Anatomy of the Back

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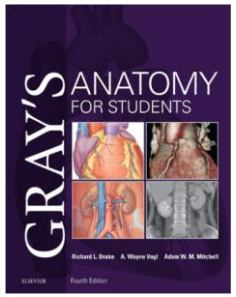
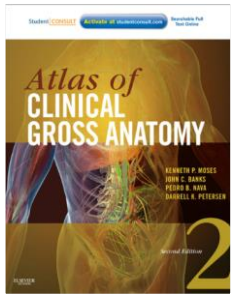
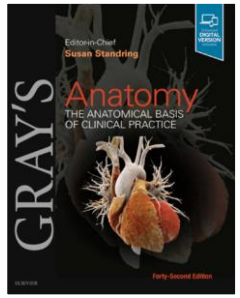
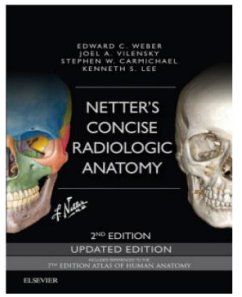








LÉKAŘSKÁ FAKULTA V PLZNI
Univerzita Karlova

Univerzita Karlova

Introduction, ie. What is this good for?!

Dear students, colleagues,

This presentation summarizes the content of the lecture. It also contains a list of required knowledge and allows its practice with regard to clinical use.

The following pictograms will accompany you:

 to recall or remember

 clinical notes

 to be completed

Introduction, ie. What is this good for?!

Anatomy test

Upper and lower limbs, joints and muscles Moodle anatomy

Testing method: teaching tablets

Questions: bones, joints and muscles only; blood vessels and nerves (except muscle innervation part of the test

Date: 30.10.- 3.11.2023 - during your practical class

5 single choice questions + 2 pictures

Time limit: 15 minutes

Make-up test: the following week at the time of your practical class, according to the teacher's

https://moodle.lfp.cuni.cz/course/index.php?categoryid=81

Anatomy spot tests

9	25	e-lecture	Chest 3 - Vessels and nerves of the chest As. MUDr. Omid Moztarzadeh, Ph.D.	Test - Spine, skull, head and neck Chest - Chest wall, pleural cavity, trachea, bronchi, lungs	Test - Spine, skull, head and neck Chest - Chest wall, pleural cavity, trachea, bronchi, lungs
	26	28. 11.	Chest 4 - Heart - General description, cavities, endocardium, myocardium, pericardium As. MUDr. Omid Moztarzadeh, Ph.D.		
	27	30. 11.	Chest 5 - Heart - Valves, coronary arteries, cardiac veins, cardiac conductive system, cardiac nerves, lymphatic drainage As. MUDr. Omid Moztarzadeh, Ph.D.		

https://moodle.lfp.cuni.cz/course/view.php?id=652

1. General osteology – general composition of the bone, parts of the bone, types of bones
2. General osteology - ossification
3. General arthrology – types of bone junctions
4. General arthrology – types of joints
5. General myology
6. Chest skeleton
7. Adult skull - neurocranium
8. Adult skull - splanchnocranium
9. Neonatal and child's skull
10. Back - vertebral column, bones, and their junctions
11. Back muscles
12. Skeleton of upper extremity – shoulder girdle and arm
13. Skeleton of upper extremity – forearm, wrist, hand
14. Joints of upper extremity – shoulder joint, elbow joint

Questions for the oral final exam

file:///C:/Users/eberlova/Desktop/ANATOMIE%20SYLLABUS%20ZS%202023_2024_AJ.pdf

Study objectives ei. what you need to know concerning the BONES of the backbone – practicals

Concerning the bones and joints of the vertebral comuln, you are expected to:

- Learn the **general structure** of a **vertebra**, the ribs and the sacrum.
- **Distinguish the vertebrae**: C1, C2, and the other cervical from the thoracic and lumbar ones with the use of knowledge of the basic morphological features.
- Describe the **sacrum**, its position in the pelvic girdle should be also understood. Concerning the **ribs**, their types, arrangement, parts, and general morphology are required connection between a rib and the 2 thoracic vertebrae should be understood and demonstrated.
- Be able to palpate the following structures: vertebra prominence (spinous process of C7), T1, nuchal ligament.
- Joints:

Study objectives ei. what you need to know concerning the BACK and the BACKBONE

Concerning the bones and joints, and muscles of the back, you are expected to:

- General anatomy, distinctive features of the vertebrae
- Joints in general; atlantooccipital and atlantoaxial joints; costovertebral joints
- Normal curvatures of the spine
- Movements in particular divisions
- Muscles: intrinsic (deep) in summary, extrinsic (superficial) in detail; thoracolumbar fascia

Concerning the general arthrology, ie. how much you remeber?

- Define the „facet“
- Define the „synostosis“
- Describe the general anatomy of the synovial joint

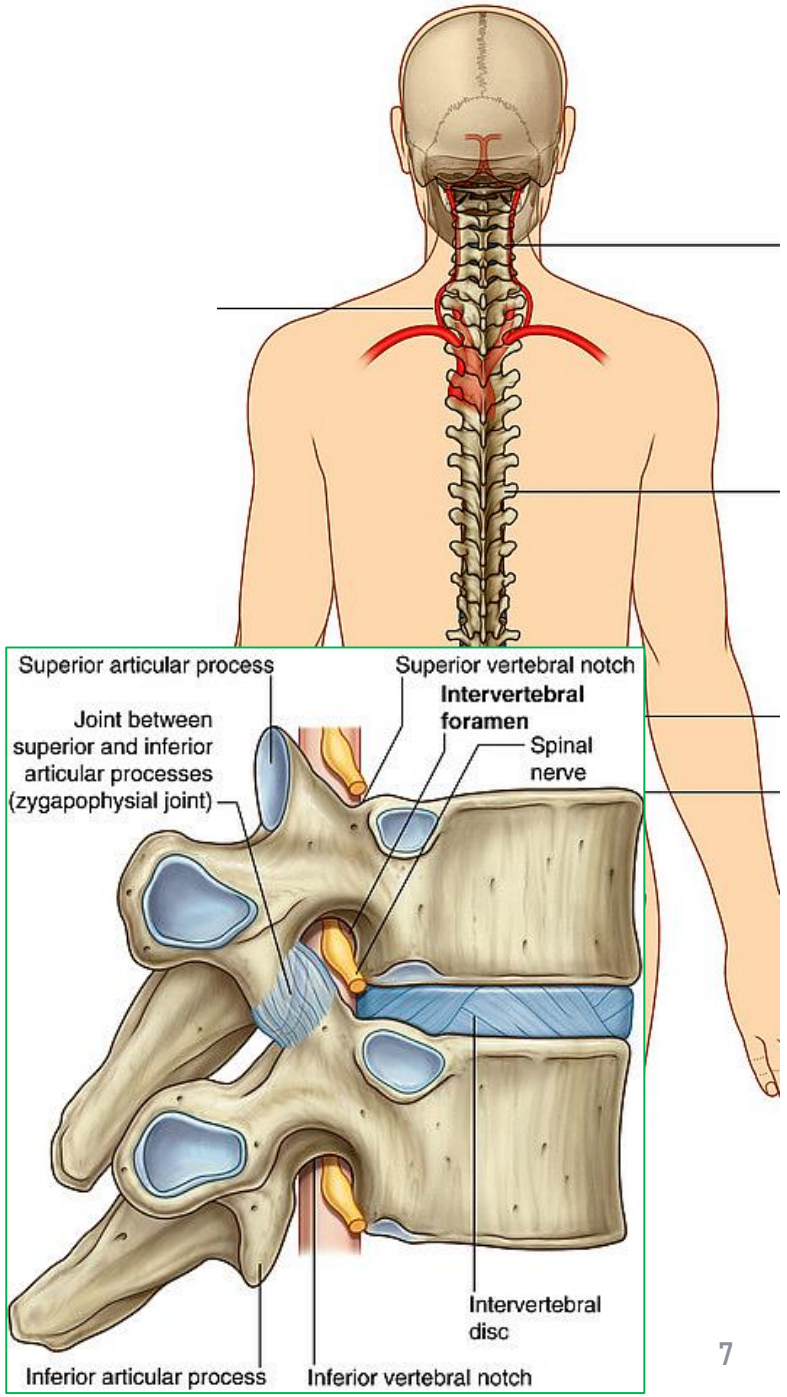
One more time?!

Vertebral column (backbone)

The vertebral column must maintain a **balance** between stability and mobility.

Main functions:

- support
- movements
- protection of the spinal cord

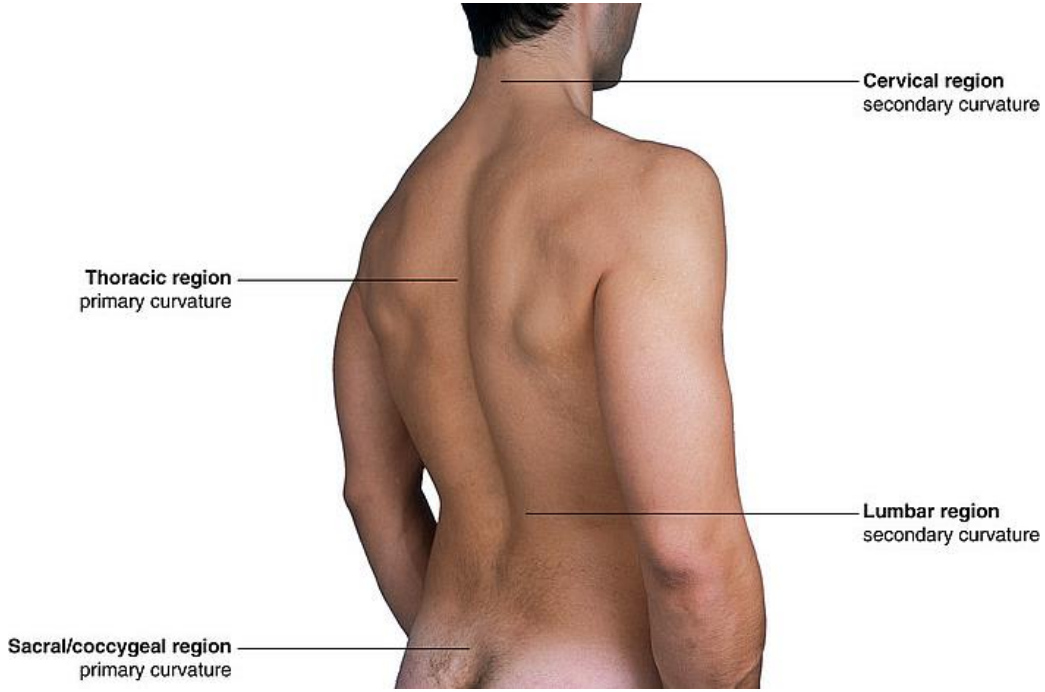


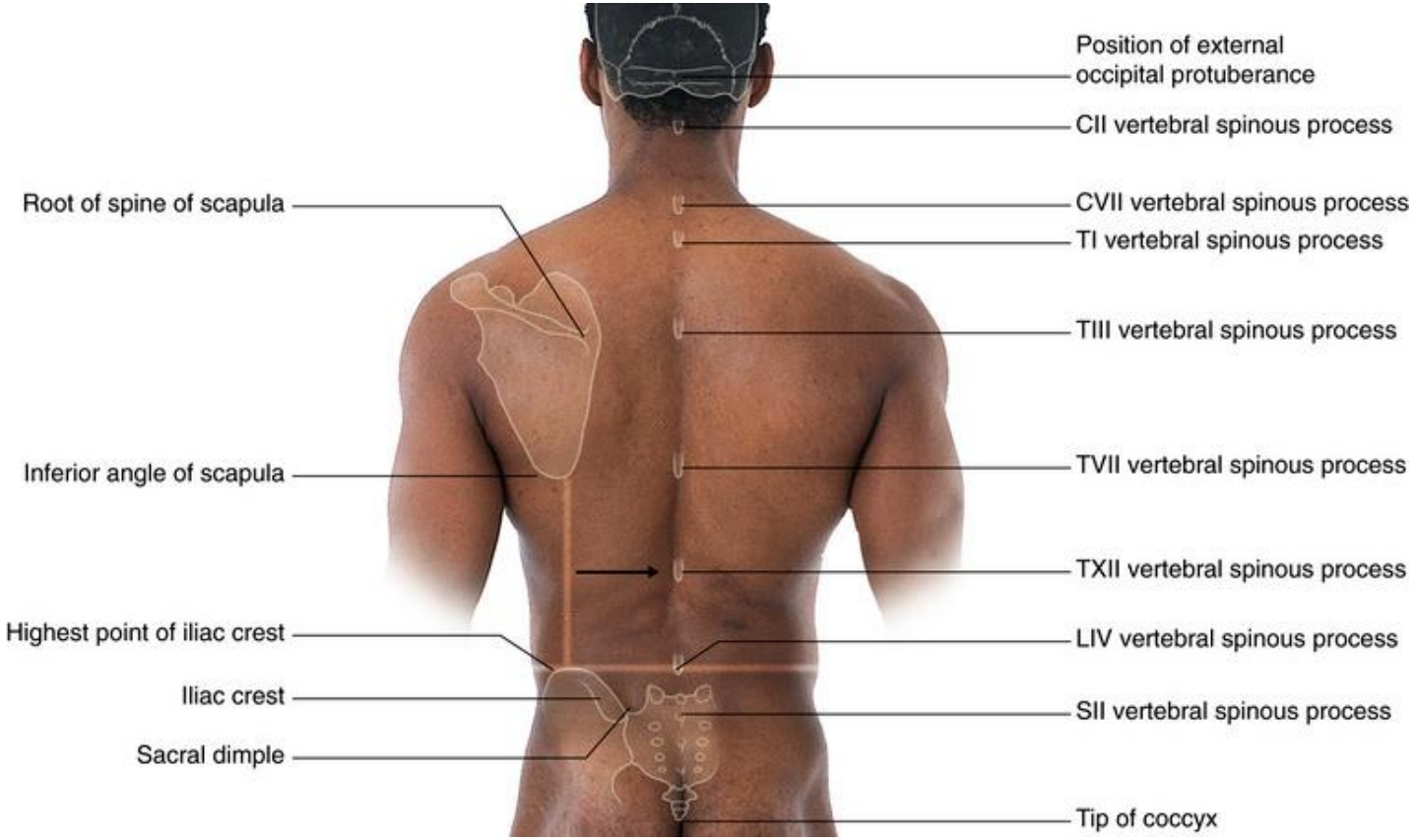
The vertebral column is composed of **33 vertebrae** divided into five regions: **cervical, thoracic, lumbar, sacral, and coccygeal**.
Each bony segment exhibits unique characteristics that determines its gross appearance but also its range of movement.

Joints: **stabilizers** (bodies: symphysial joints) and **mobilizers** (laterally: facet joints, costovertebral, and costotransverse joints; atlantoaxial and occipital joints).

Movements: flexion, extension, lateral flexion, and rotation.

the BACK, *dorsum*





LAYERS:

- skin
- **fascia**
- **muscles**
- **vertebral column**
- **spinal cord**
- supporting neurovasculature

The back is the posterior part of the trunk extending **from the neck to the pelvis: cervical, thoracic, lumbar, and sacrococcygeal regions**

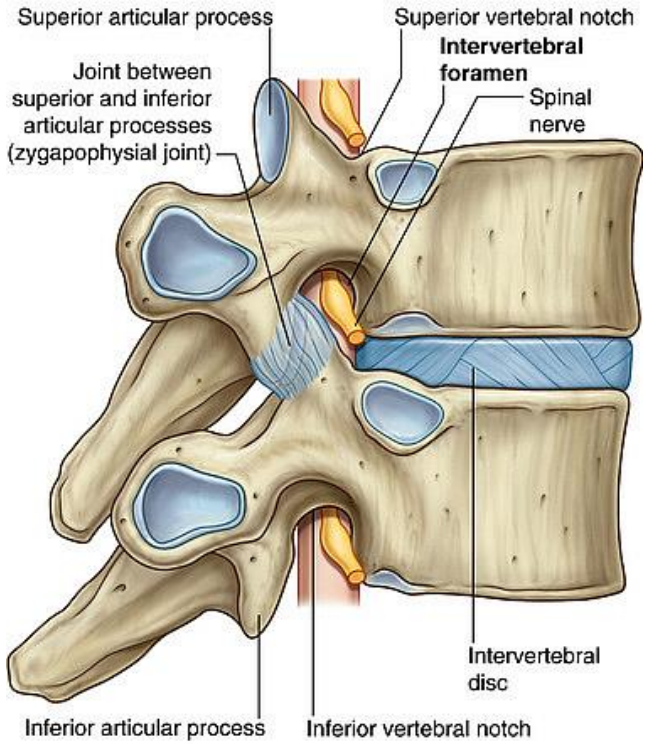
Vertebral column (backbone)

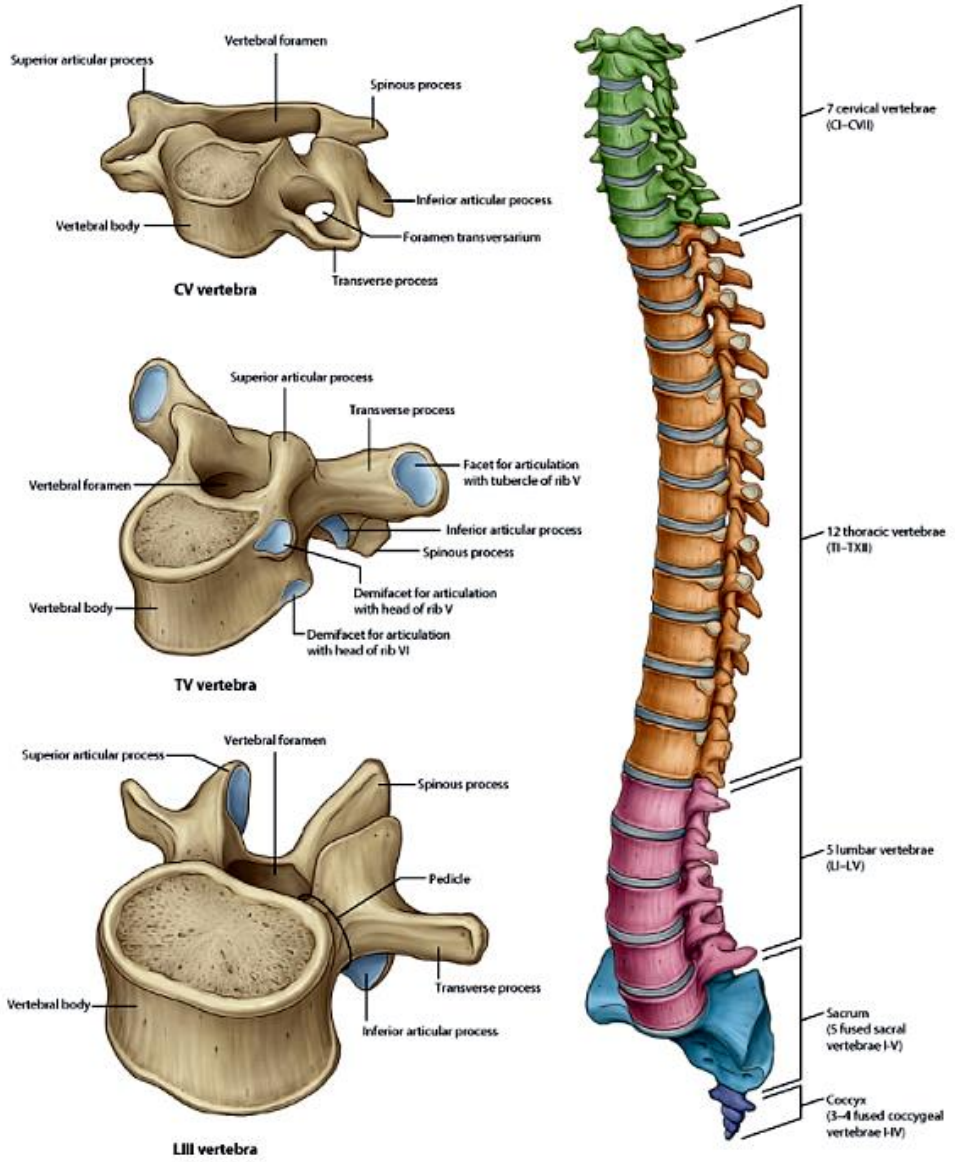
The vertebral column is composed of cca 33 vertebrae divided into 5 segments: cervical, thoracic, lumbar, sacral, and coccygeal.

Vertebrae

irregular bones

- 7 cervical (C1-7)
- 12 thoracic (T1-12)
- 5 lumbar (L1-5)
- 5 sacral (S1-5)
- 3-5 coccygeal (Co)



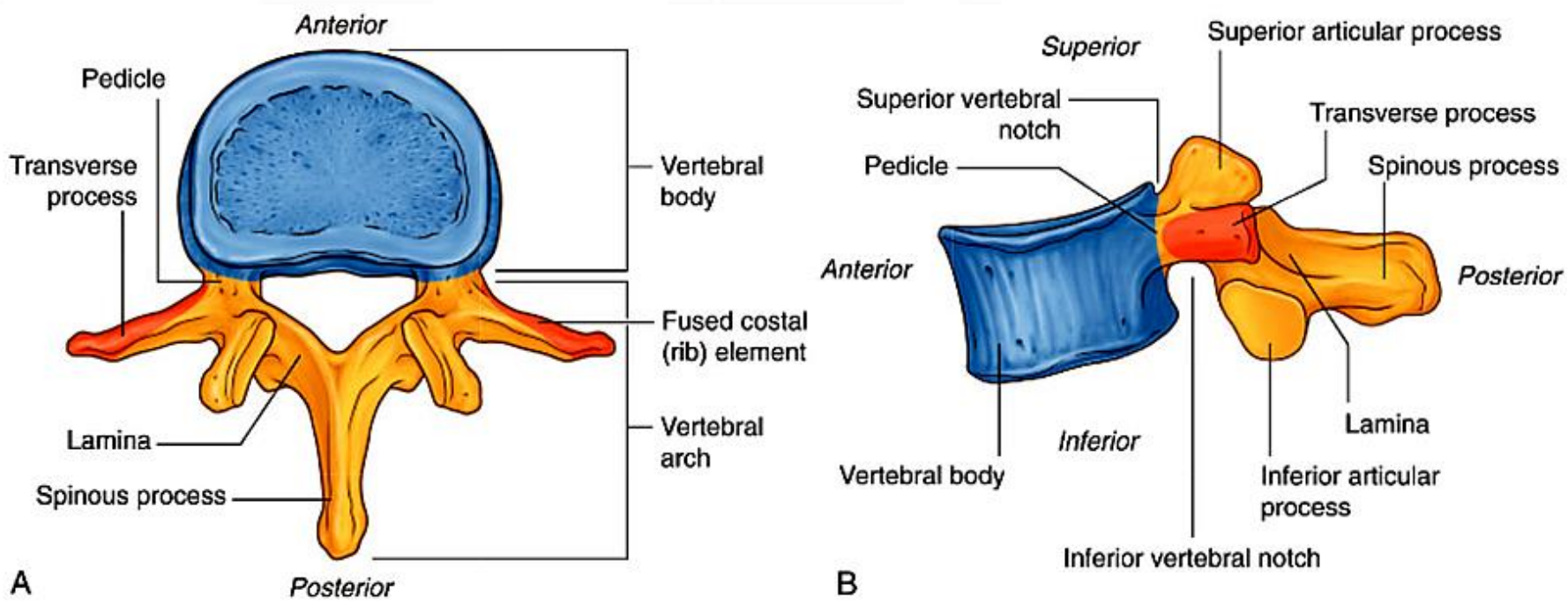


Anatomy of the back; L. Eberlova, 2023

Basic vertebral structure

- body
- arch
- processes: transverse, spinous, articular

- vertebral foramen – vertebral canal
- superior et inferior vertebral notch – intervertebral foramina
- pedicle



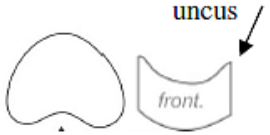
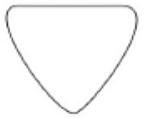
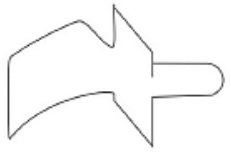
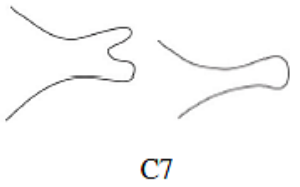
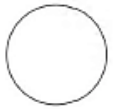
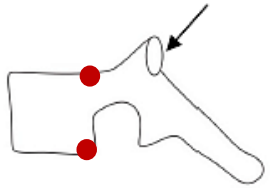
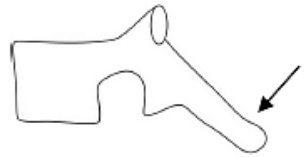
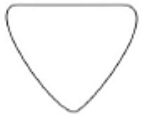
Exceptional vertebrae:
Atlas
Axis
Sacral
Coccys

Fig.: General anatomy of a vertebra

Regional vertebrae

PDF worksheet Table 1 is available here
https://lms.lfp.cuni.cz/pluginfile.php/24665/mod_resource/content/1/vertebrae.pdf

Table 1: Specificities of vertebrae

	body	vertebral foramen	articular processes	transverse processes	spinous process
cervical vertebrae except C1, C2	kidney-shaped 	triangular 	descend dorsocaudally 	foramen of transverse process 	except C1 and bifid 
thoracic vertebrae	longer than wider costal facets 	round 	frontal plane 	costal facets 	hook-like 
lumbar vertebrae	kidney-shaped 	triangular 	sagittal plane	costal process (rudimentary rib)	rectangular 

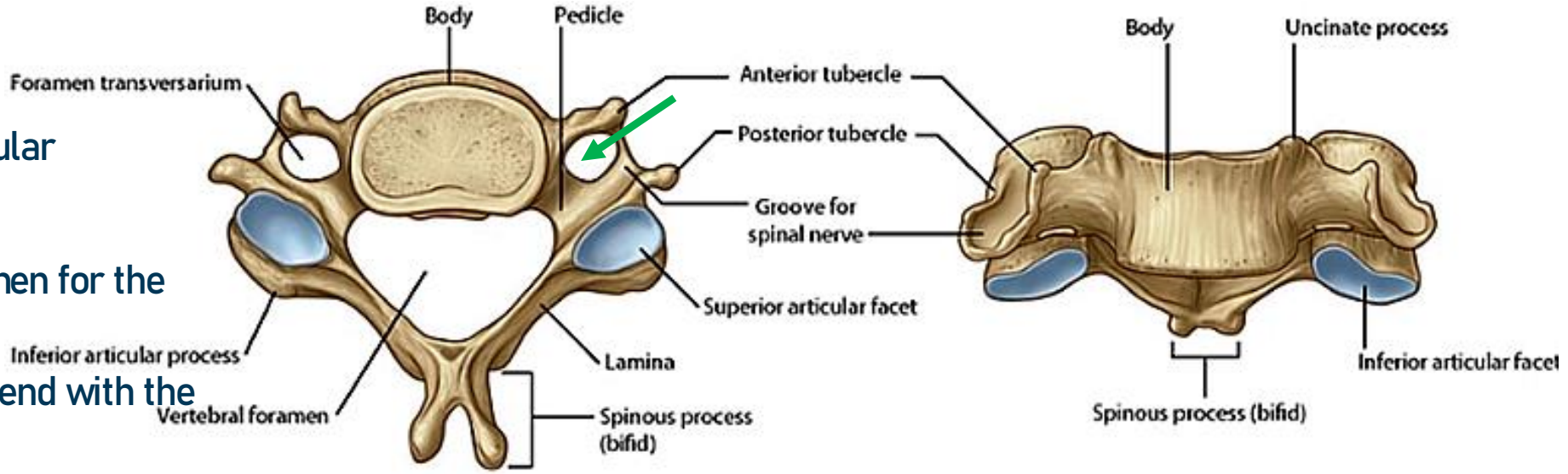
General stucture of vertebra:

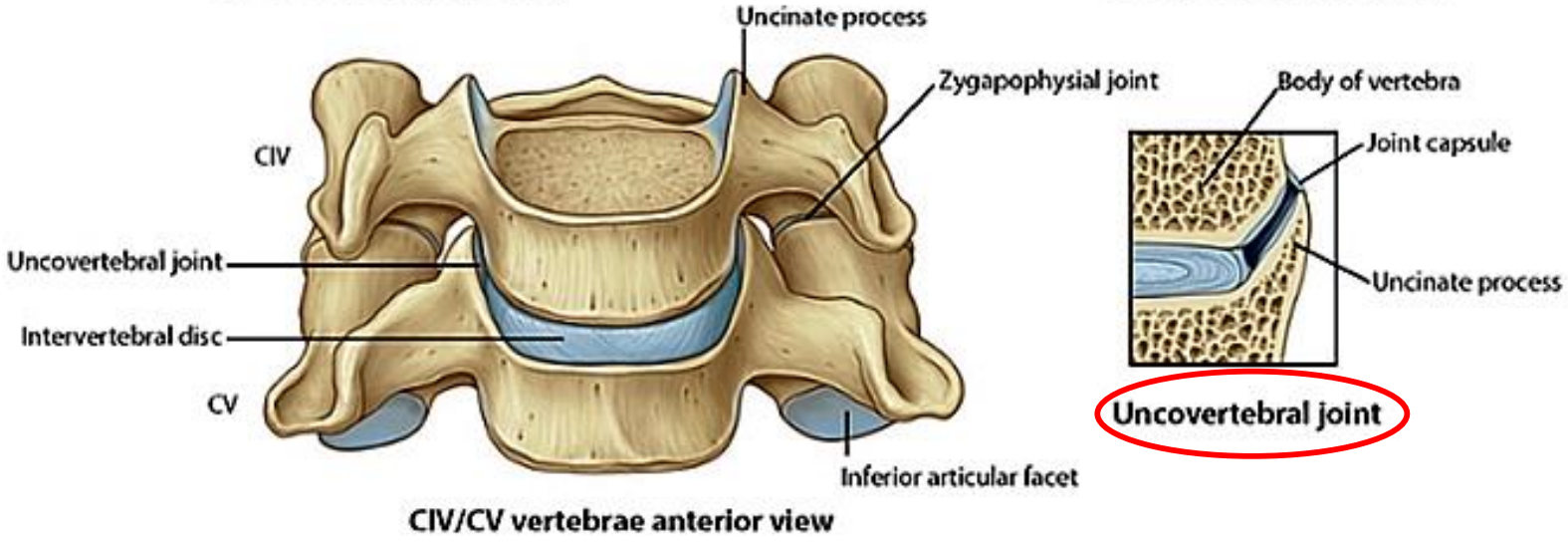
- **body**
- **arch**: pedicule, lamina, vertebral foramen, superior and inferior vertebral notch; **processes**: superior and inferior articular, transverse, spinous

Cervical vertebrae (except for the C1 and C2)

Typical features

- BODY: uncinate process
- VERTEBRAL FORAMEN: triangular
- SPINOUS PROCESS: bifid
- TRANSVERSE PROCESS: foramen for the vertebral vessels
- ARTICULAR PROCESSES: descend with the facets dorsocaudally





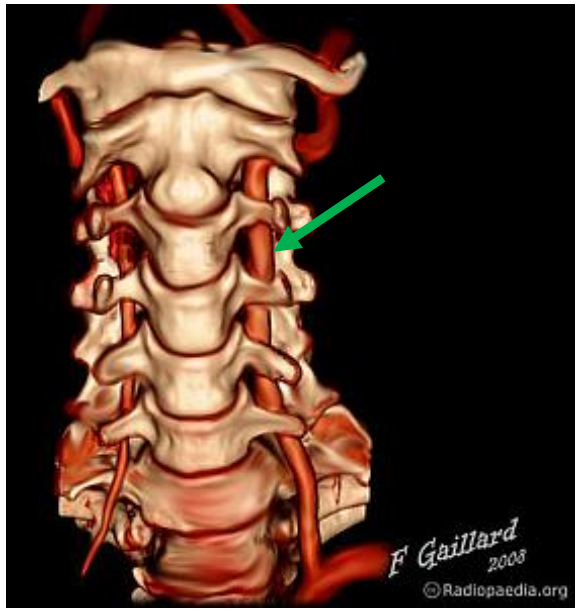
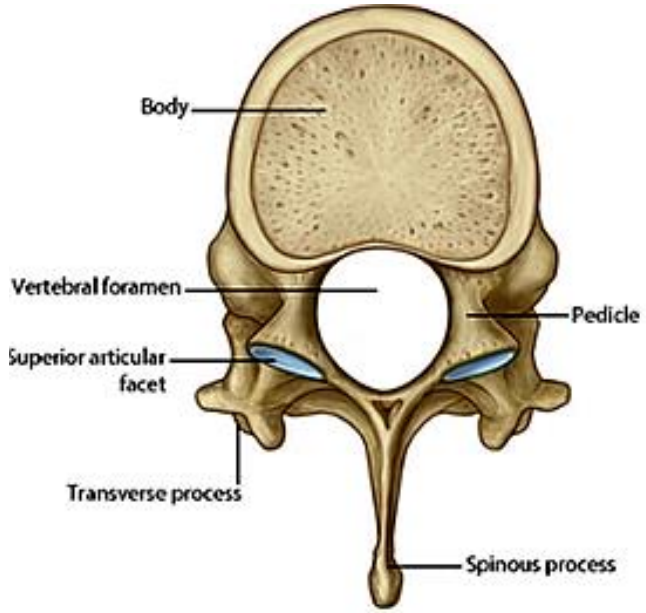


Fig.: Vertebral artery

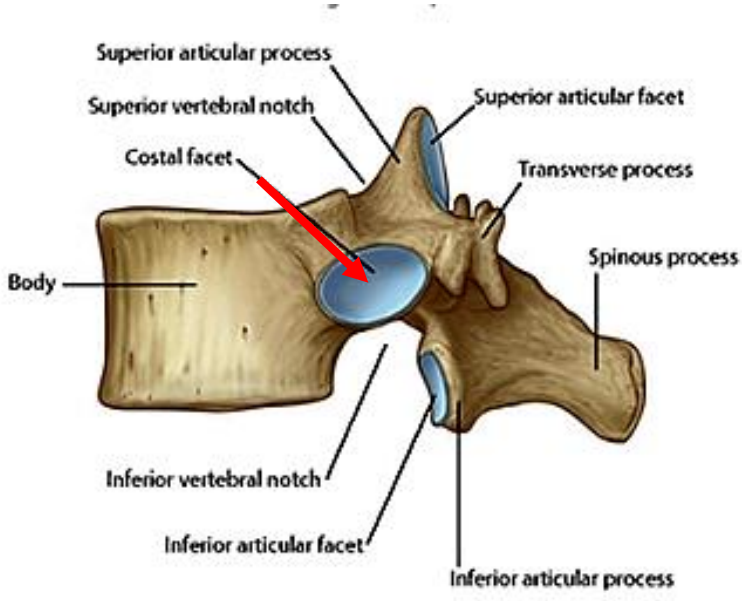
Thoracic vertebrae

Typical features:

- BODY: costal facets and foveae
- VERTEBRAL FORAMEN: round
- SPINOUS PROCESS: hook-like
- TRANSVERSE PROCESS: costal facet
- ARTICULAR PROCESSES: frontal plane

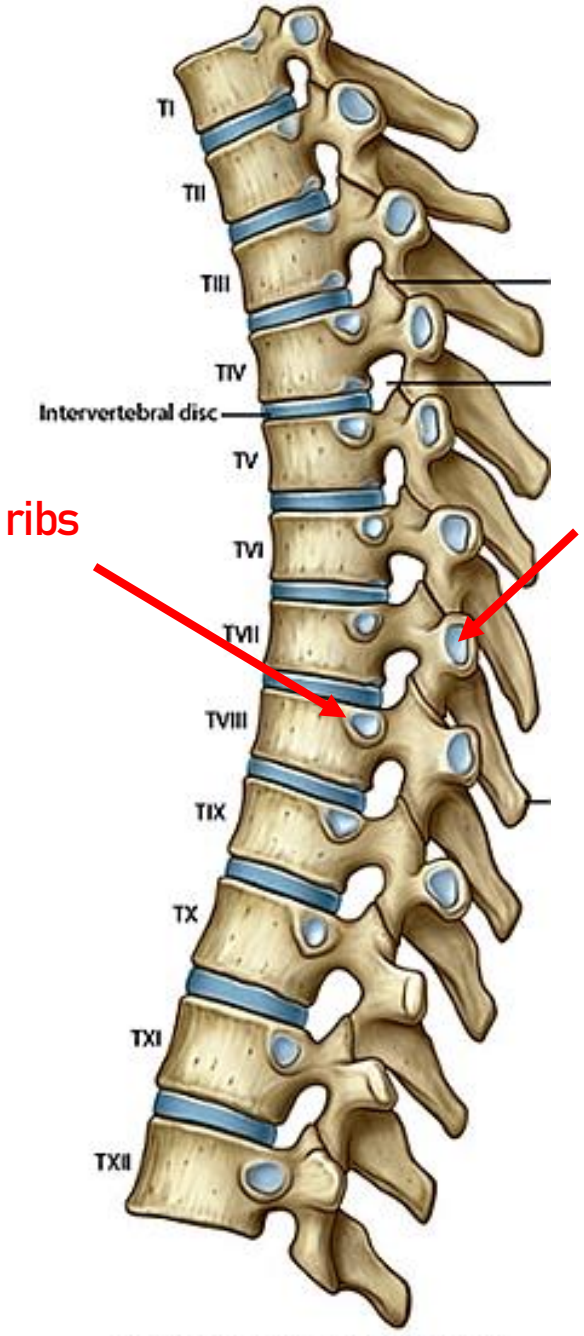


TXII vertebra superior view



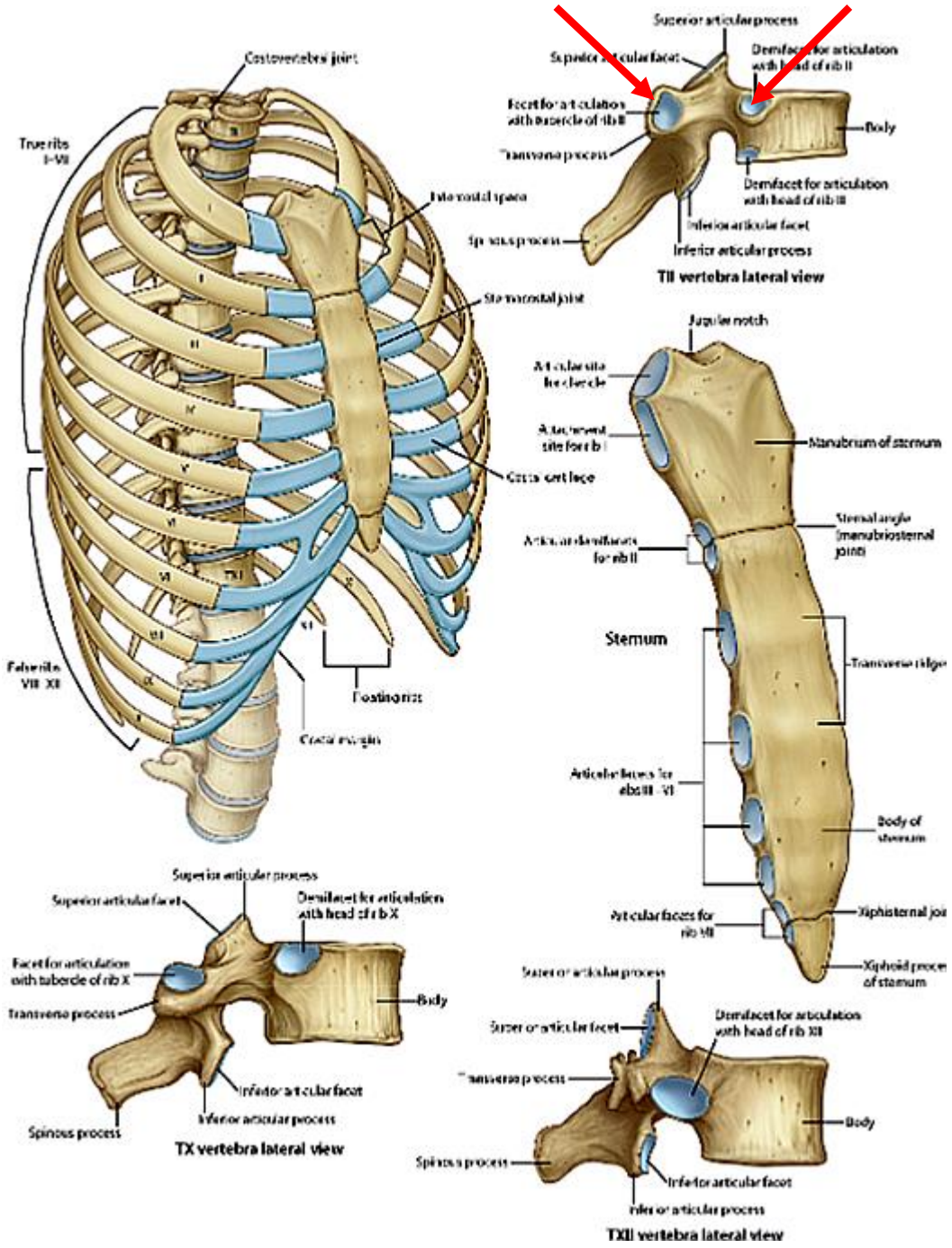
TXII vertebra lateral view

articular surfaces („facets“) for the ribs



Thoracic vertebrae lateral view

Costal facets: T vertebra – body and transverse processes



RIBS and STERNUM
Thoracic cage

Types of the ribs:

- TRUE 1–7
- FALSE 8–12
- FLOATING 11, 12

Sternum:

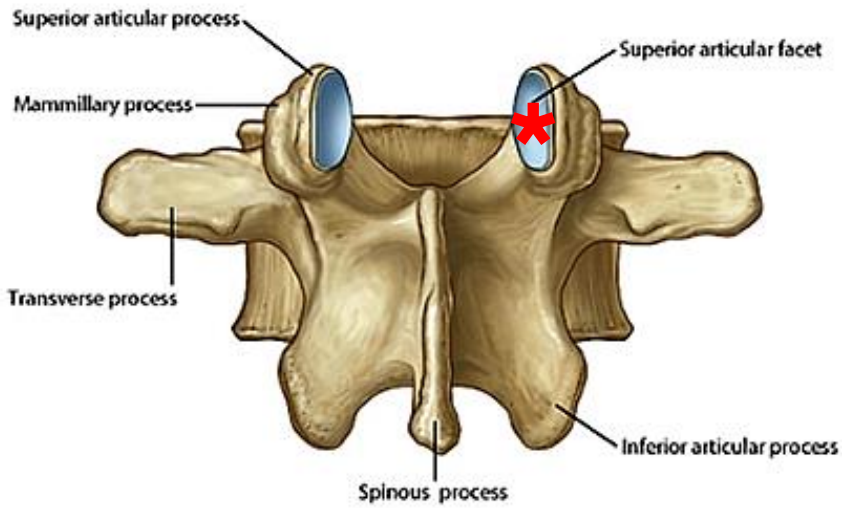
- Manubrium
- Body
- Xyphoid process

Lumbar vertebrae

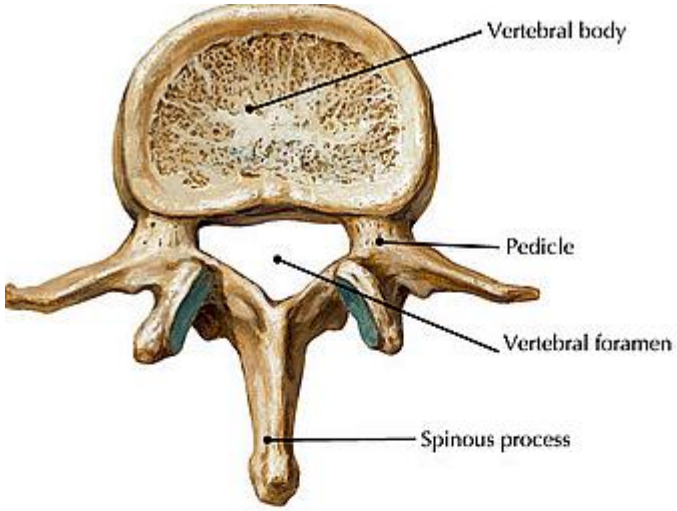
Typical features:

- BODY: big, kidney-shaped
- VERTEBRAL FORAMEN: triangular
- SPINOUS PROCESS: rectangular
- CAUTION! The **transverse proces** is a **rudimentary rib**
- ARTICULAR PROCESSES: almost in the sagittal plane *

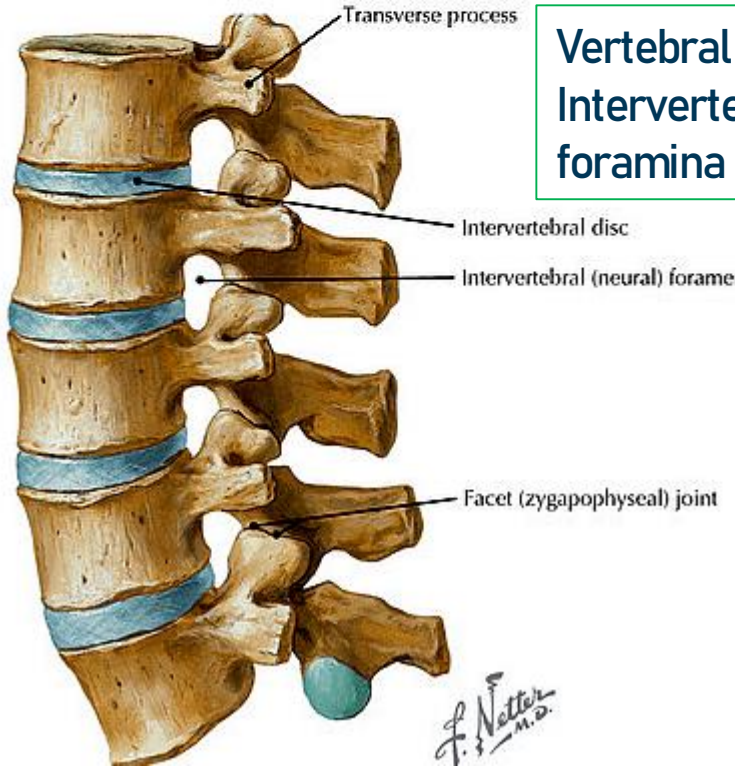
A



B



C

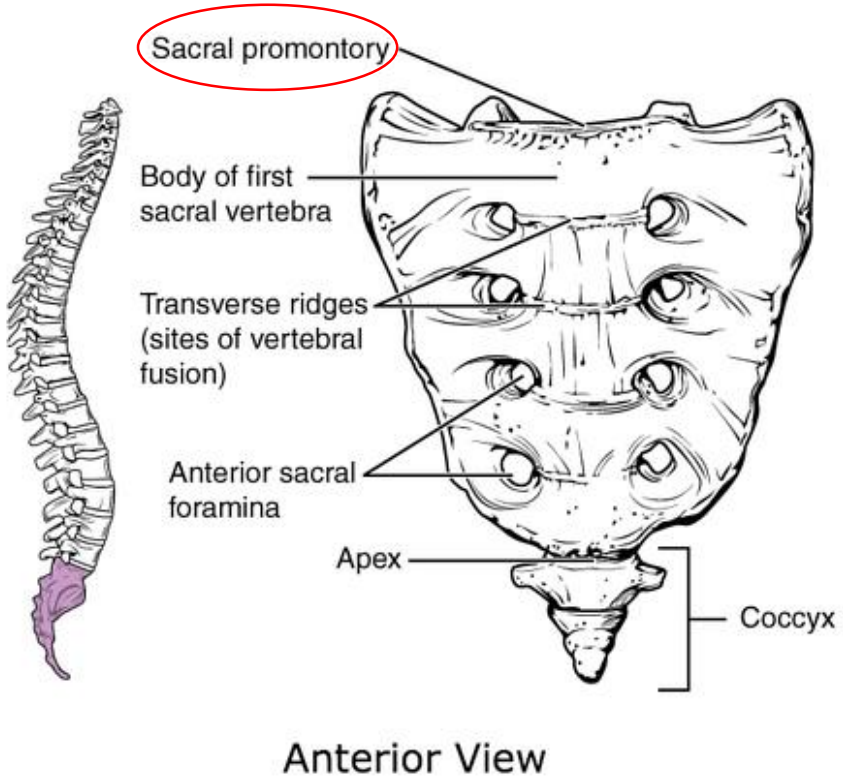


Vertebral canal
Intervertebral foramina

Fig.: L1 vertebra – dorsal (A), superior (B), and lateral (C) view

SACRUM

- base – **promontory**
- **sacral canal**
- auricular surface
- sacral tuberosity
- ventral and dorsal sacral foramina
- sacral crests: medial, intermediate and lateral



Anterior View

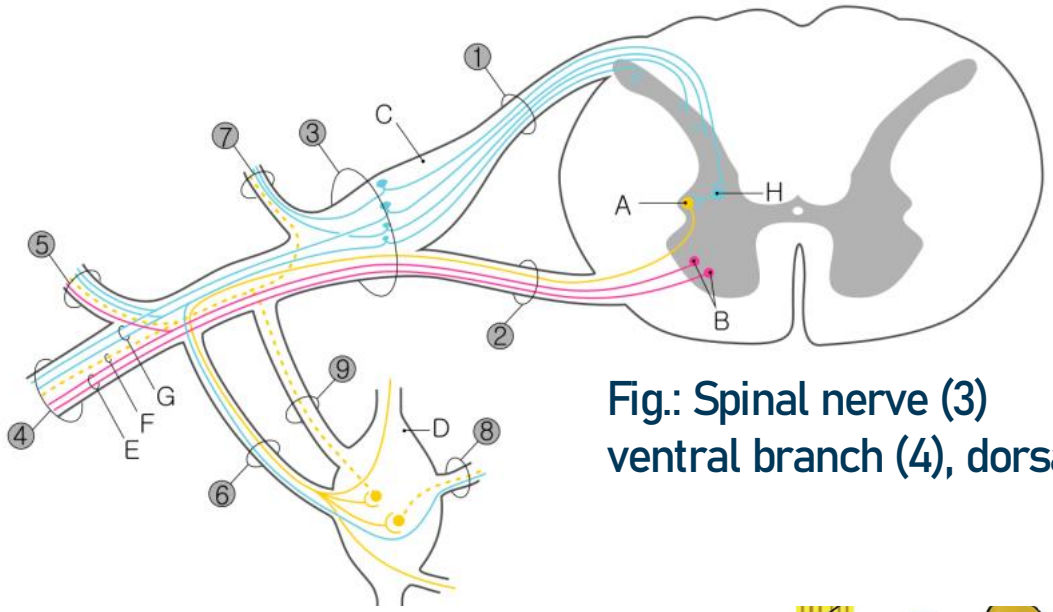
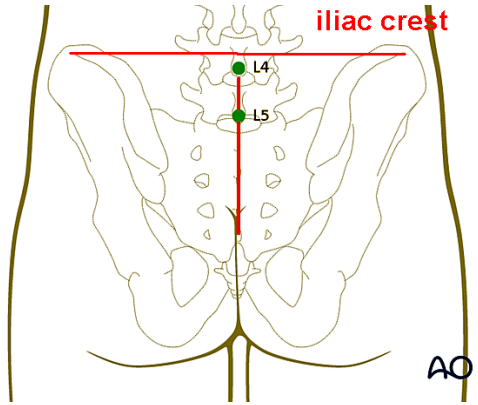
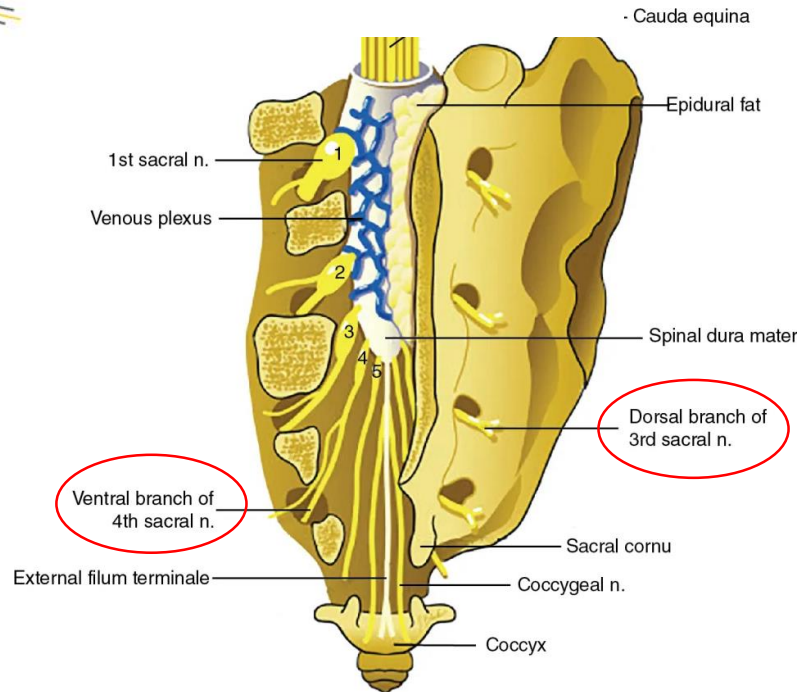


Fig.: Spinal nerve (3)
ventral branch (4), dorsal branch (5)





Anatomy of the sacral spine region. *n*, Nerve.
(From Waldman SD. *Atlas of Interventional Pain Management* . 4th ed. Philadelphia: Saunders; 2015:578.)

Joints

A. Solid (continuous)

B. Synovial (discontinuous, diarthrosis)

A1. Synostosis (sacrum, coccys)

A2. Syndesmosis (intervertebral ligaments)

A3. Synchondrosis – symphysis (intervertebral discs)

B. Synovial joints (uncovertebral, costovertebral, atlantoaxial, and occipital joints)

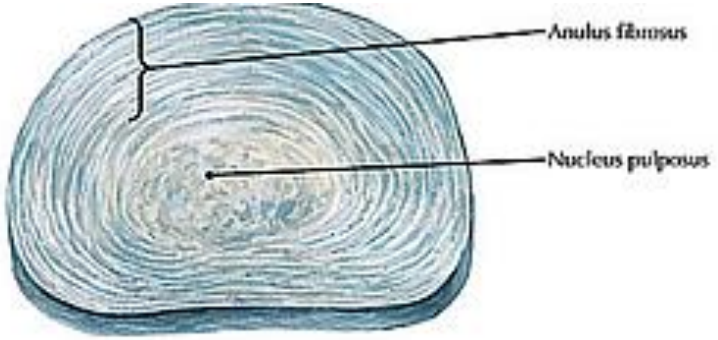


Fig.: Intervertebral disc

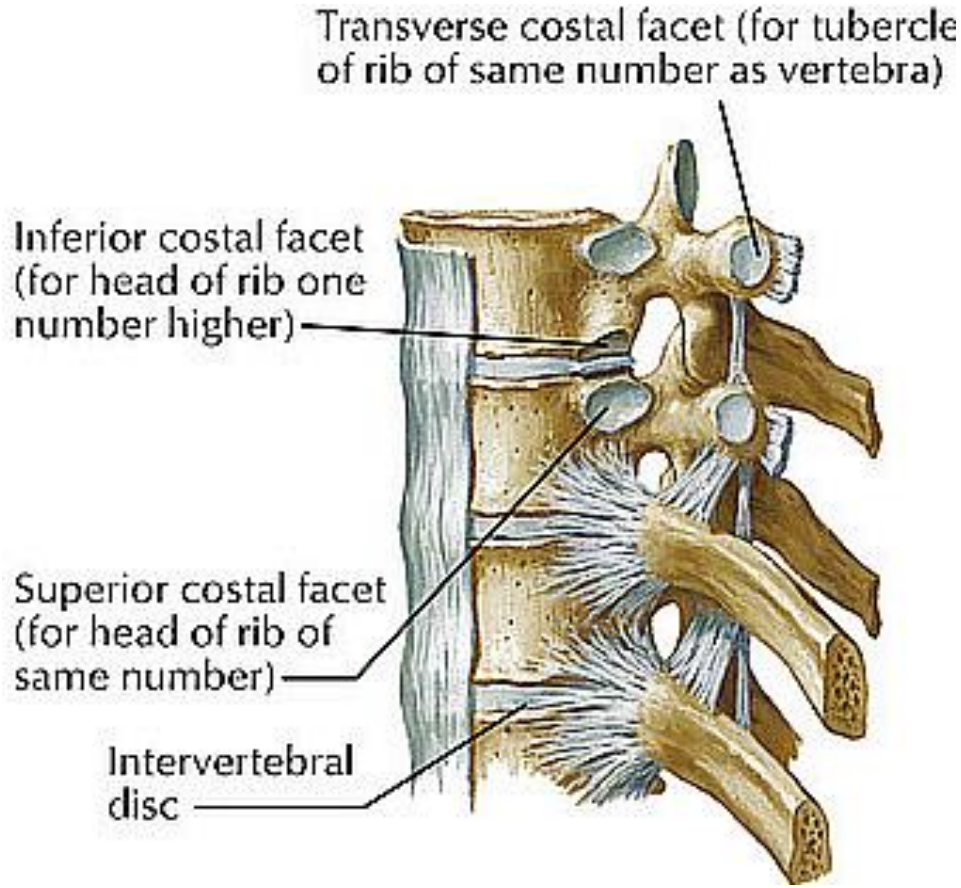
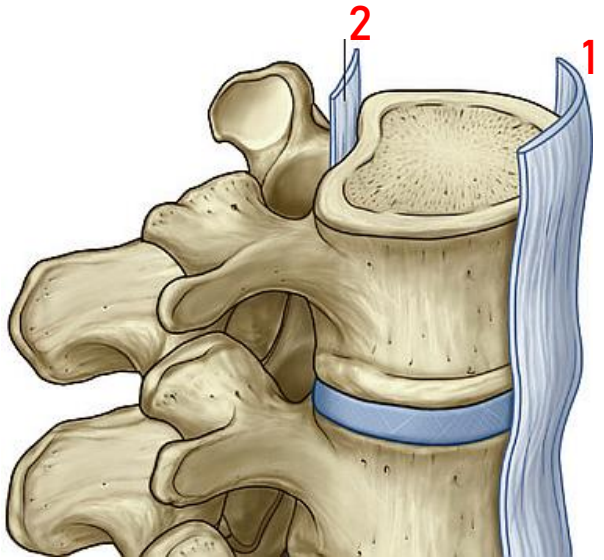


Fig.: Joints of the thoracic spine

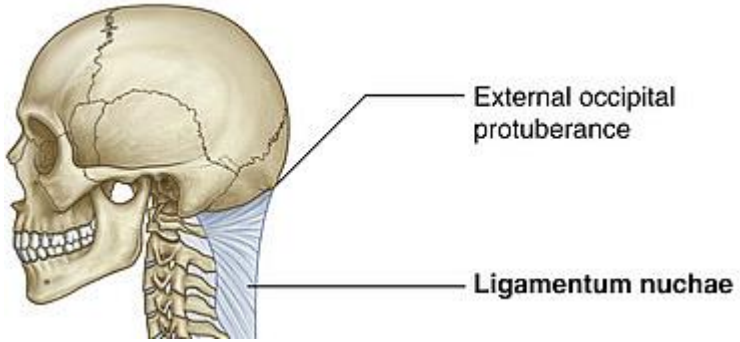
A2. Intervertebral ligaments

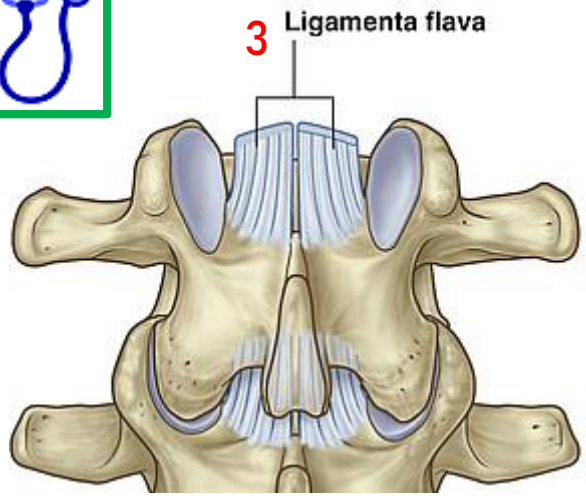
- Anterior (1) and posterior (2) longitudinal ligaments (bodies)
- Ligamenta flava (3, arches)
- Interspinous ligaments (4, spinous processes) – supraspinous, nuchal lig.

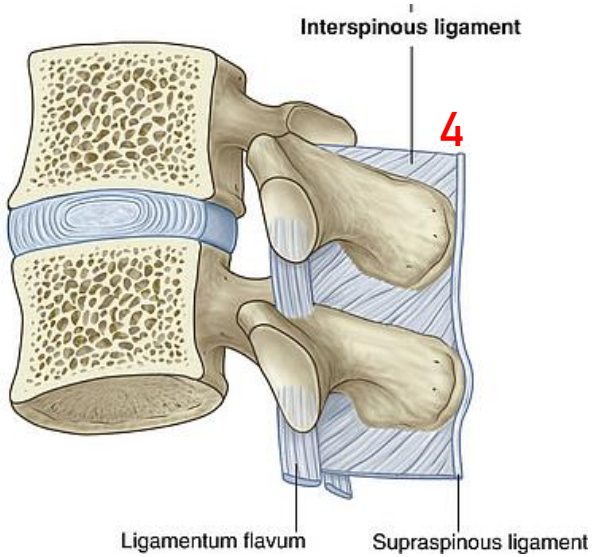


Clinical Notes

- The posterior longitudinal ligament is well innervated with nociceptive fibers and is thought to be the origin of some of the pain associated with intervertebral disc herniation.
- The **ligamentum flavum** (ie. yellowish) contains **elastic tissue** that prevents the ligament from being pinched between the lamina when the vertebral column is hyperextended.
- Anesthesiologists use penetration of the ligamentum flavum as an indicator that the needle has reached the epidural space for epidural anesthesia.





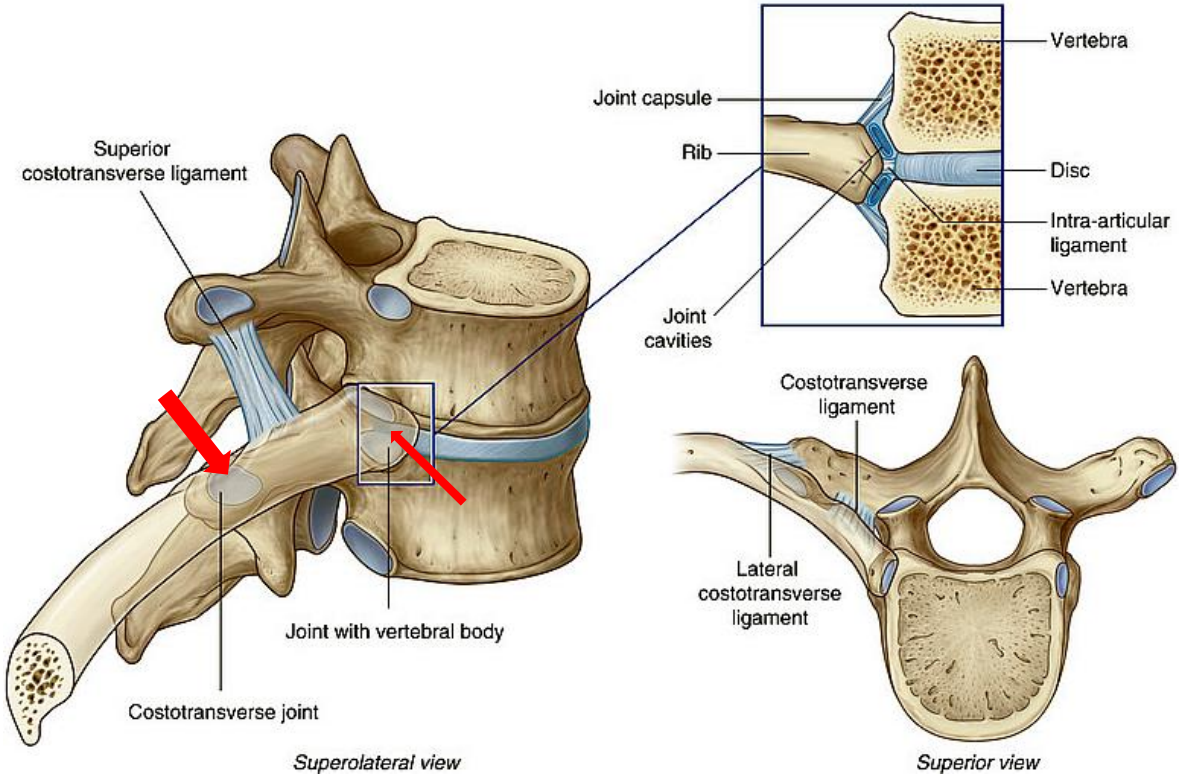


Intervertebral joints

A typical vertebra articulates with a neighboring vertebra via 6 joints: 4 synovial (two above, two below) and **2 symphysial** (one above, one below).

Stabilizers – anteriorly, between the bodies, **symphysial** joints via the **intervertebral discs (1)**

Mobilizers (laterally): facet joints (**2**), costovertebral, and costotransverse joints



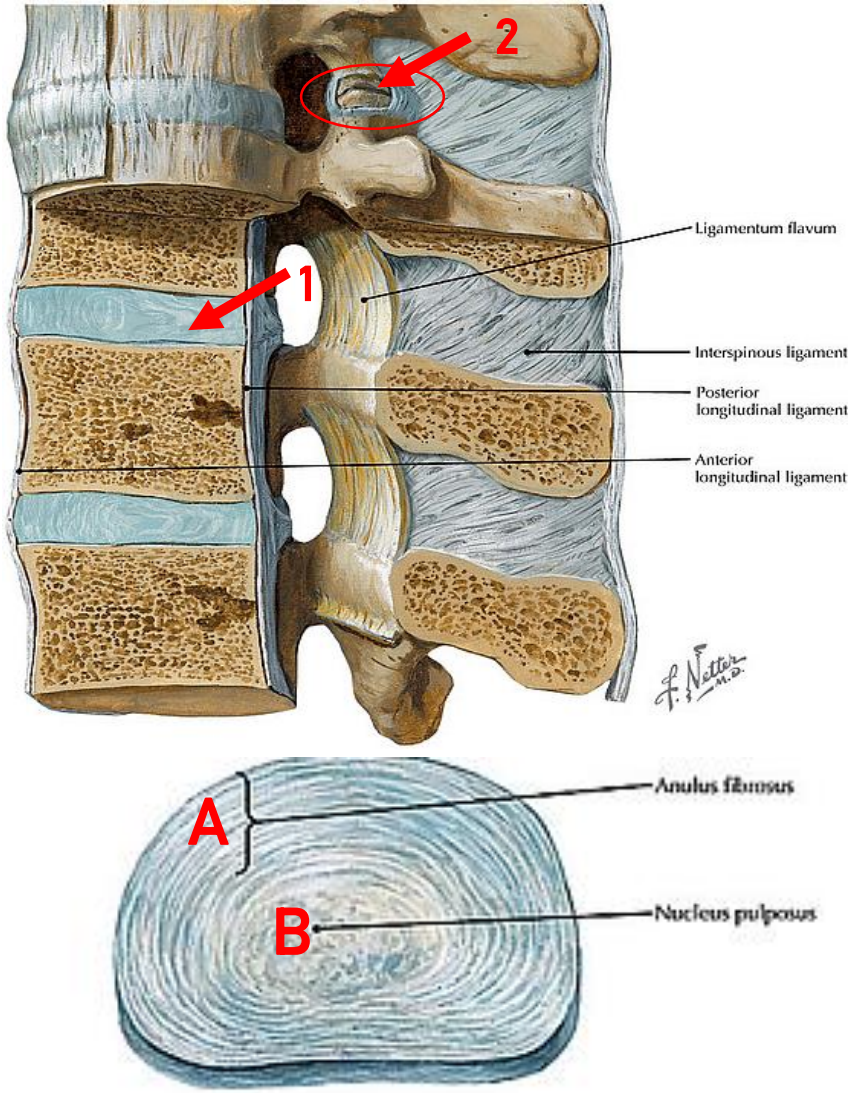


Fig.: Intervertebral disc – anulus fibrosus (A), nucleus pulposus (B)

CAVE! Disc herniation

RIBS

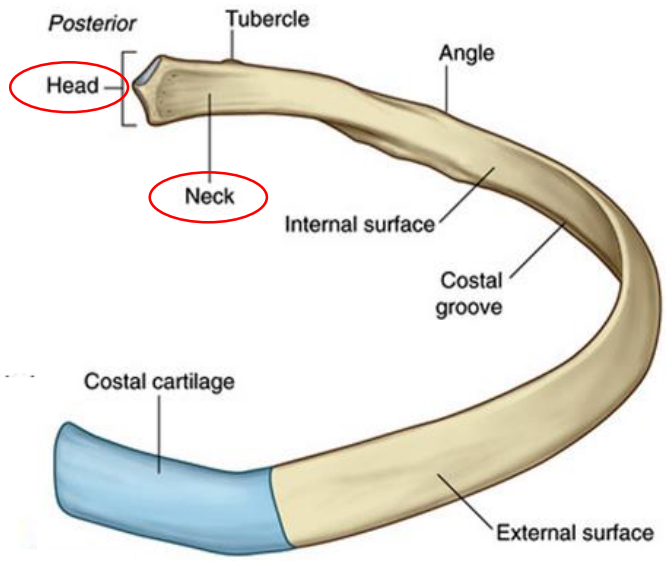
Types:

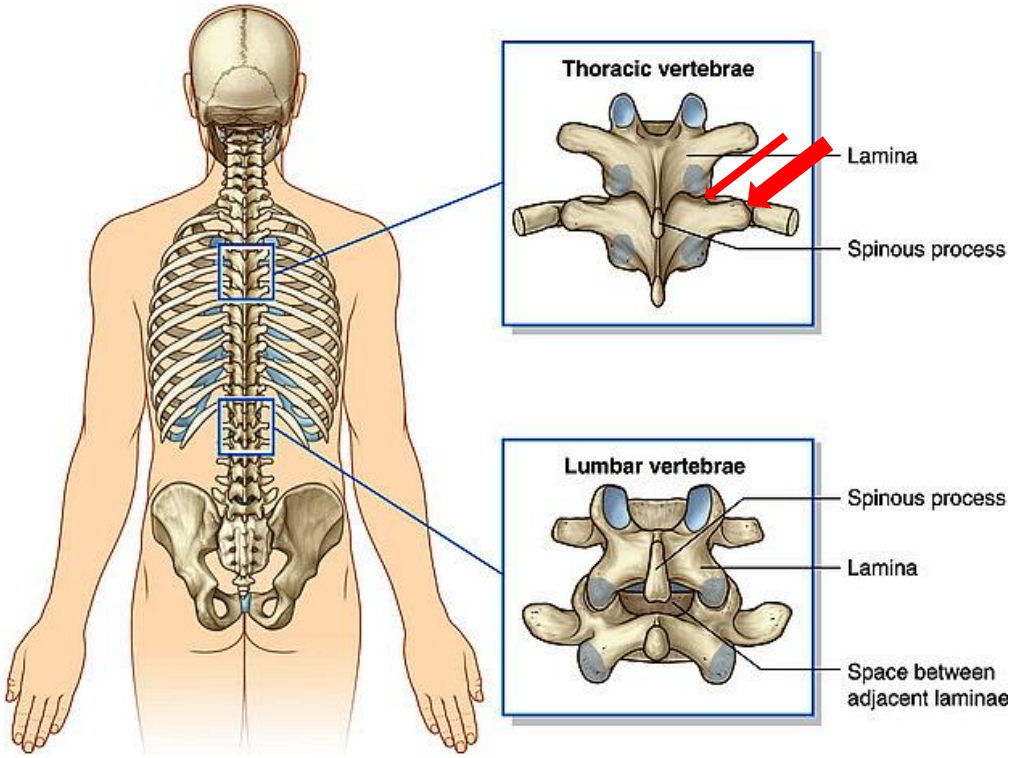
TRUE 1 – 7

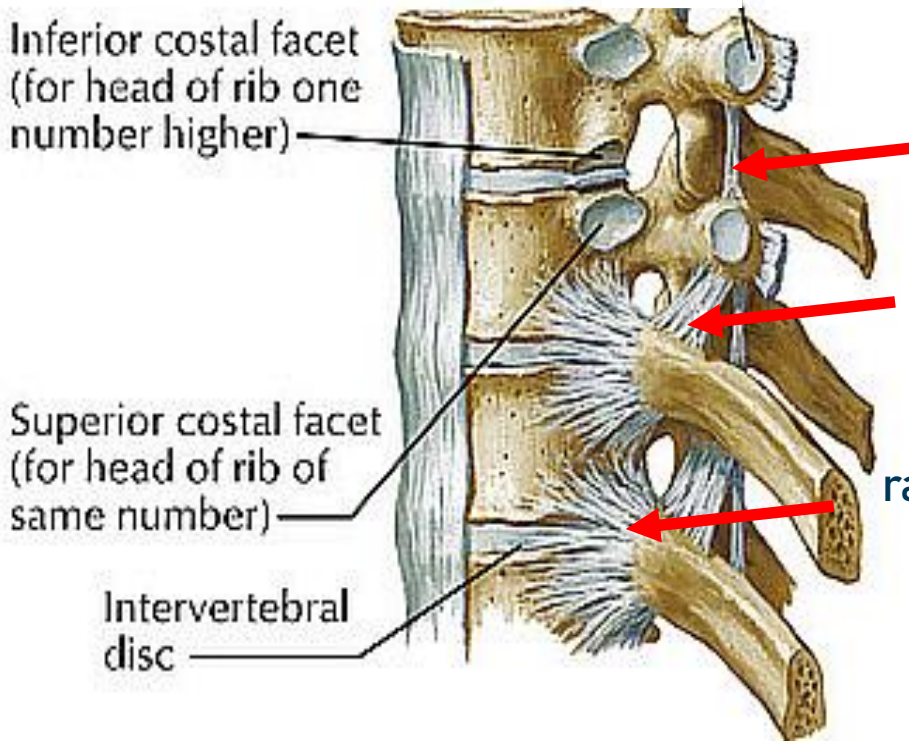
FALSE 8 – 12

Floating 11, 12

Parts: head, neck, body







intertransverse lig.

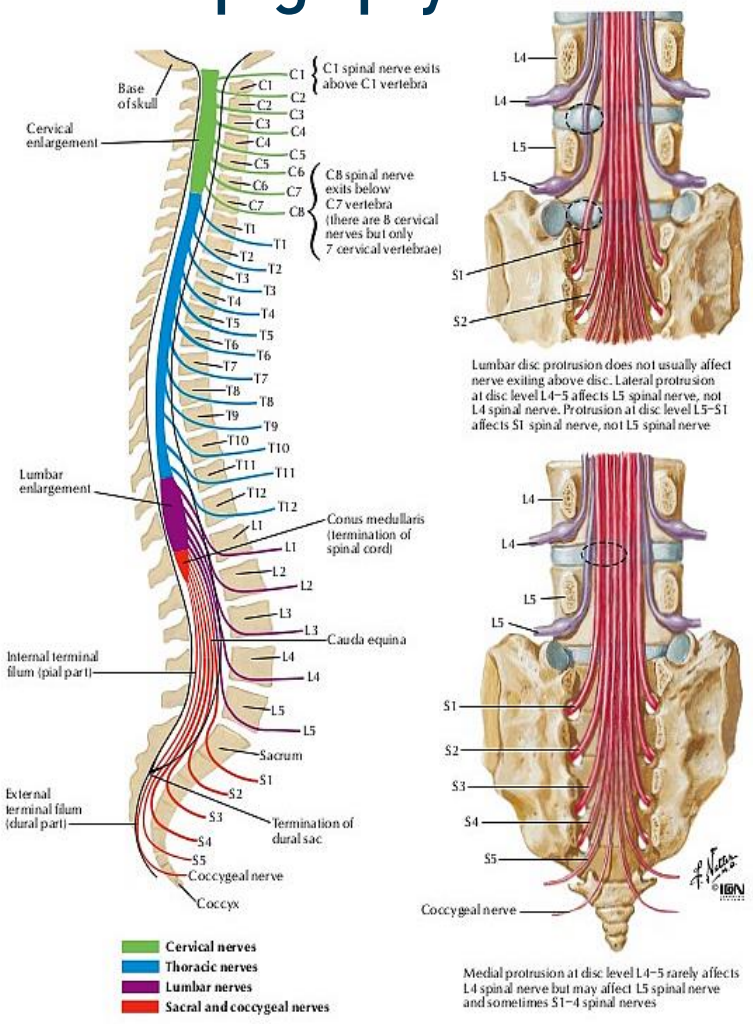
costotransverse lig.

radiate lig.

Costovertebral joints

Ligaments:
Radiate ligg. of the head of the rib
Costotransverse ligg.
Intertransverse ligg.

Vertebromedullar topography



Lumbar disc protrusion does not usually affect nerve exiting above disc. Lateral protrusion at disc level L4–5 affects L5 spinal nerve, not L4 spinal nerve. Protrusion at disc level L5–S1 affects S1 spinal nerve, not L5 spinal nerve

Medial protrusion at disc level L4–5 rarely affects L4 spinal nerve but may affect L5 spinal nerve and sometimes S1–4 spinal nerves

Chipault´s rule

Vertebra	No of the segment
upper C	equal
lower C	vertebra + 1
upper T	vertebra + 2
lower T	vertebra + 3
T11–12	segments L1–4
T12–L1	segments L5–S2
L1–2	S3–S5+Co

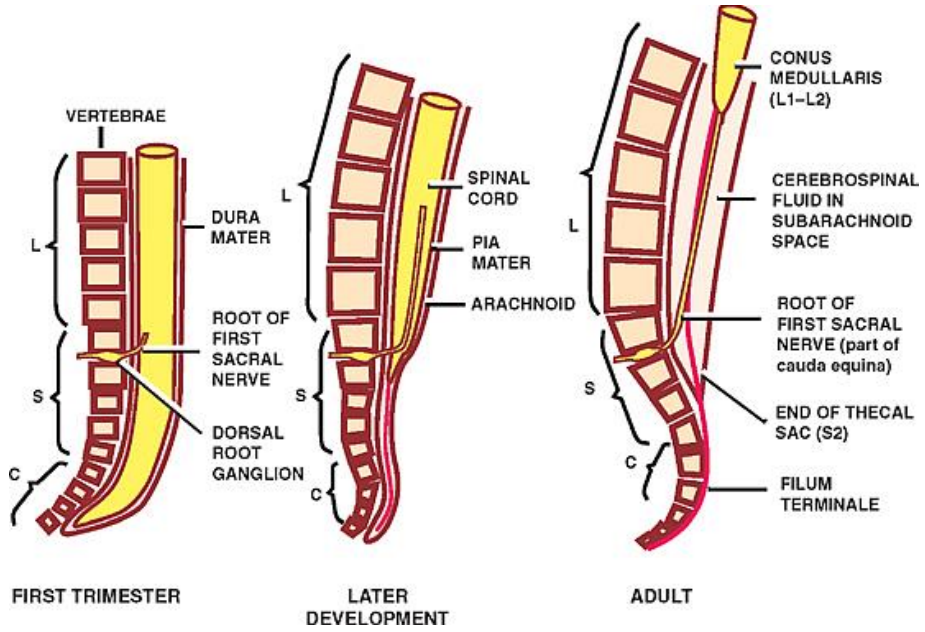


Fig.: Growth of the spinal cord

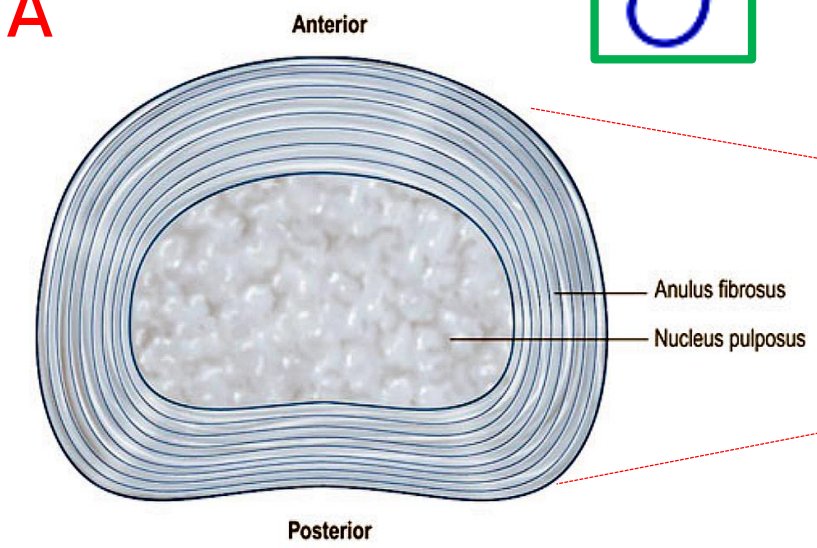
Spinal cord
From: foramen magnum
To: L1–L2

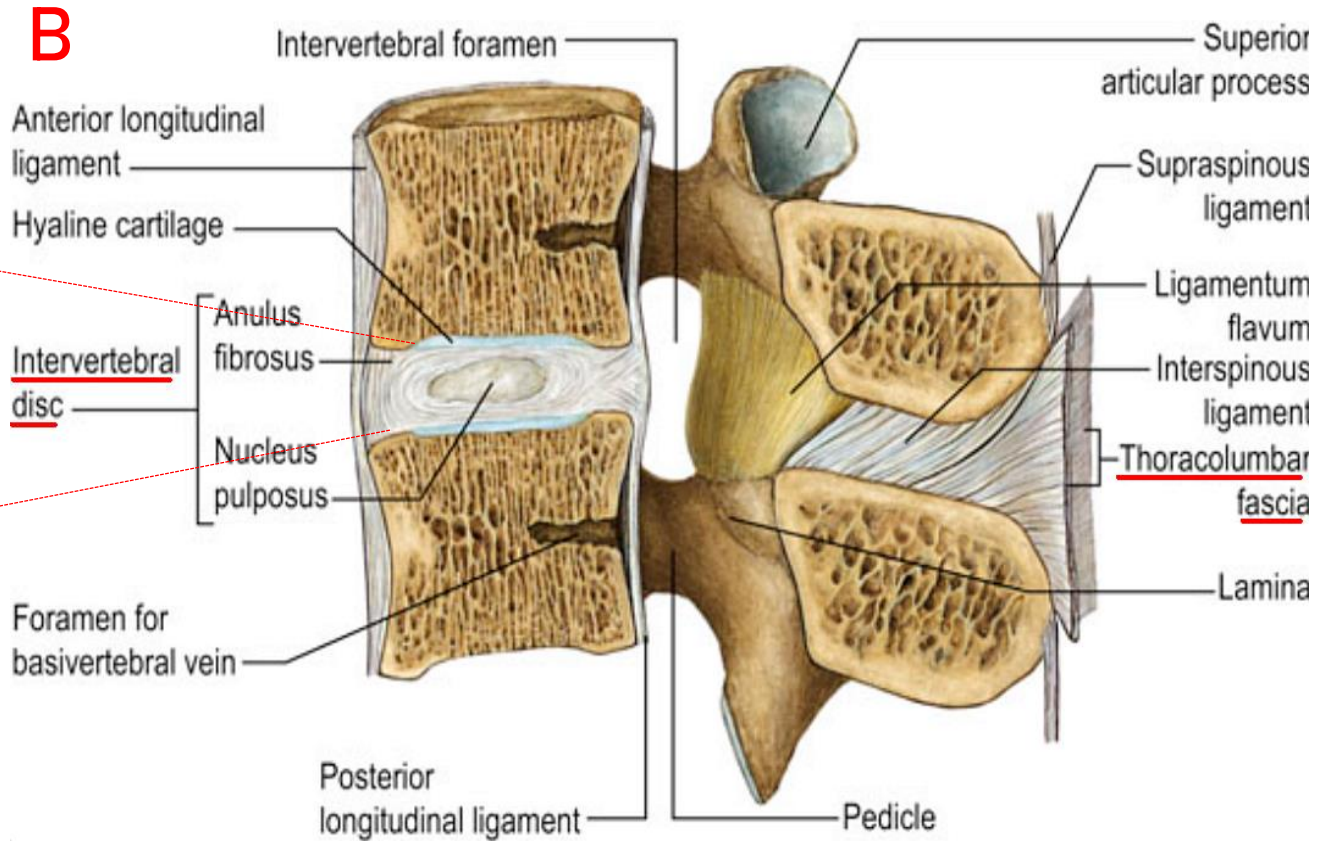
Dural sac
From: foramen magnum
To: S2

Epidural vs. spinal anesthesia 3:29
https://www.youtube.com/watch?v=DtzI5bX7NyA&ab_channel=MaxFeinstein

The **approximate location of spinal cord segments relative to the bony vertebrae** may be identified in the adults by **reference to the posterior spinous processes** of the vertebrae. **Cervical segments lie approximately one spine higher** than their corresponding vertebrae (e.g. C7 cord segment lies adjacent to C6 vertebra), **thoracic segments lie approximately two spines higher**, and **lumbar segments three to four spines higher** than their corresponding vertebrae (Fig.).

DISC HERNIATION





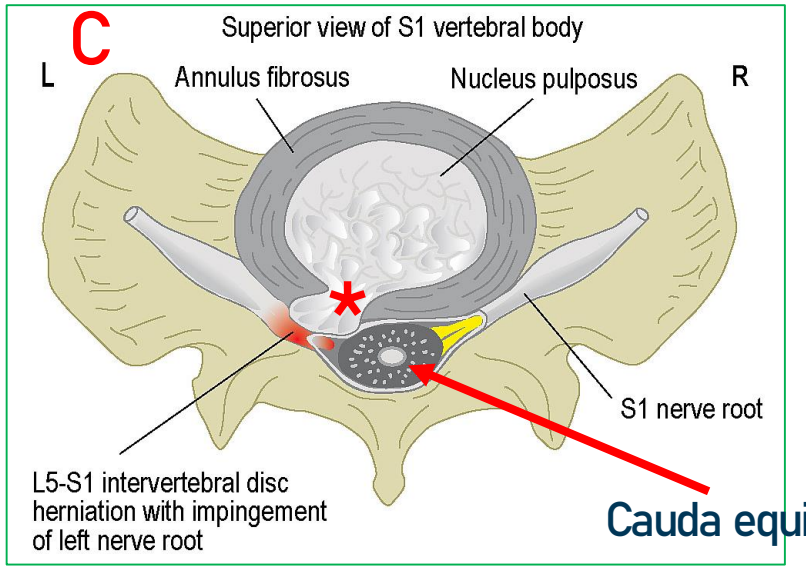
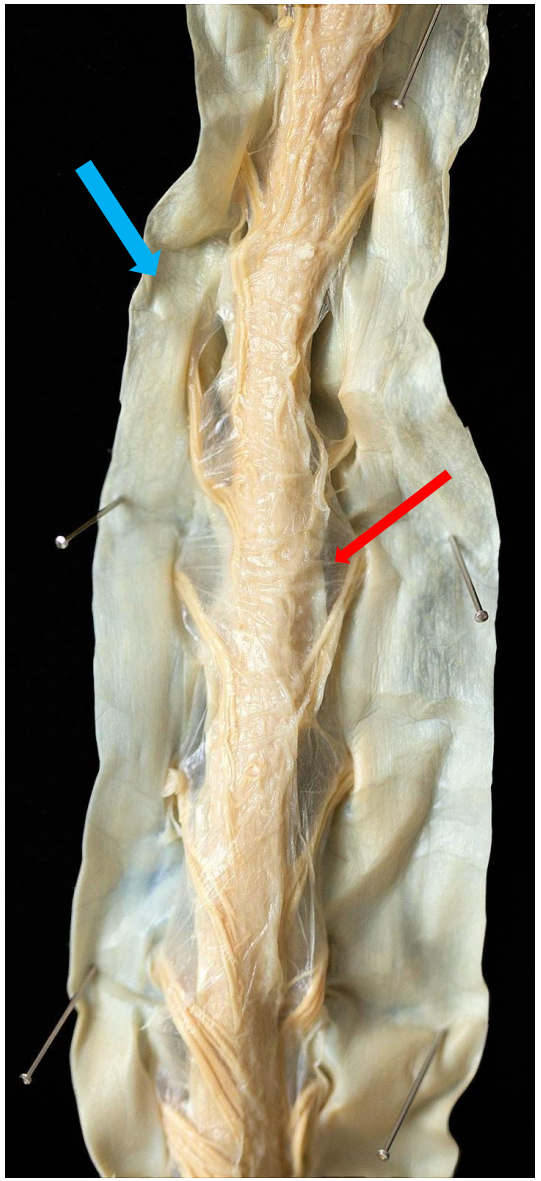


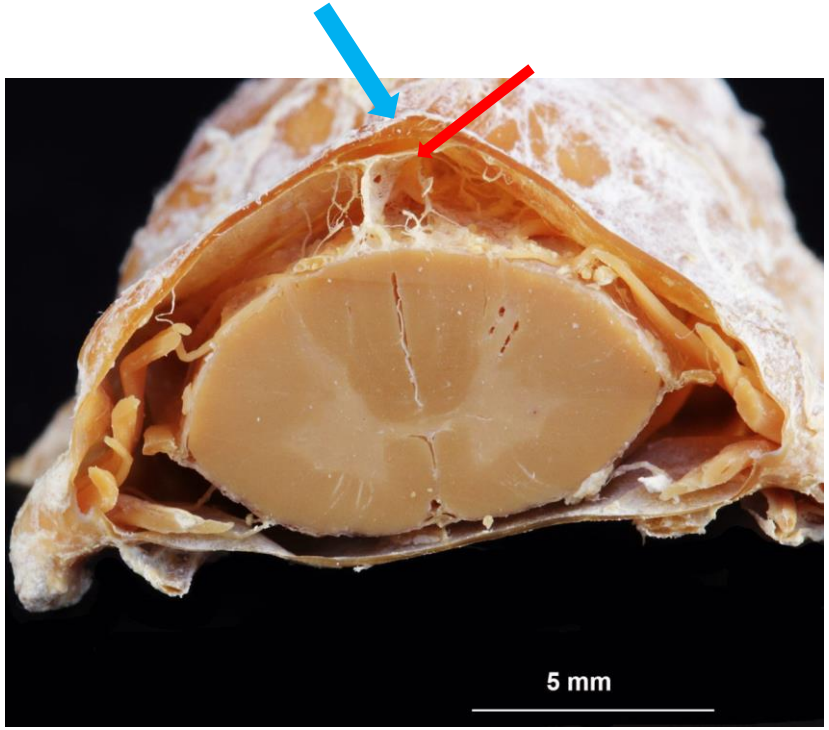
Fig.: Intervertebral disc, superior view (A), joints of the spine, lateral view (B), disc herniation (*), superior view (C)

The most common locations for **disc herniation** are at the LIV/LV and LV/S1 discs. The **nucleus pulposus**, the central fluid material within a disc, herniates or protrudes from the disc, and pressures on nearby structures.

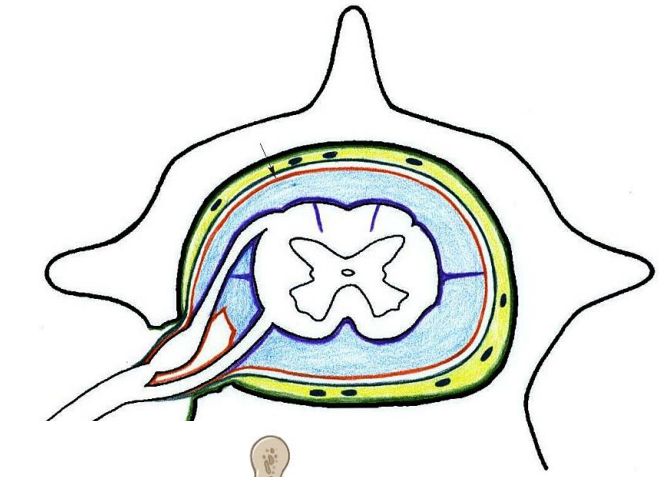
Cauda equina in spinal (sacral) canal

Meninges





Spinal cord: dura mater (blue arrow), arachnoid (red arrow)



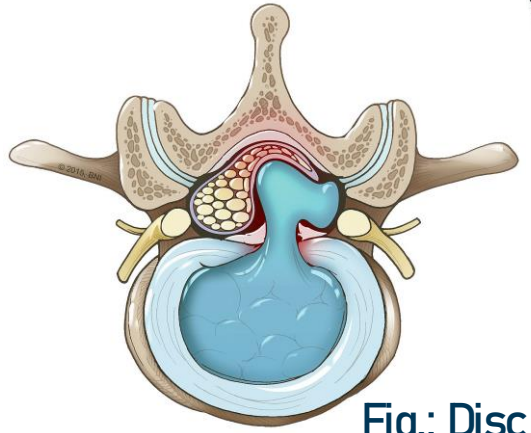
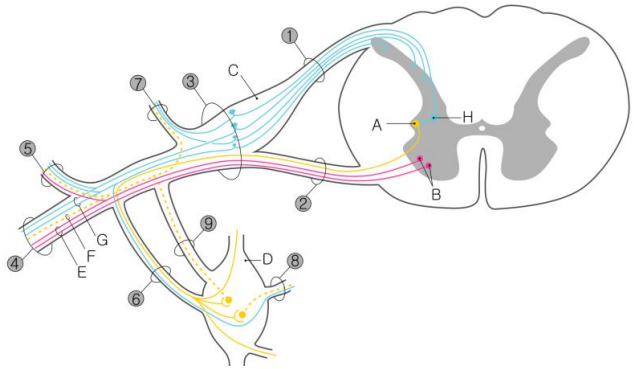


Fig.: Disc herniation

Dura mater
Arachnoid
Pia mater



Spinal nerve – 4 branches:
anterior branch – plexuses
posterior branch – mm. of the back

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Epidural anesthesia:
https://www.youtube.com/watch?v=DtzI5bX7NyA&ab_channel=MaxFeinstein

Atlantoaxial and occipital joint

ATLAS (C1):

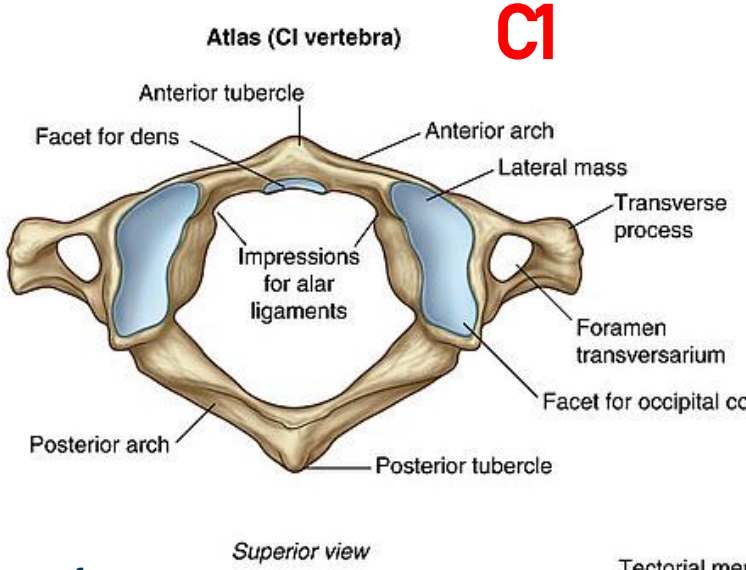
- anterior arch, anterior facet for dens
- posterior arch, groove for the vertebral artery
- lateral masses, superior articular facet, foramen transversarium

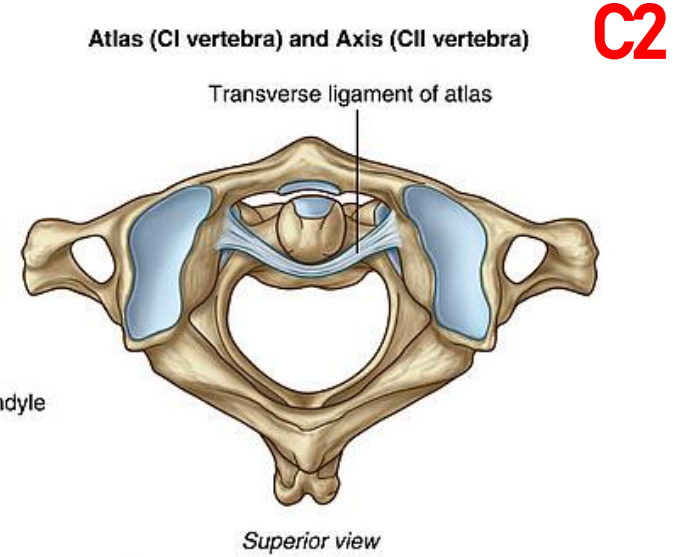
AXIS (C2):

- Dens, body

Atlantoaxial – pivot
Atlantooccipital – ellipsoid

Together, the atlantooccipital and atlantoaxial joints confer extra range of motion to an already mobile cervical spine (the most mobile part of the vertebral column). See this for yourself as you shake your head "yes" and "no."



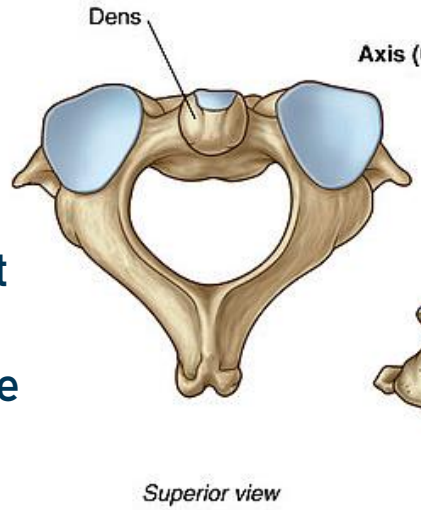


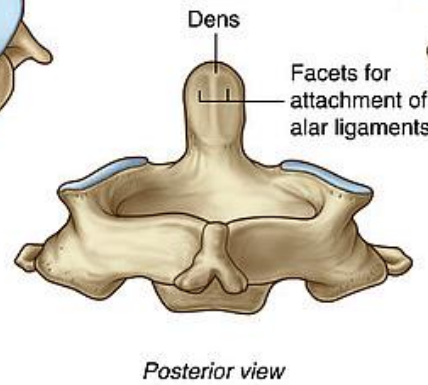
Ligaments

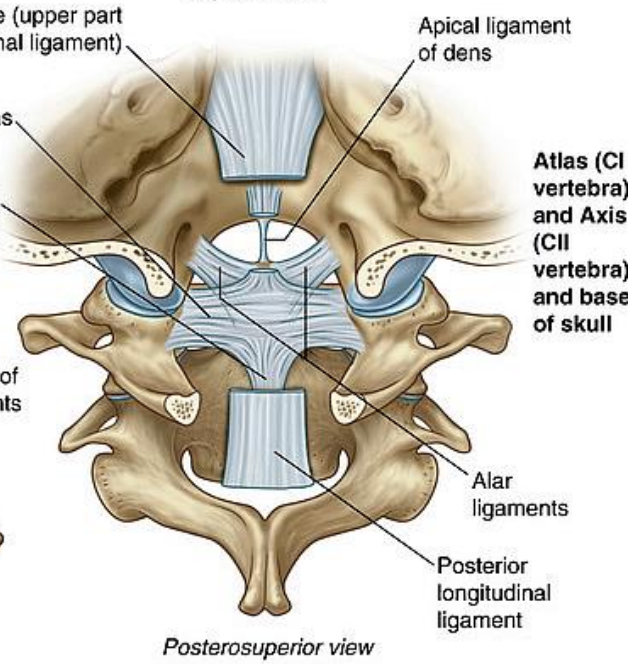
Atlantooccipital membrane – prevents excessive hyperflexion and hyperextension

Atlantoaxial ligaments (transverse, cruciate) – prevent excessive rotation.

Transverse ligament of the atlas, apical ligament of the dens – prevent dislocation of the dens



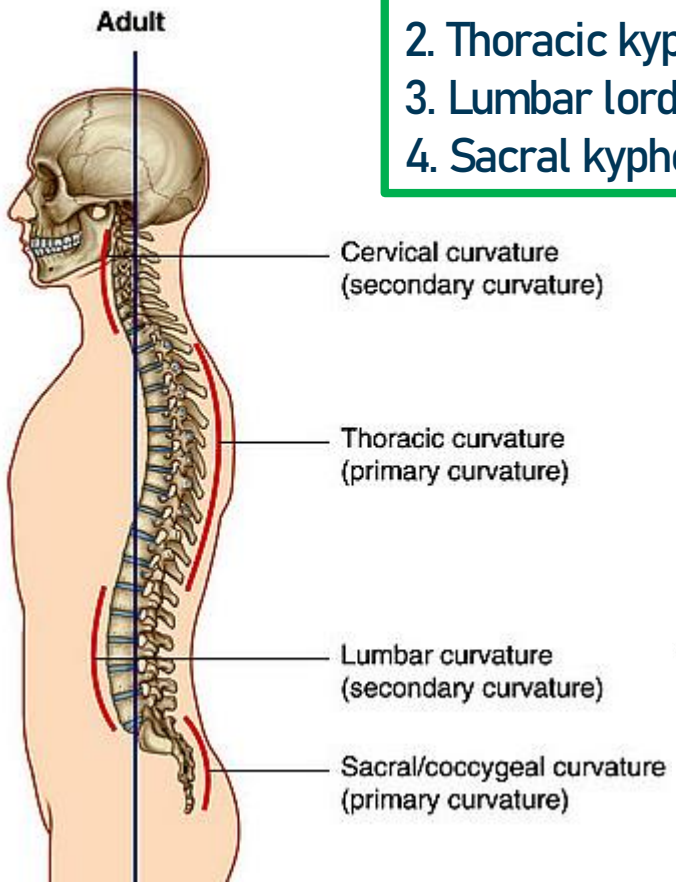




B

Normal spine curvatures

1. Cervical lordosis
2. Thoracic kyphosis
3. Lumbar lordosis
4. Sacral kyphosis



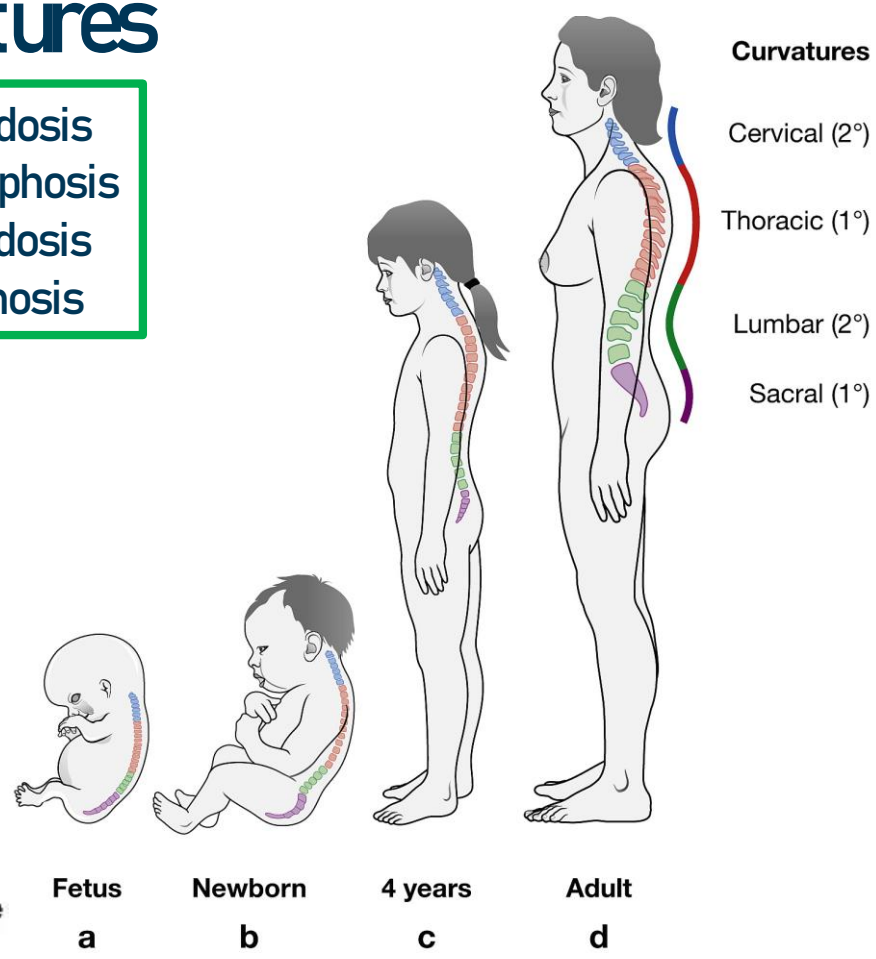


Fig.: Vertebral column, normal curvatures.

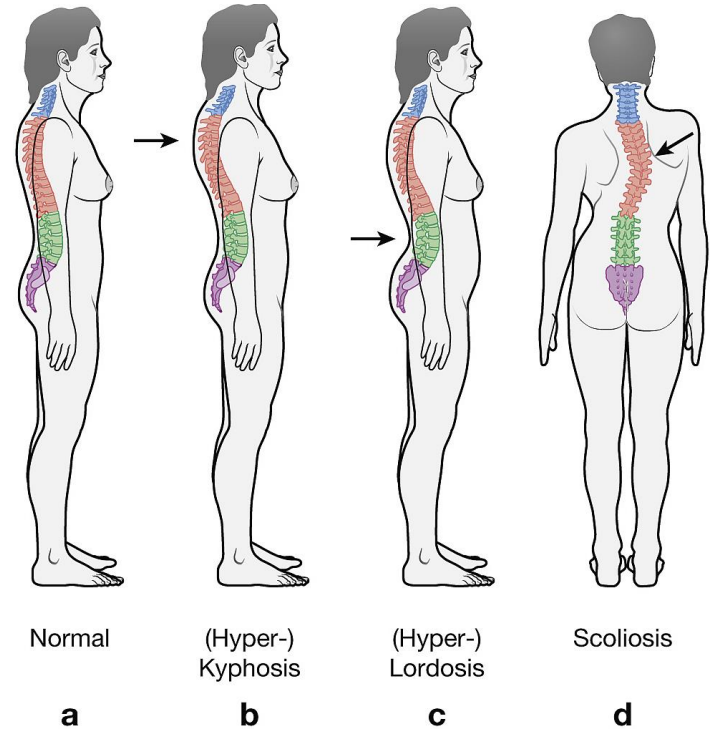
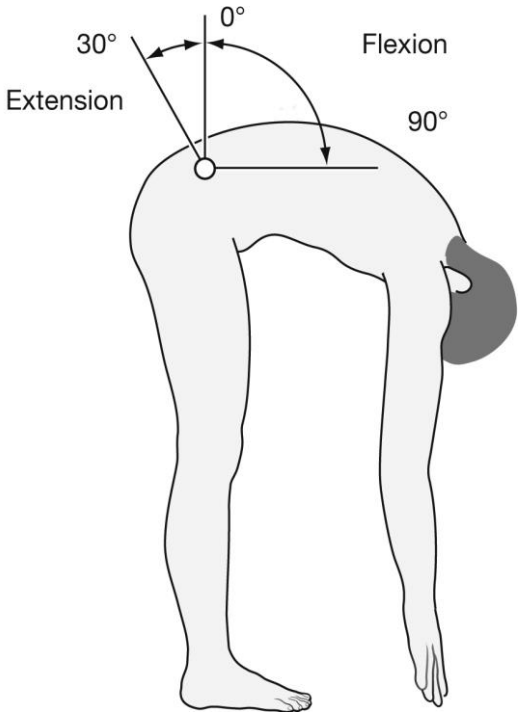


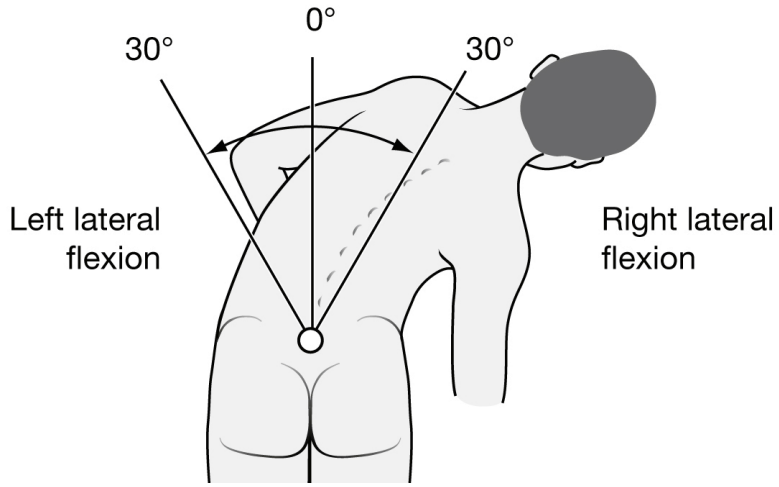
Fig.: Vertebral column, pathological curvatures.

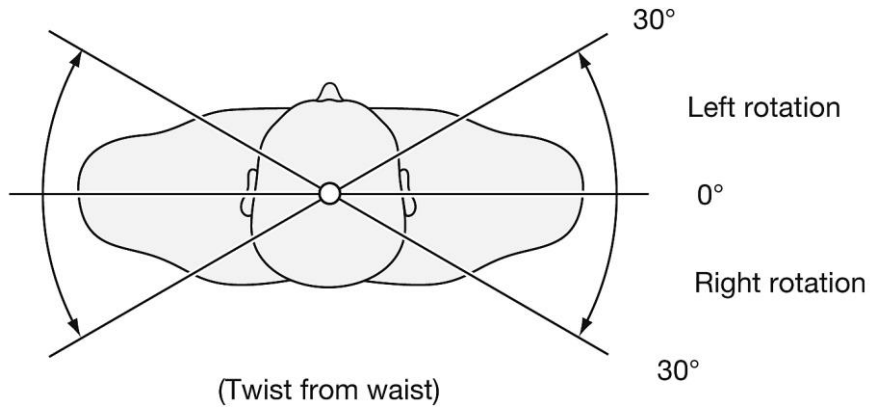
Excessive curvature of the spine can occur as a result of postural changes associated with habitual activities. **Scoliosis** is a growth deformity of the spine that results in a **fixed lateral curvature**, and rotation of the vertebral column. **(Hyper-) Kyphosis** describes an abnormal increase in the primary convex curvature of the thoracic spine. **(Hyper-)Lordosis** is an exaggeration of the secondary concave curvature in the lumbar spine.

Thoracolumbar Movements

Movement	Range	Muscles acting
Flexion	90°	Rectus abdominis, psoas major (iliopsoas), internal oblique, external oblique
Extension	30°	**Erector spinae**, **multifidus**, **semispinalis thoracis**, quadratus lumborum, **serratus posterior inferior**
Lateral flexion	30°	**Multifidus**, external and internal oblique muscles, quadratus lumborum, **erector spinae**, psoas major
Rotation	30°	**Rotatores**, **multifidus**, external oblique (acting together with opposite internal oblique), **semispinalis thoracis**

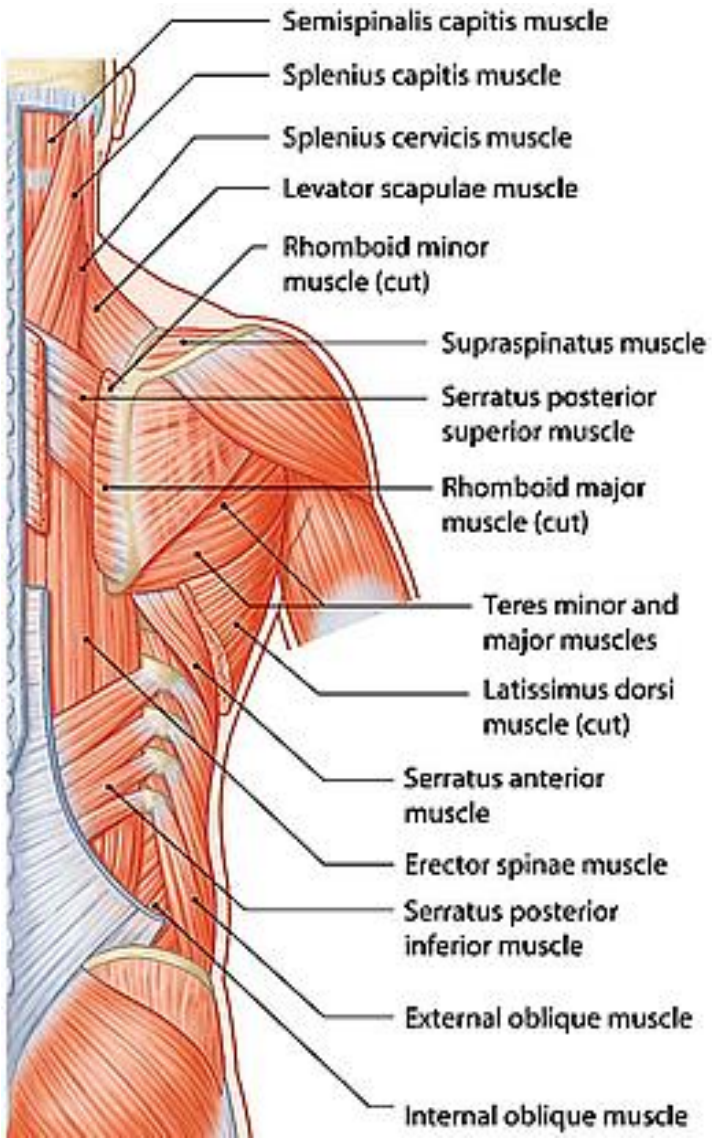


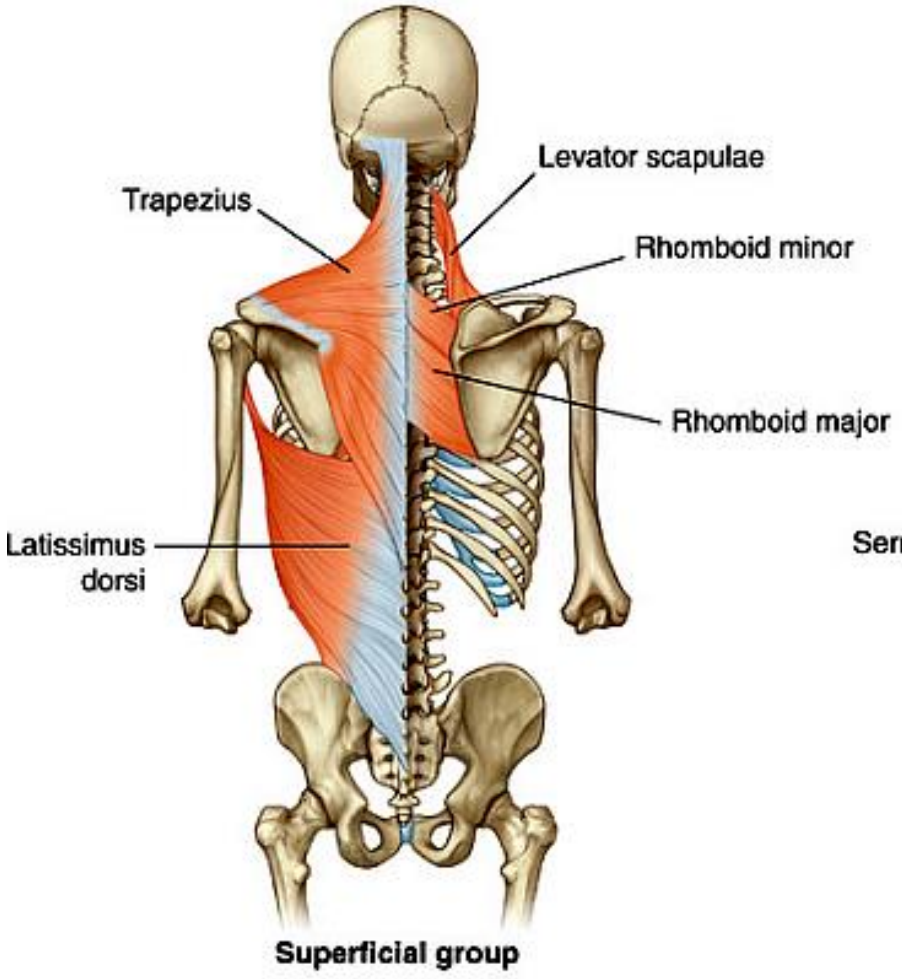


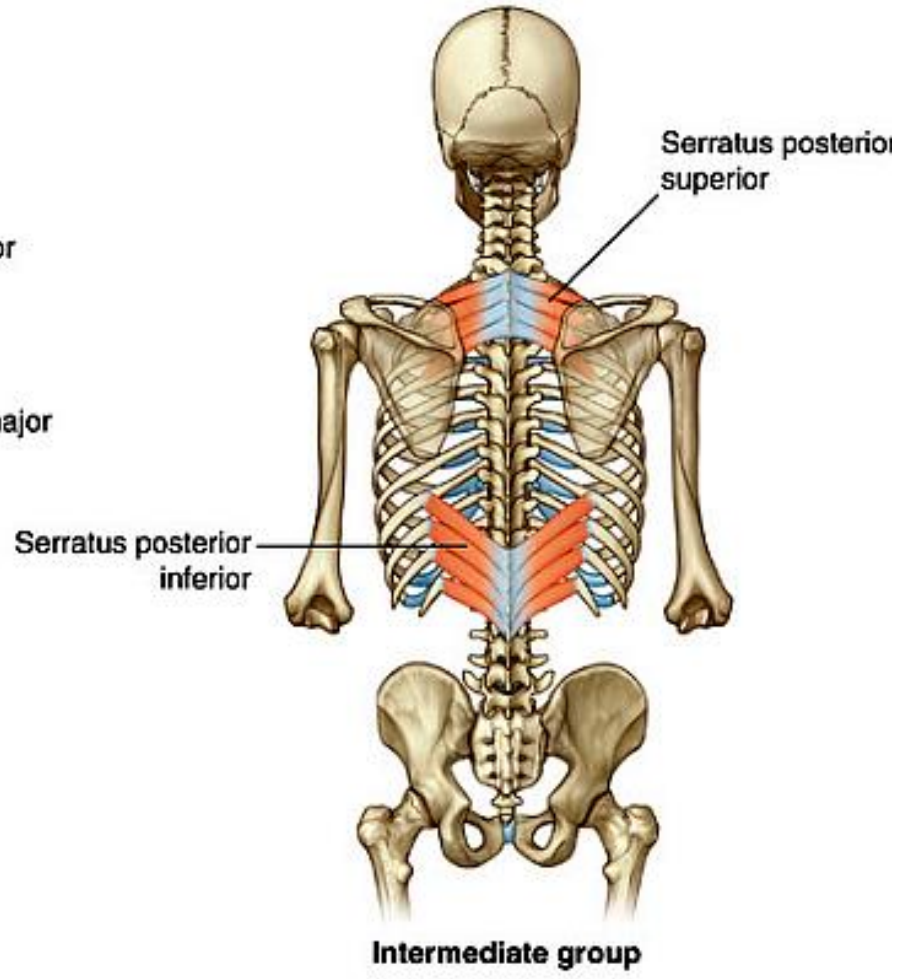


MUSCLES OF THE BACK

The **superficial layer**, the *extrinsic back muscles* (trapezius, latissimus dorsi, levator scapulae, and rhomboids) connect the upper limbs to the trunk (spine) and control limb movements. The **intermediate layer**, also the *extrinsic muscles* , ie. the serratus posterior superior et inferior mm., connects the spine to the ribs. The **deep layer mm.**, *intrinsic mm.,* errect or rotate the spine.



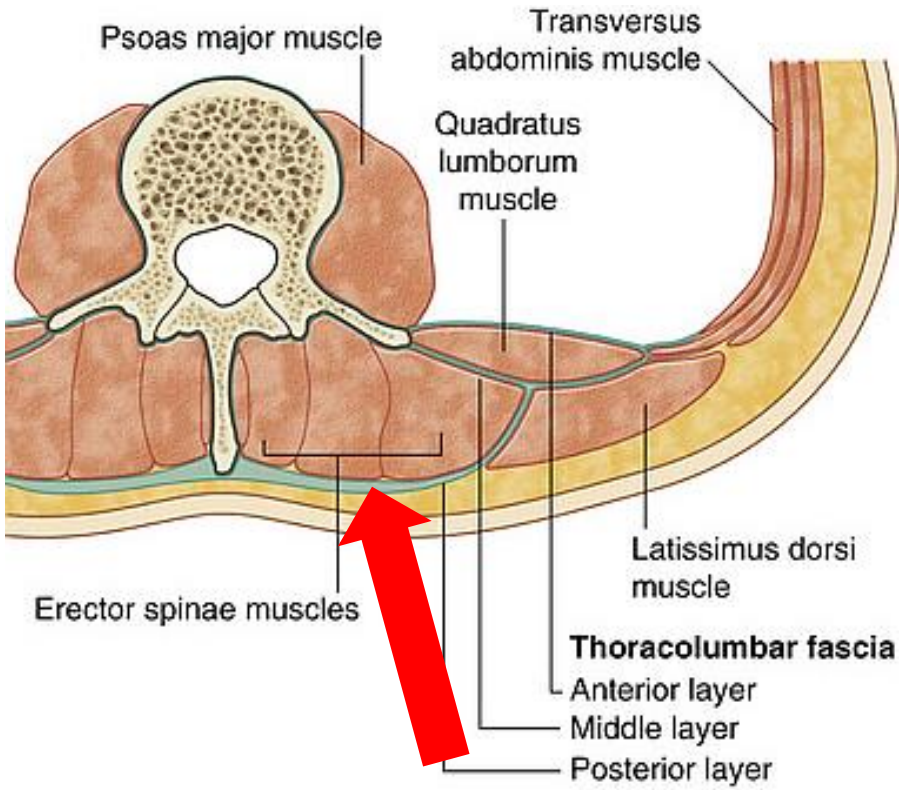




Extrinsic muscles
Innervated by anterior rami of spinal nerves or cranial nerve XI (trapezius)

Muscles of the back

A. Extrinsic – superficial and intermediate – innervated from the anterior branches of the spinal nerves
B. Intrinsic – deep - innervated from the posterior branches of the spinal nerves



Thoracolumbar fascia

Anterior layer
Middle layer
Posterior layer

Superiorly, it continuous with deep fascia in the neck.
In the thoracic region, it covers the deep muscles of the back and separates them from the muscles in the superficial and intermediate groups.
Medially, it attaches to the spinous processes of the thoracic vertebrae and, laterally, to the angles of the ribs.

THORACOLUMBAR FASCIA (TLF)

covers the deep muscles of the back and the trunk. Above, is continuous with tthe serratus posterior superior fascia and the superficial lamina of the deep cervical fascia.

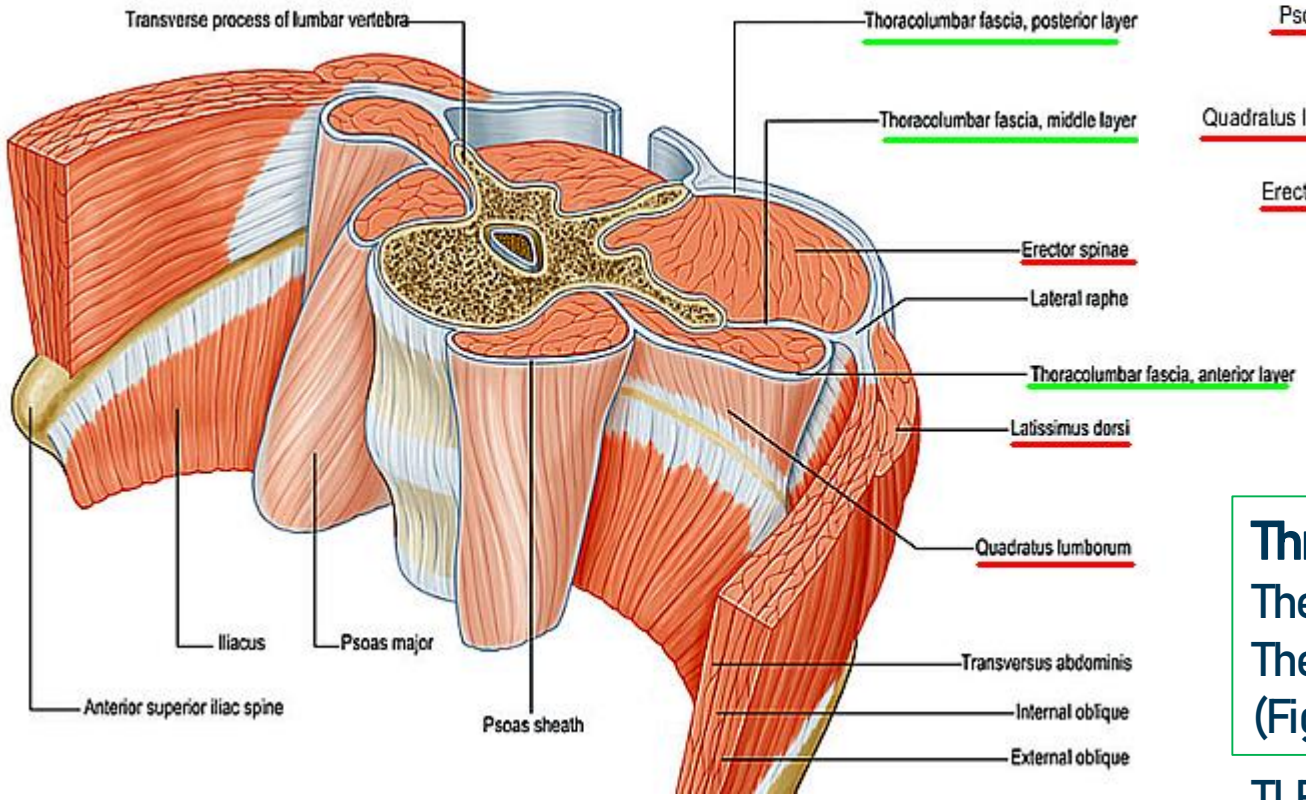


Fig. 1: Muscles and fasciae of the posterior abdominal wall, see also Fig. 2

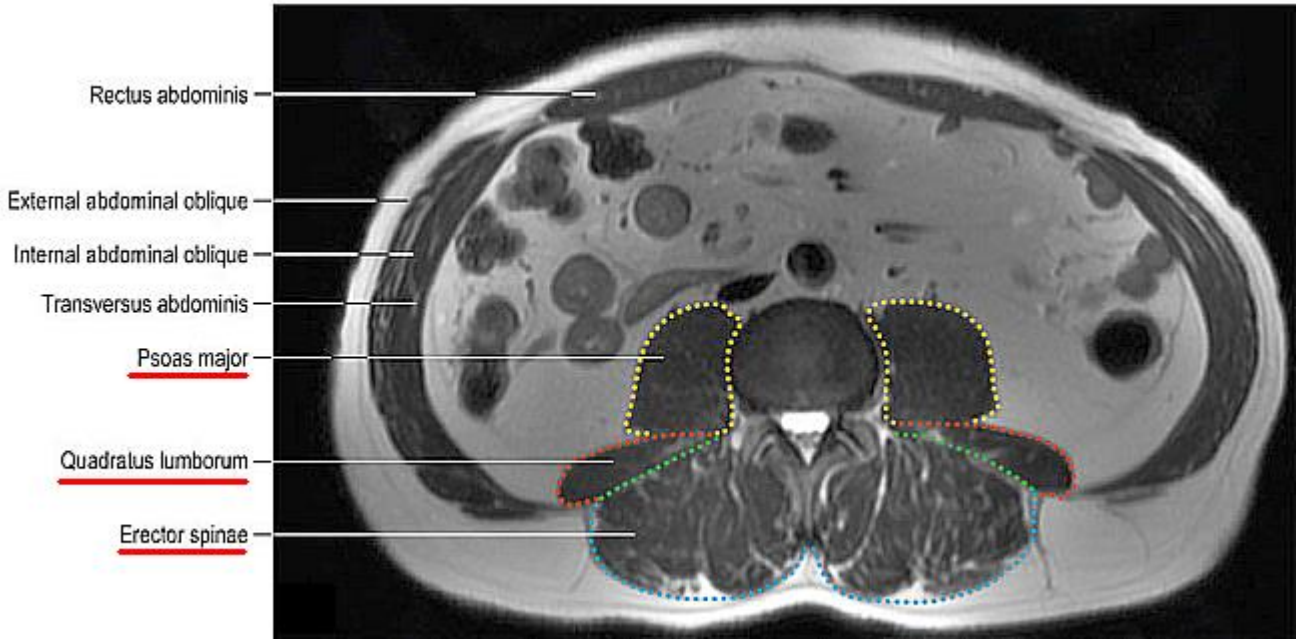
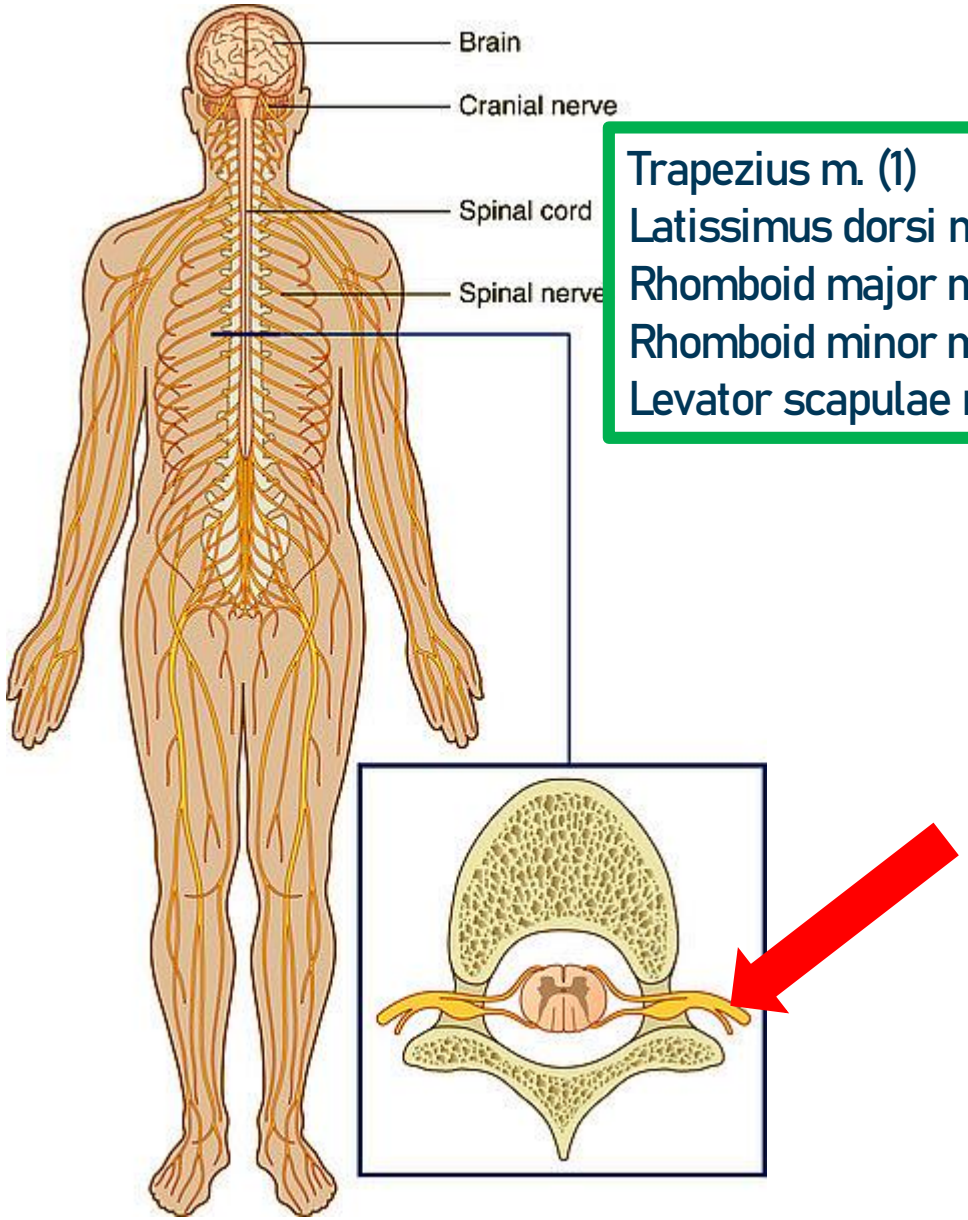


Fig. 2: An axial T2-weighted MR image through the lower abdomen at the level of L3

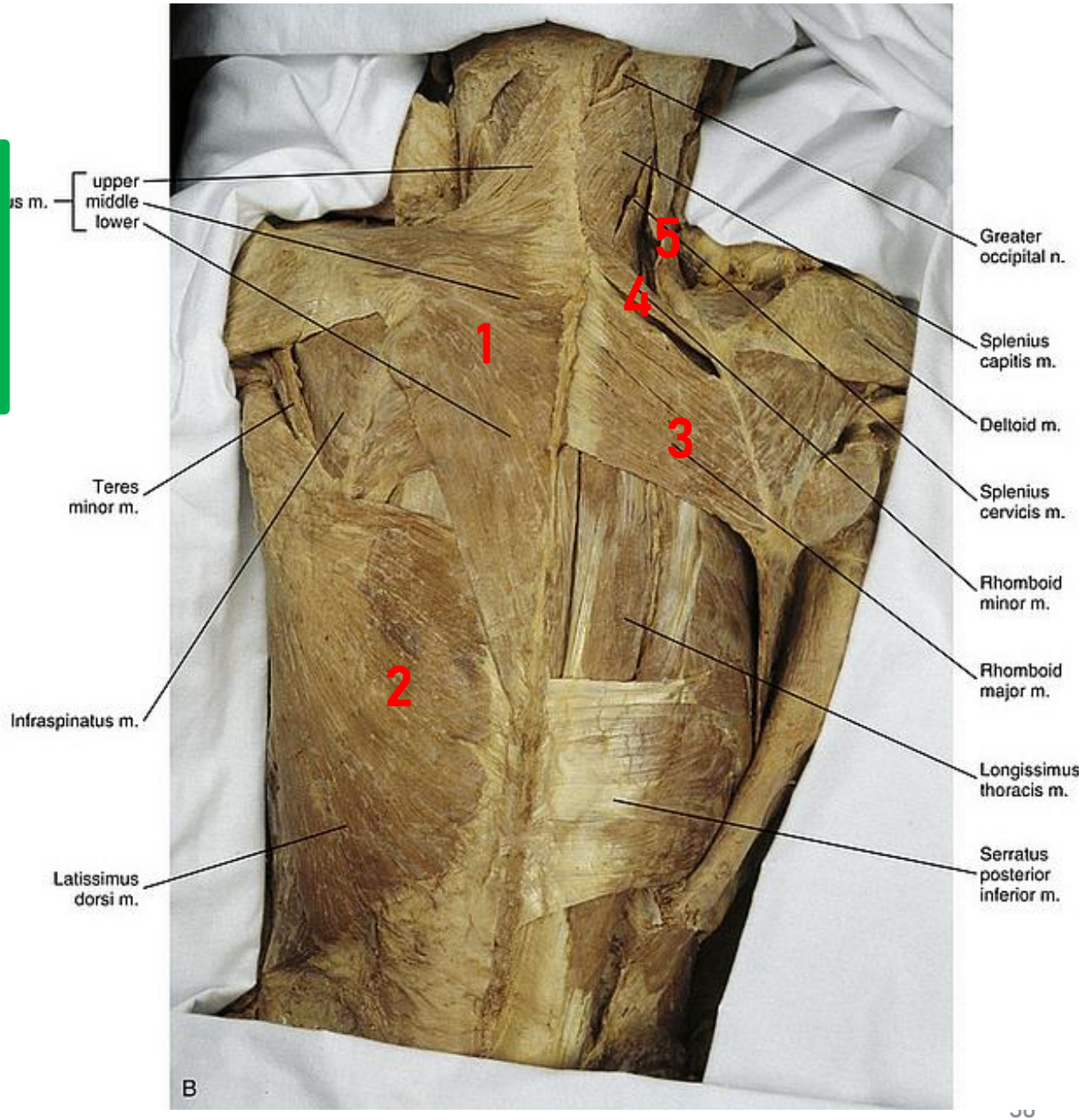
Three layers of the TLF: posterior, middle, anterior
The anterior layer covers quadratus lumborum.
The posterior and middle layers cover the errector spinae (Fig. 1).

TLF plays an important role in load transfer between the trunk and the limbs: its tension is affected by the actions of latissimus dorsi, gluteus maximus and the hamstrings. TLF contains nociceptive nerve endings.

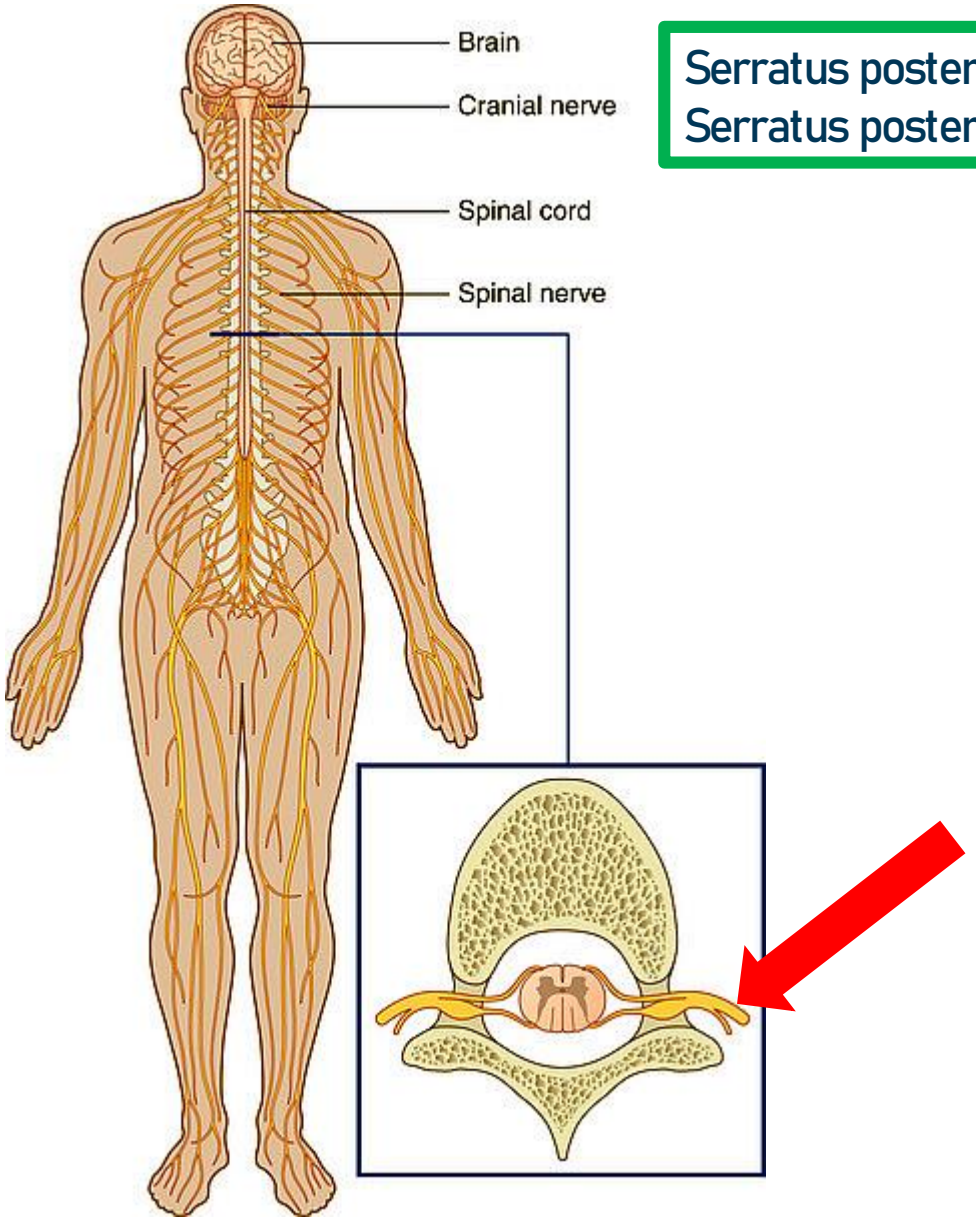
A1. Superficial (appendicular) group of back muscles



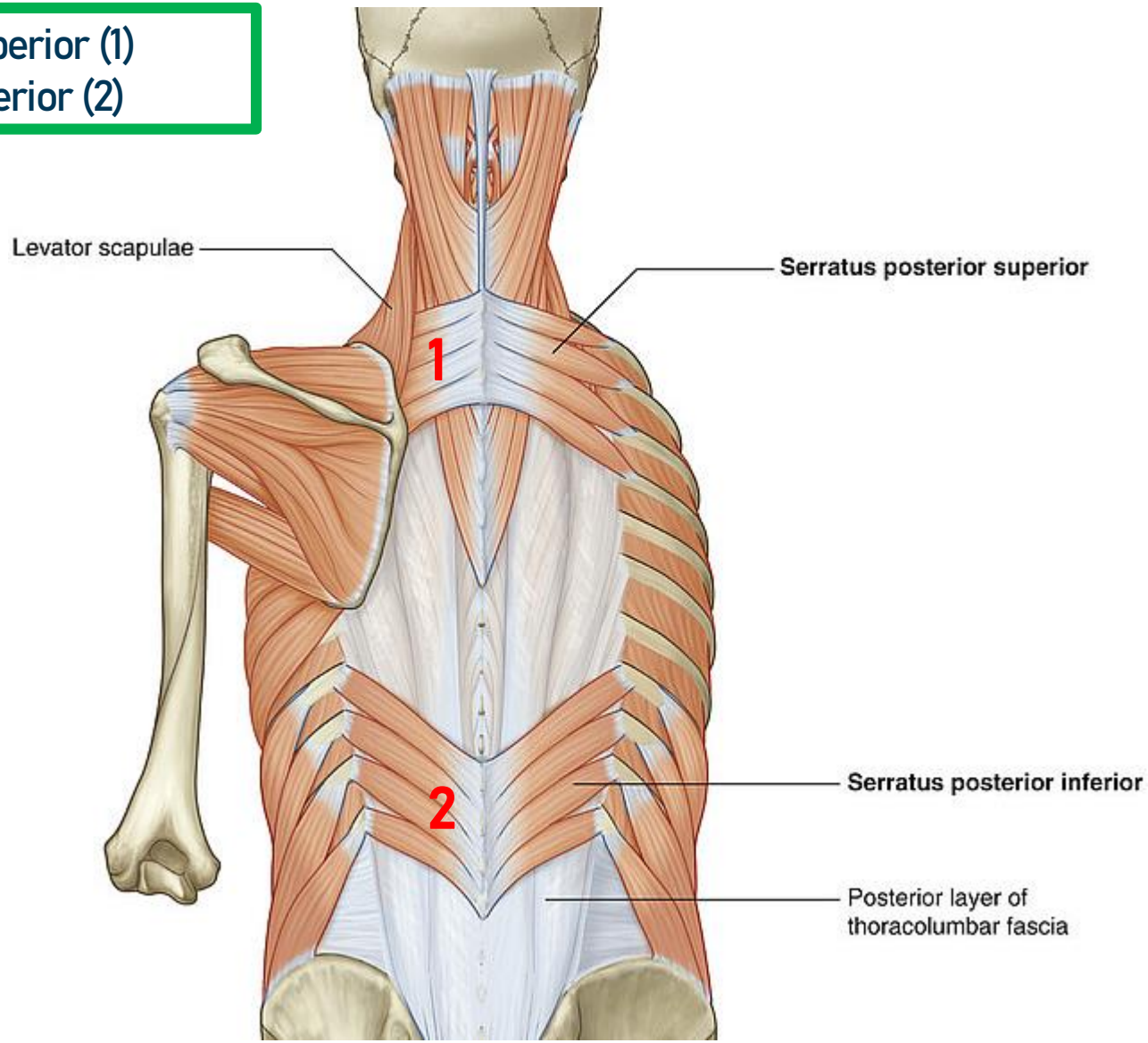
Trapezius m. (1)
Latissimus dorsi m. (2)
Rhomboid major m. (3)
Rhomboid minor m. (4)
Levator scapulae m. (5)



A2. Intermediate (respiratory) group of back muscles

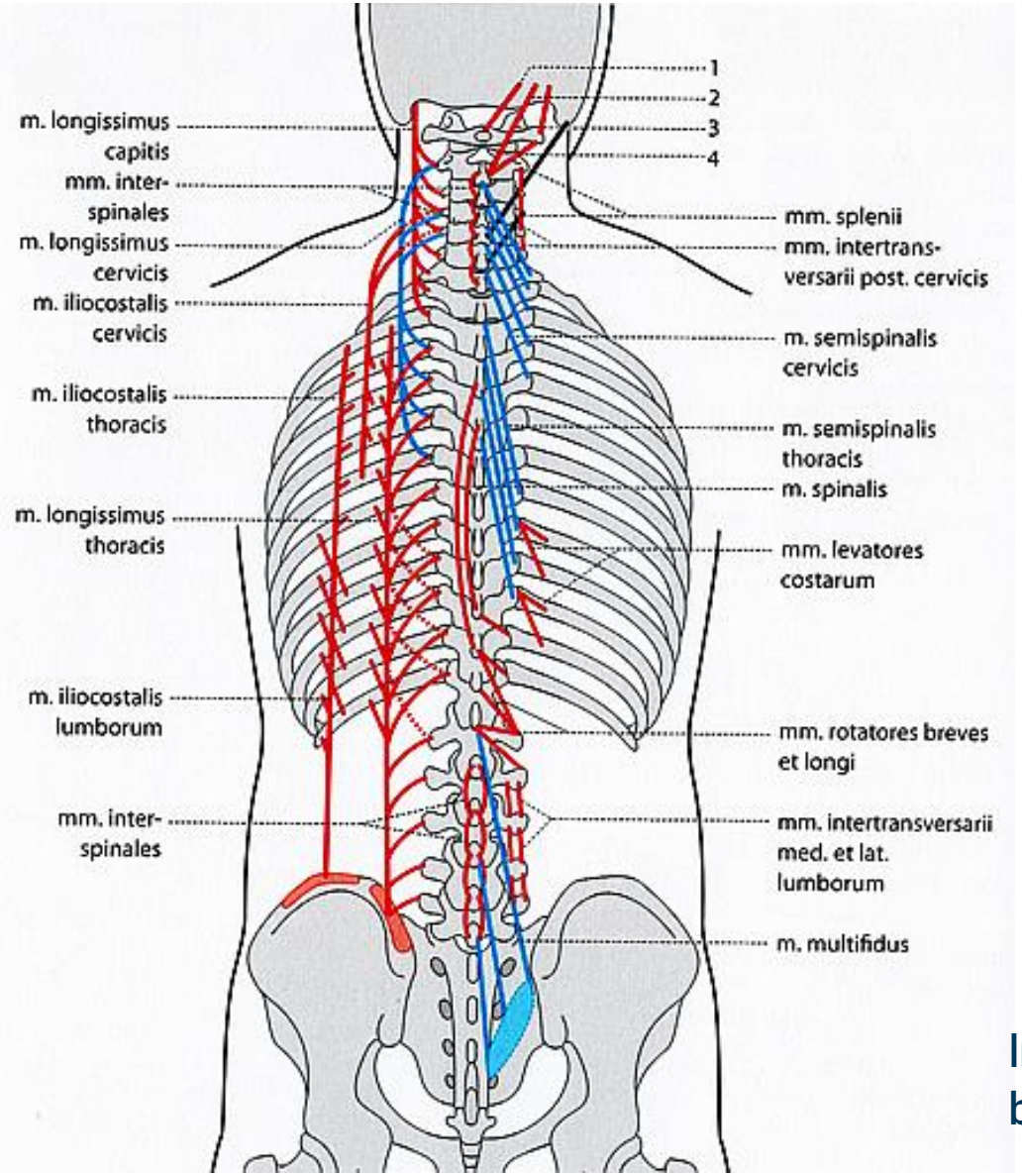


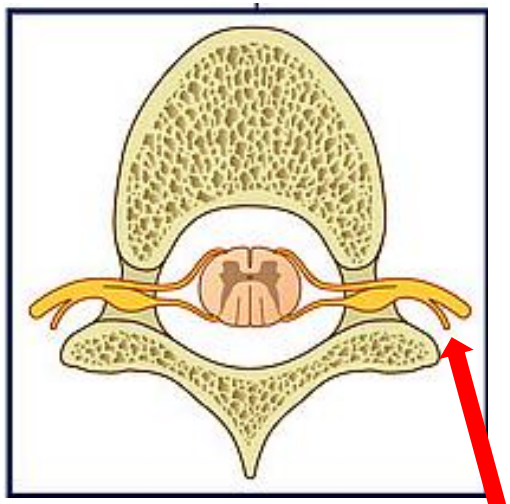
Serratus posterios superior (1)
Serratus posterios inferior (2)



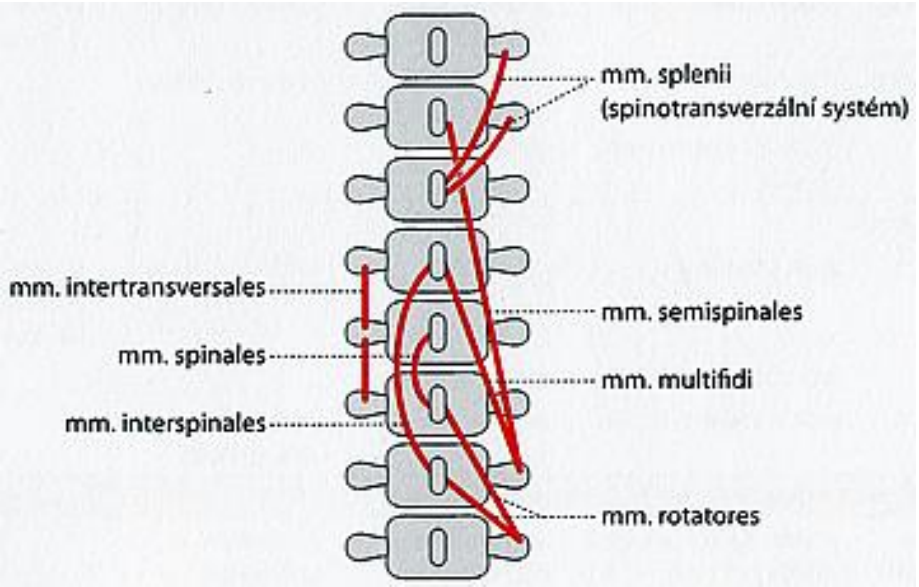
B. Deep group of back muscles

- **Extensors and rotators of the head and neck** — the splenius capitis and cervicis (spinotransversales muscles)
- **Extensors and rotators of the vertebral column** — the erector spinae and transversospinales
- **Short segmental muscles** — the interspinales and intertransversarii





Innervation from the **dorsal** branches of the spinal nerves



How much do you remember?
Name the marked structures. Not sure? The key is on the next slide :)

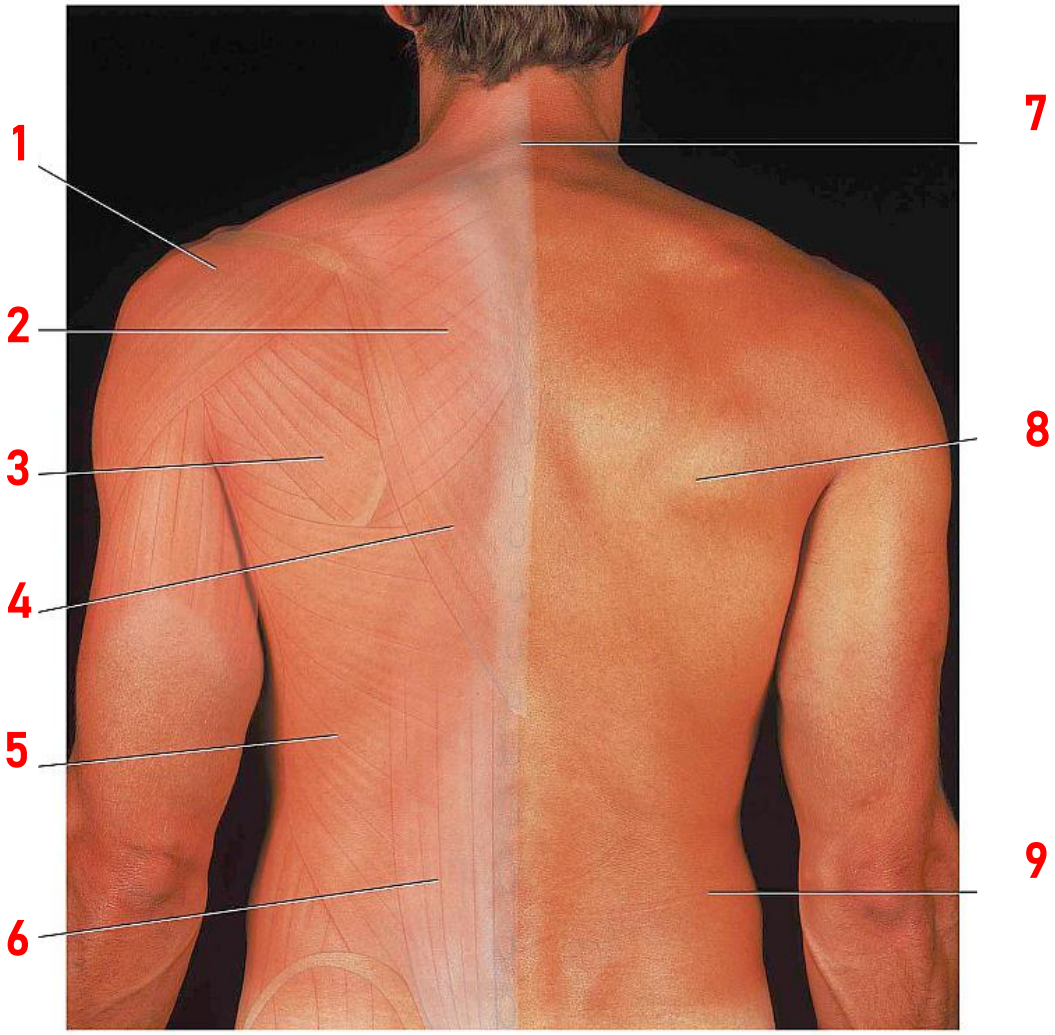


FIGURE 28.4 Back muscles—surface anatomy.
Observe the prominences created by the muscles of the back as the muscles are partially flexed.

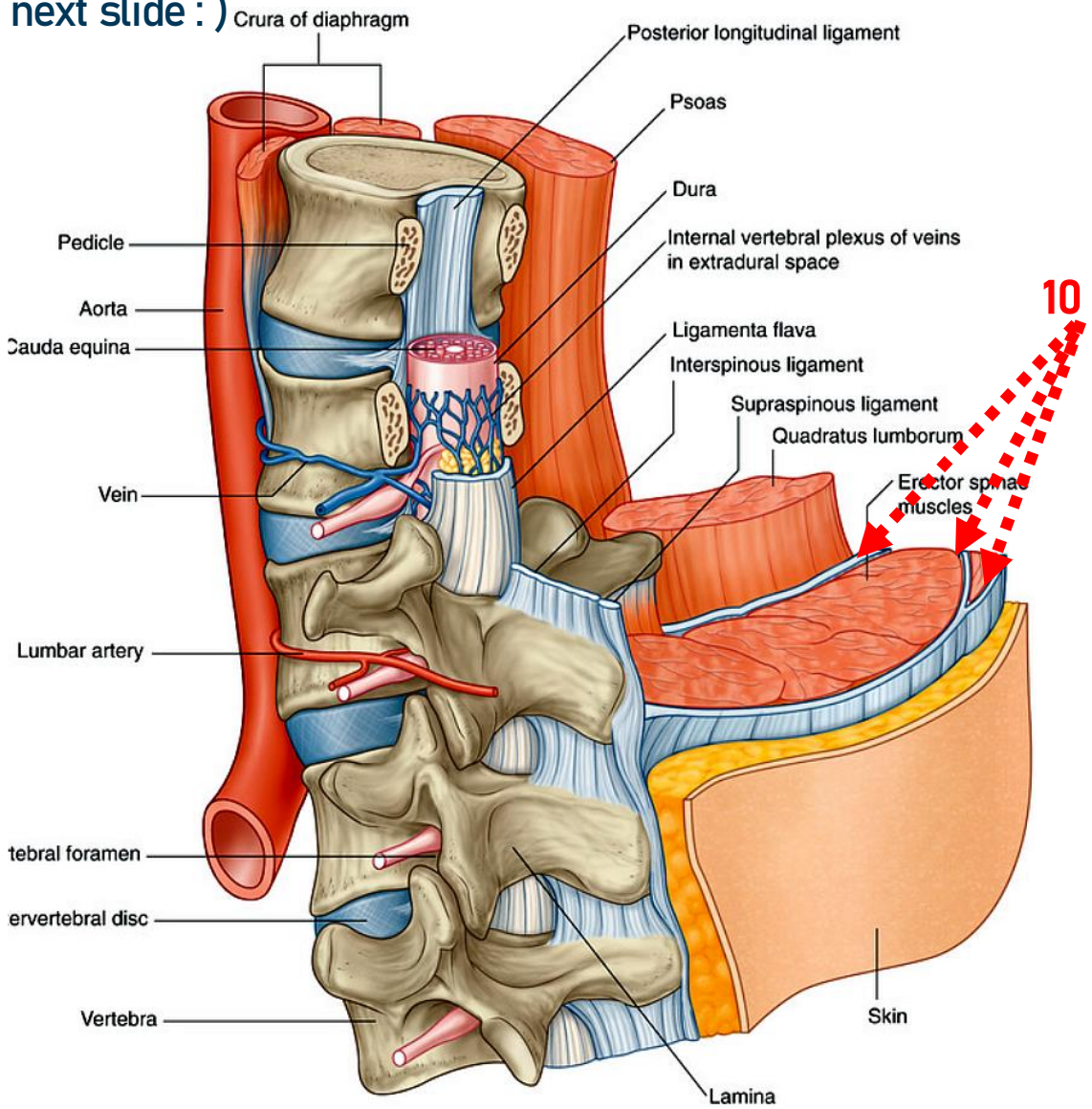


Fig.: Vertebral canal and the back, lumbar region

How much do you remember?
Here is the key:

1 – deltoid m.
2 – trapezius m., rhomobid major m. under it
3 – teres minor m.
4 – trapezius m.
5 – latissimus dorsi
6 – erector spinae m.
7 – vertebra prominens
8 – inferior angle of scapula
9 – external oblique m.

10 – thoracolumbar fascia

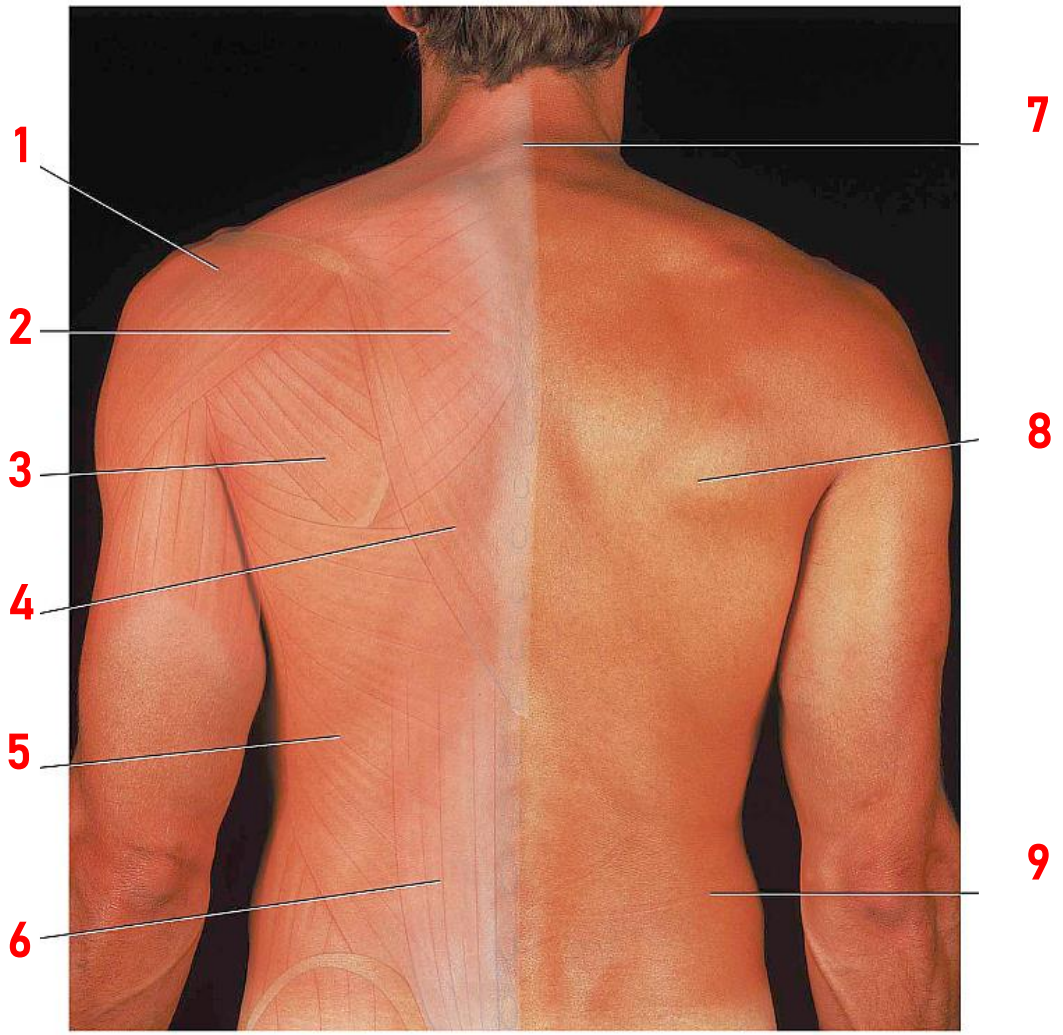


FIGURE 28.4 Back muscles—surface anatomy.
Observe the prominences created by the muscles of the back as the muscles are partially flexed.