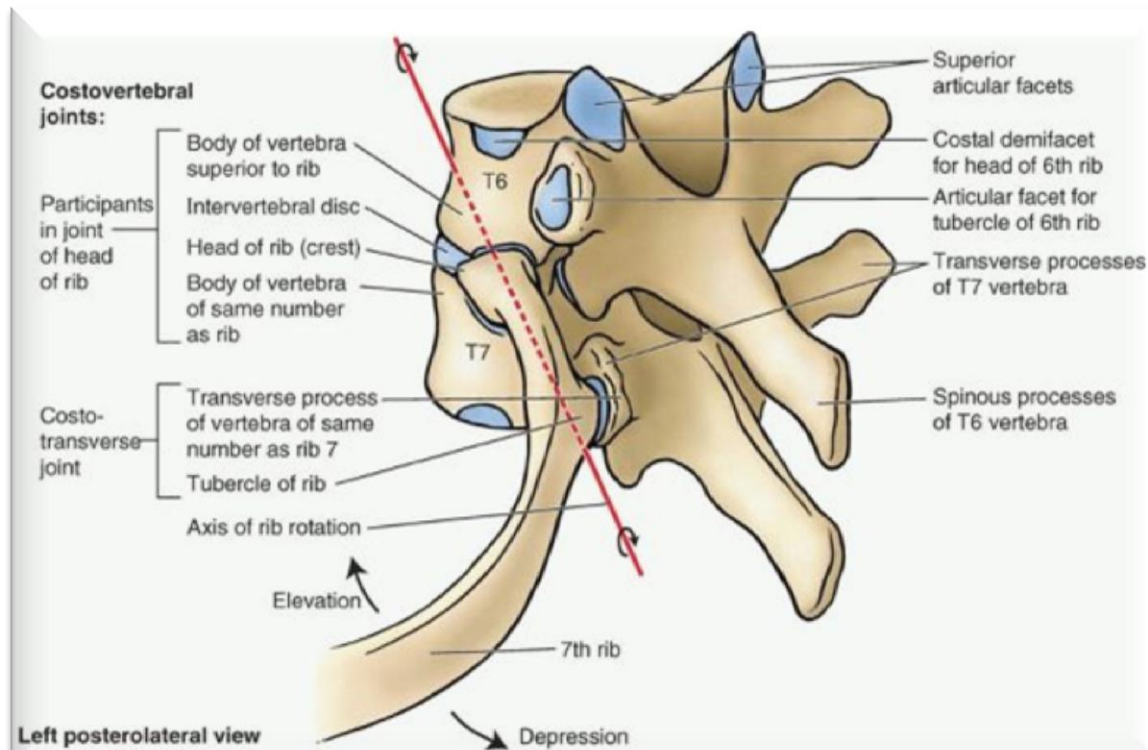
A typical rib articulates with:

- **bodies** of adjacent vertebrae joint with the head of the rib
- **transverse process** of its related vertebra costotransverse joint

▲ Necks rotate around their longitudinal axis **mainly in upper ribs**

▲ Ribs ascend descend relative to the spine **mainly in lower ribs**

essential for altering the volume of the thoracic cavity during breathing



Joint with head of rib



Head of the rib

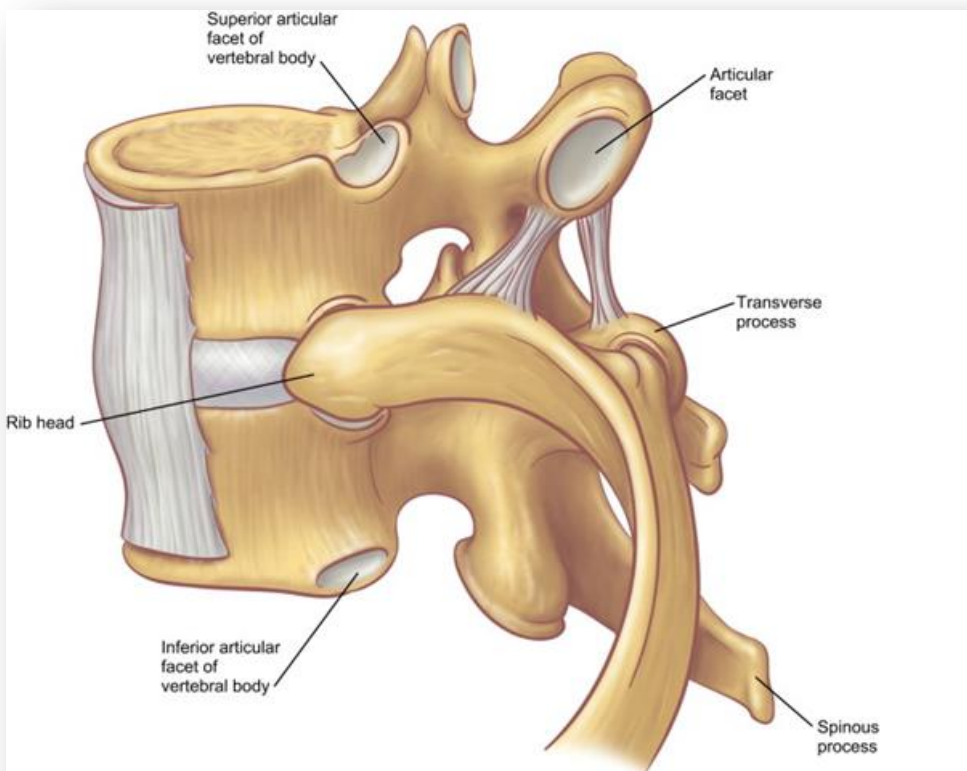
Two facets face of articulation

1- with superior facet of its own vertebra

2- with inferior facet of the vertebra above

divided into two synovial compartments

by an **intra-articular ligament**



Costovertebral joints



costovertebral ligament medial to the joint

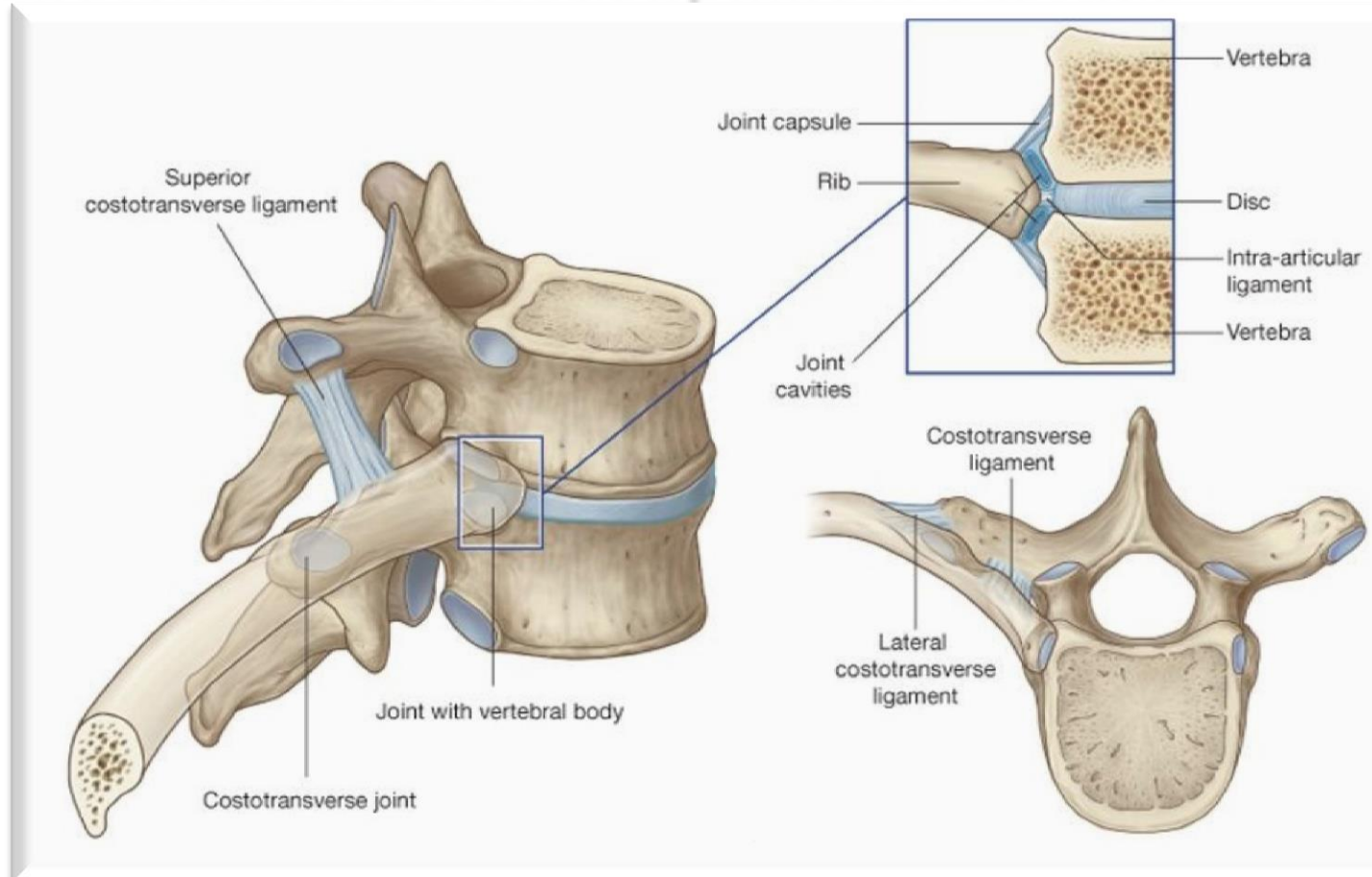
lateral costovertebral ligament lateral to the joint

attaches the tip of the transverse process to nonarticular part of the tubercle of the rib.

superior costovertebral ligament

attaches the superior surface of the neck of the rib to the transverse process of the vertebra above.

SLIGHT
GLIDING
MOVEMENTS



MOVEMENTS OF THE VERTEBRAL COLUMN

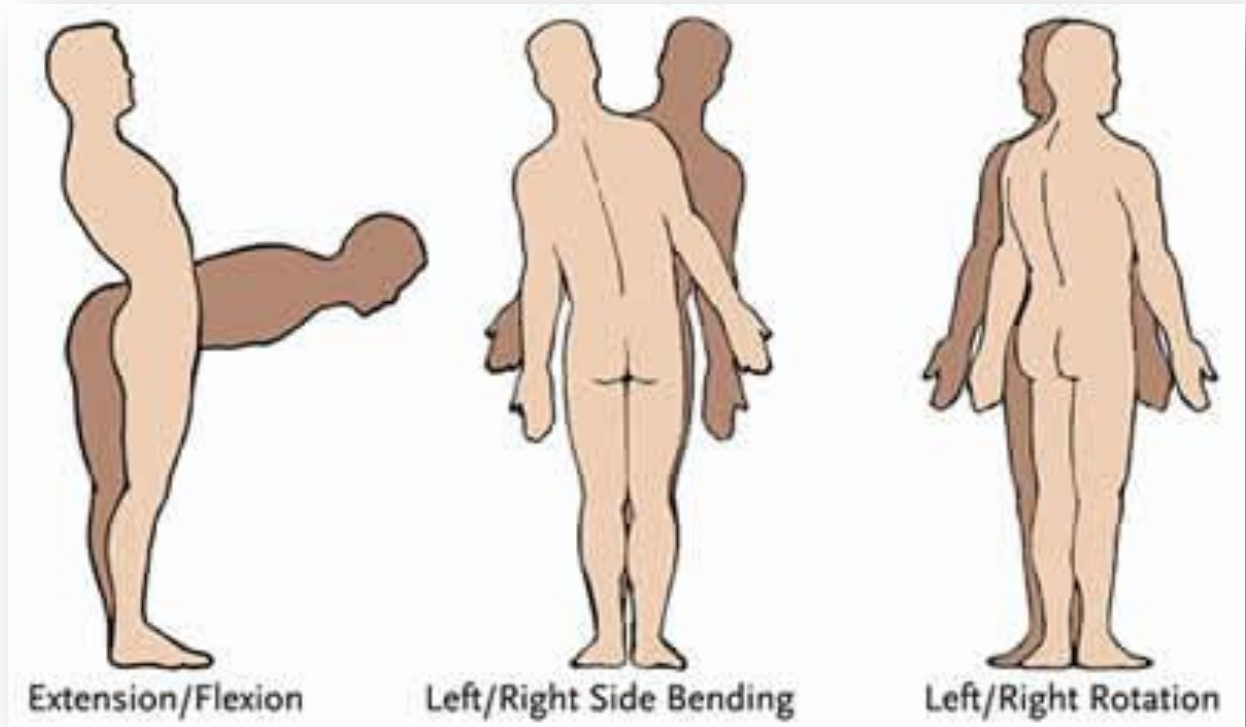


Range of movement according to the region and the individual
Mobility primarily from compressibility & elasticity of the intervertebral discs

Normal range of movement reduced by 50% or more as a result of aging

Movements by the vertebral column

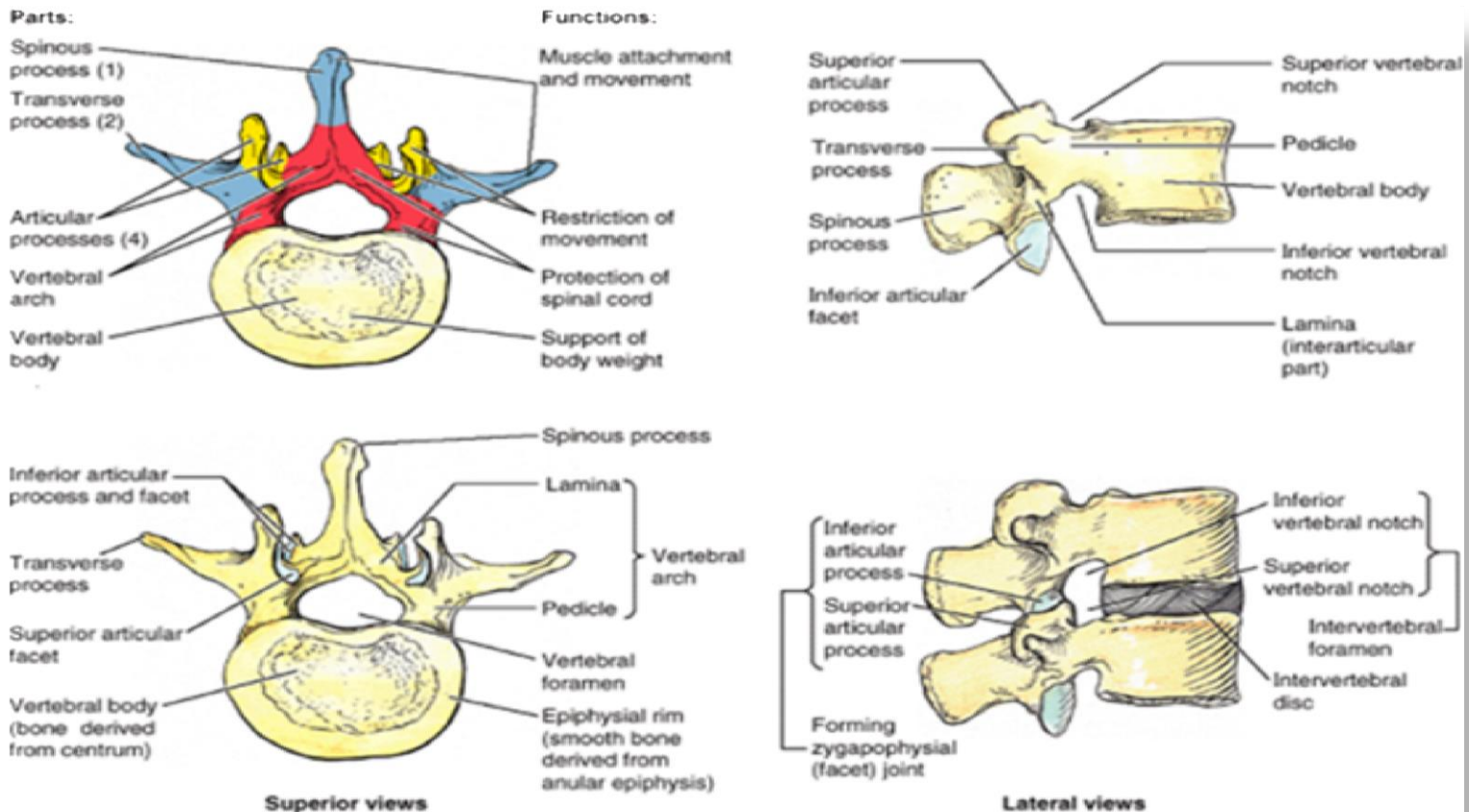
- *Flexion*
- *Extension*
- *Lateral flexion*
- *Rotation*
- *Circumduction*



MOVEMENTS OF THE VERTEBRAL COLUMN



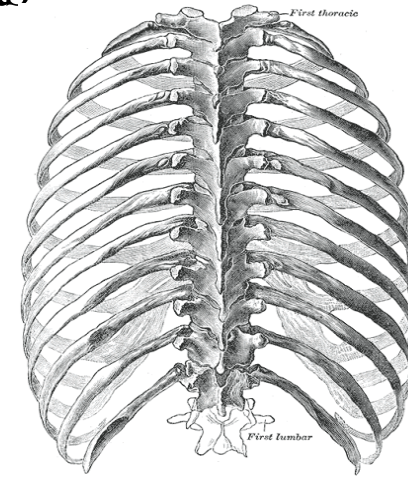
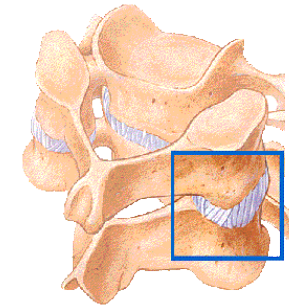
Movements in a specific region (cervical, thoracic, and lumbar) determined by **shape & orientation of joint surfaces on the articular processes & on the vertebral bodies**



MOVEMENTS OF THE VERTEBRAL COLUMN

Range of movement limited by

- 1) Thickness, elasticity, and compressibility of the IV discs
- 2) Shape & orientation of the zygapophysial joints
- 3) Tension of the joint capsules of the zygapophysial joints
- 4) Resistance of the back muscles and ligaments
- 5) Attachment to the thoracic (rib) cage
- 6) Bulk of surrounding tissue



DISC HERNIA & BACK PAIN

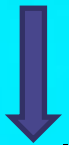
A tear within the annulus fibrosus



Material of the nucleus pulposus can track

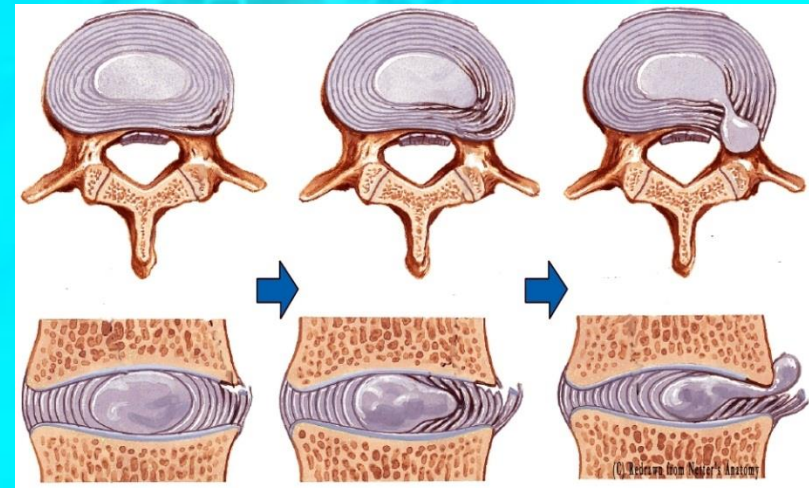
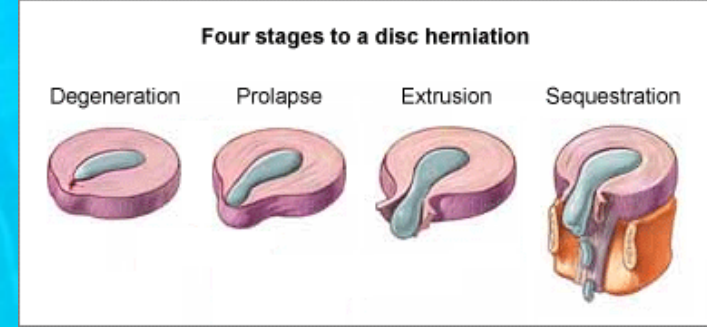
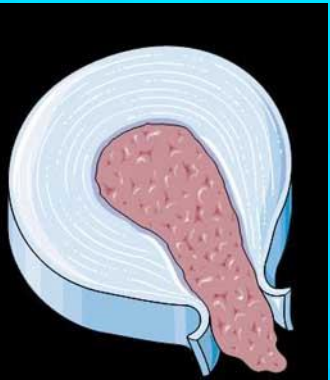


This material tracks into the vertebral canal or into the intervertebral foramen

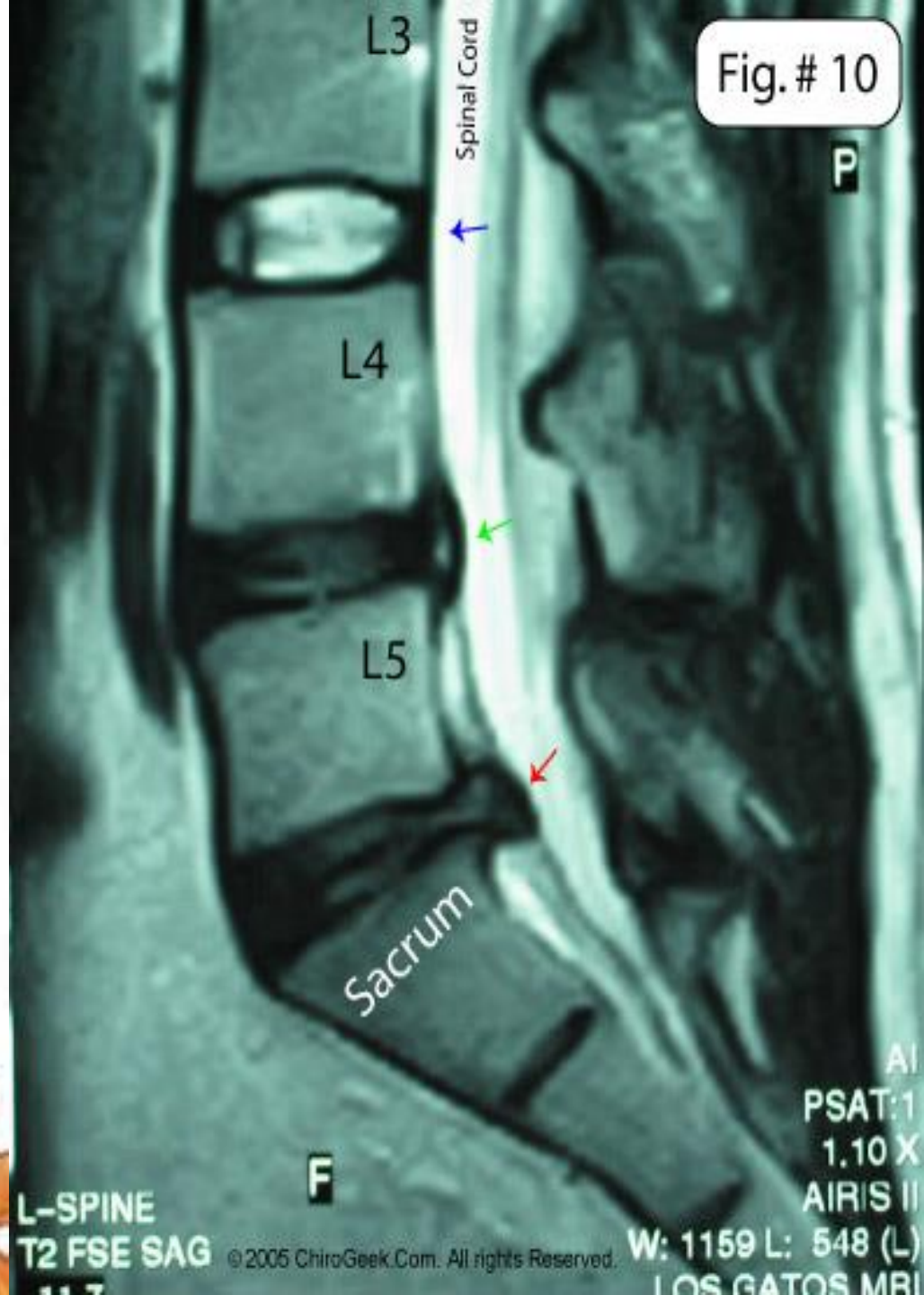
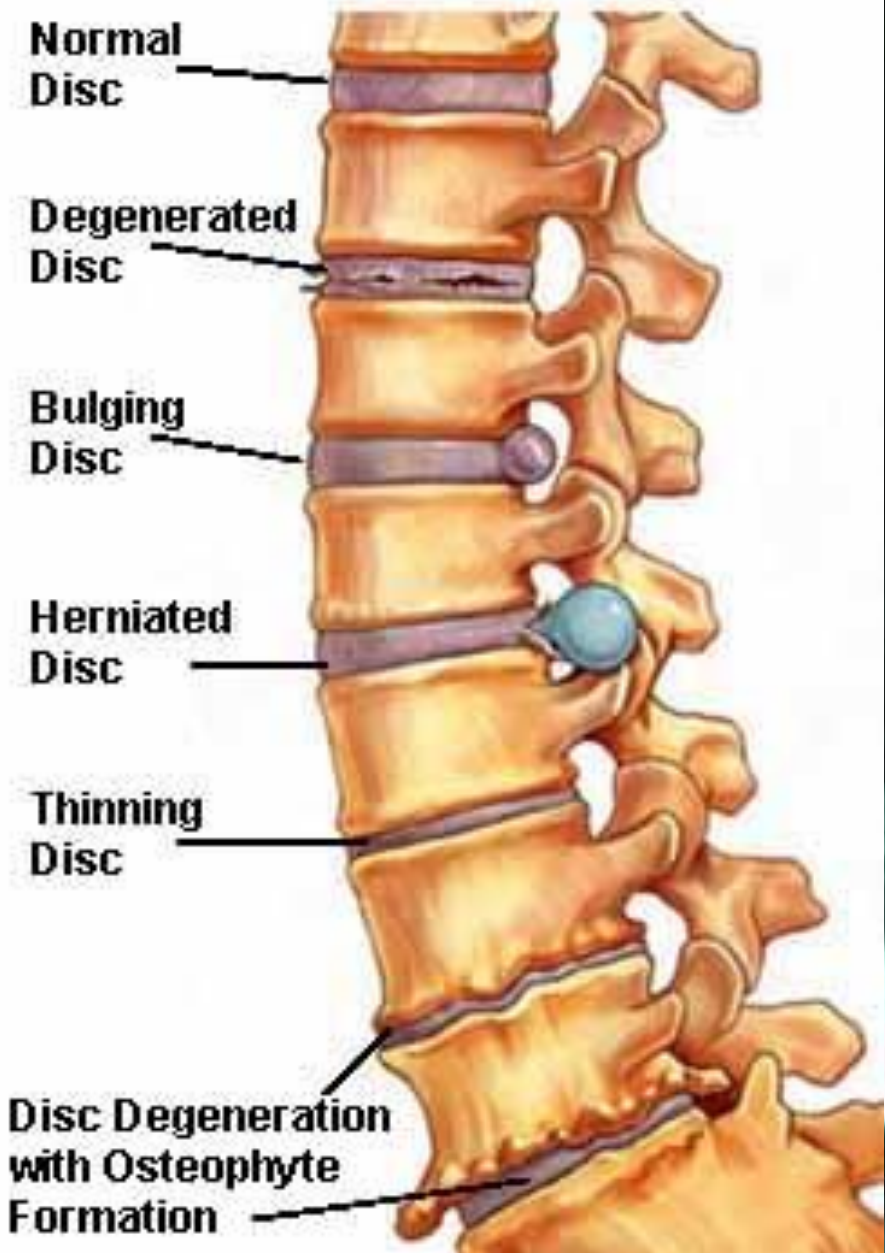


Pressure on neural structures

common cause of back pain



Examples of Disc Problems



DISC HERNIA & BACK PAIN

[The use of diagnostic imaging in sports medicine Med J Aust 2005; 183: 482-486.](#)

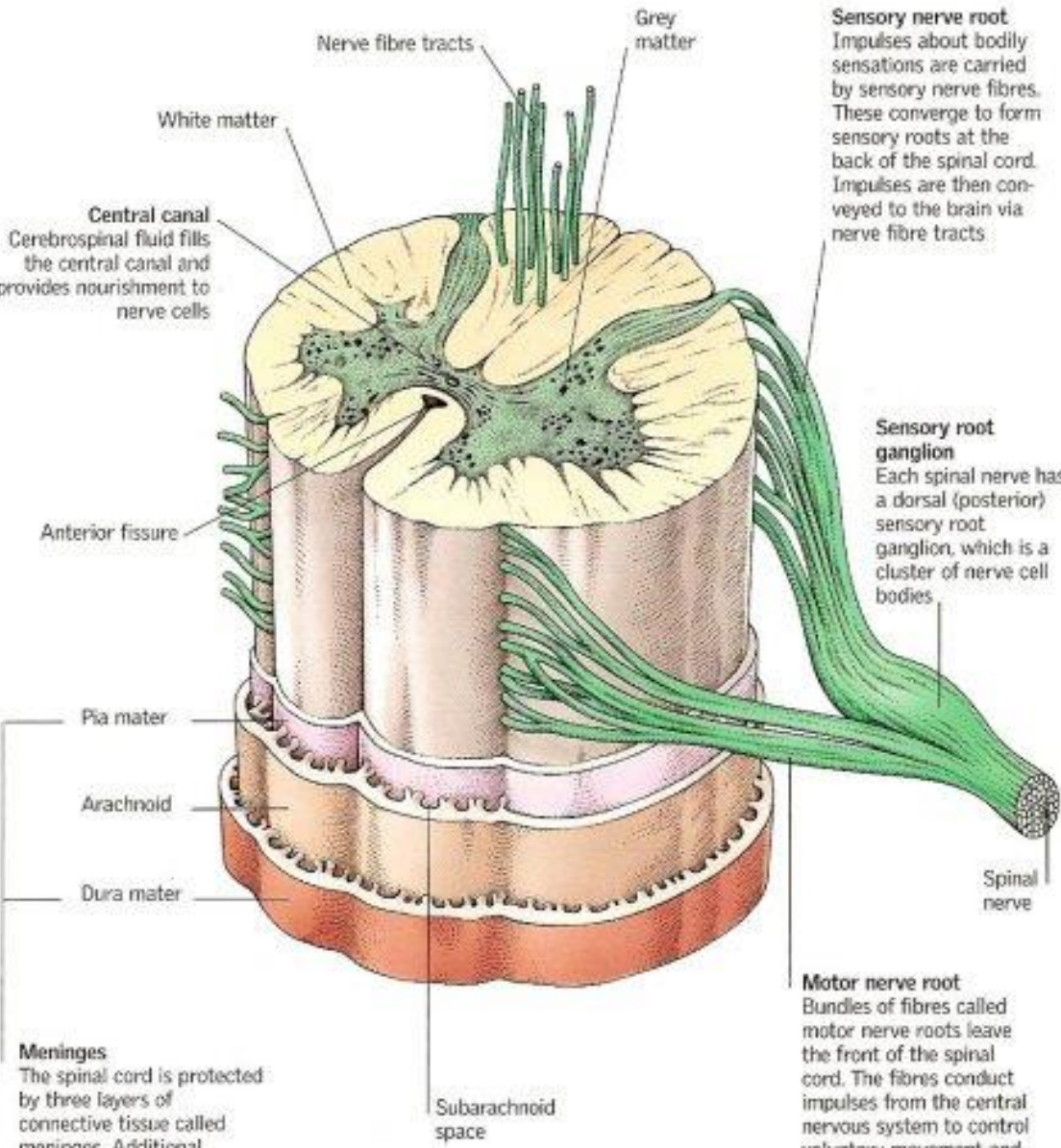
[Clinical Evaluation and Treatment Options for Herniated Lumbar Disc. Am Fam Physician. 1999;59:575-582.](#)

[Degeneration and regeneration of the intervertebral disc: lessons from development. Dis Model Mech. 2011;4:31-41.](#)

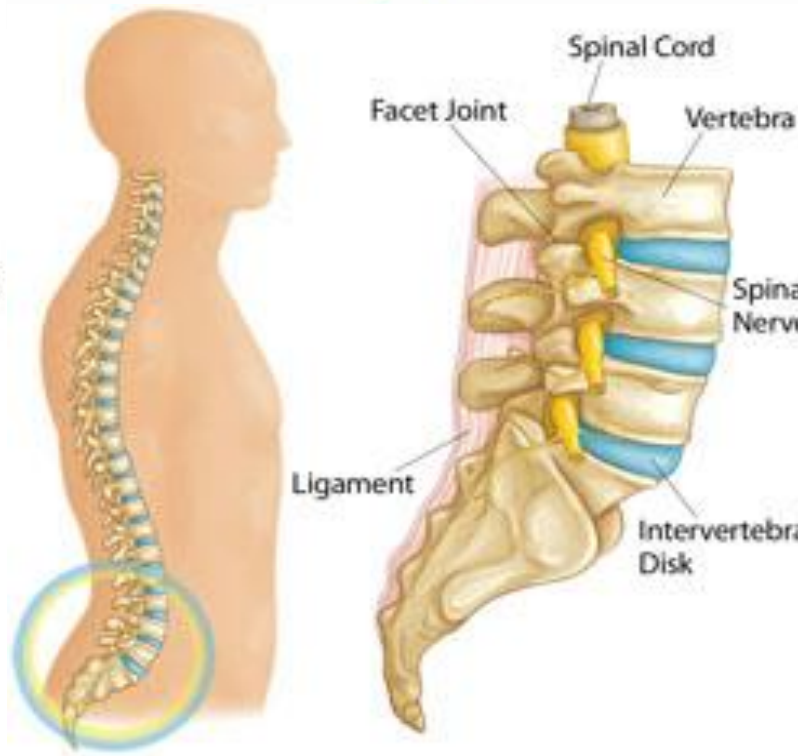
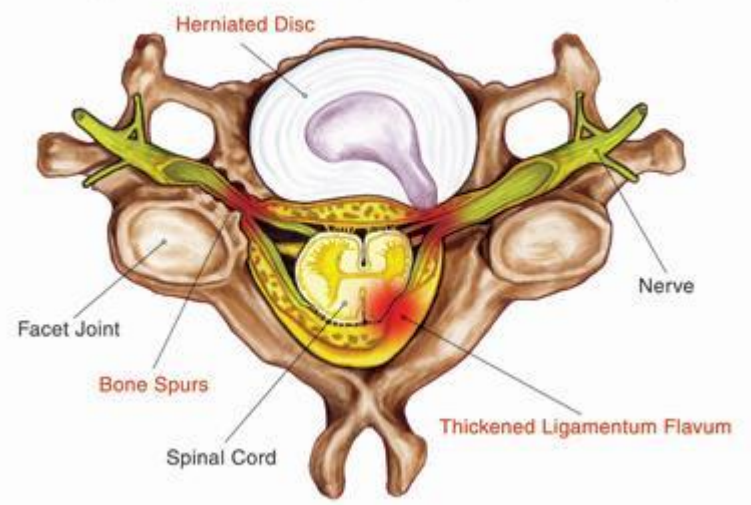
[Quantitative MRI as a diagnostic tool of intervertebral disc matrix composition and integrity. Eur Spine J. 2008;17 Suppl 4:432-440.](#)

[Anatomy and pathophysiology of intervertebral disc disease. Techniques in Regional Anesthesia and Pain Management. Volume 13, 2009, Pages 67-75.](#)

DISCECTOMY/LAMINECTOMY



Example of Spinal Nerve Compression (viewed from above)



DISCECTOMY/LAMINECTOMY

- **Level of the disc protrusion identified before surgery.**
- MRI scanning and on-table fluoroscopy to prevent operating on the wrong level.
- In some instances removal of the lamina will increase the potential space and may relieve symptoms.

