ANP 1106: Topic 3C

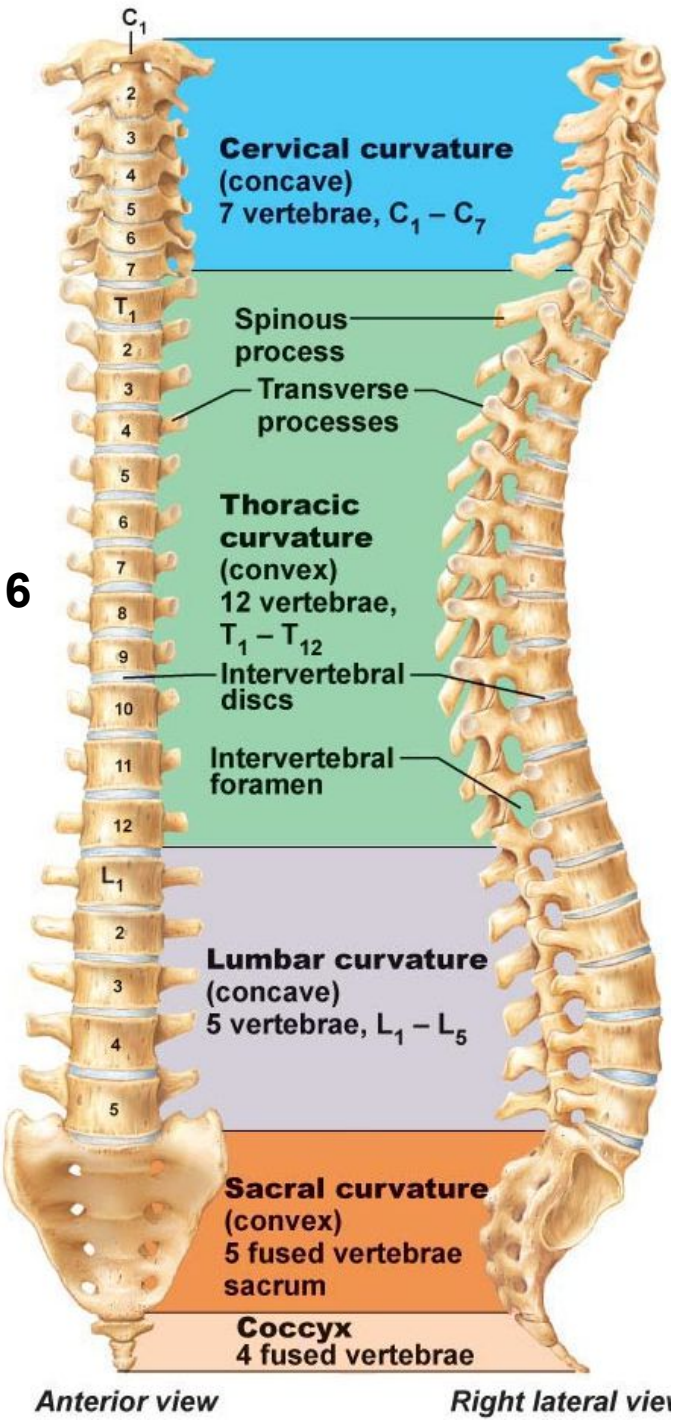
More Anatomy of the Skeletal System

VERTEBRAL COLUMN

33 bones of which 24 remain separate (flexibility) and the remaining 9 fuse to form 2 composite bones (**sacrum** & **coccyx**) - 70 cm long

7 cervical, 12 thoracic, 5 lumbar, 5 sacral, 3/4 coccyx

Fig. 7.16



3 main functions:

(1) **weight-bearing**
(2) **anchor** for muscles & ligaments
(3) **protection** of spinal cord

CURVATURES

- **resilience** & **flexibility**

cervical & **lumbar:** **concave**

thoracic & **sacral:** **convex**

SUPPORTING ELEMENTS OF VERTEBRAL COLUMN

1. Ligaments:

- strap-like; support column of bones so stay upright
- major supporting ligaments are **anterior** & **posterior longitudinal**
- continuous bands down front & back of vertebral bodies from neck to sacrum
- broad **anterior** is strongly attached to bony vertebrae & the discs; prevents **hyperextension** (bending backwards) of spine
- **posterior** is narrow, weaker & attached only to discs; prevents **hyperflexion** (bending forwards) of spine

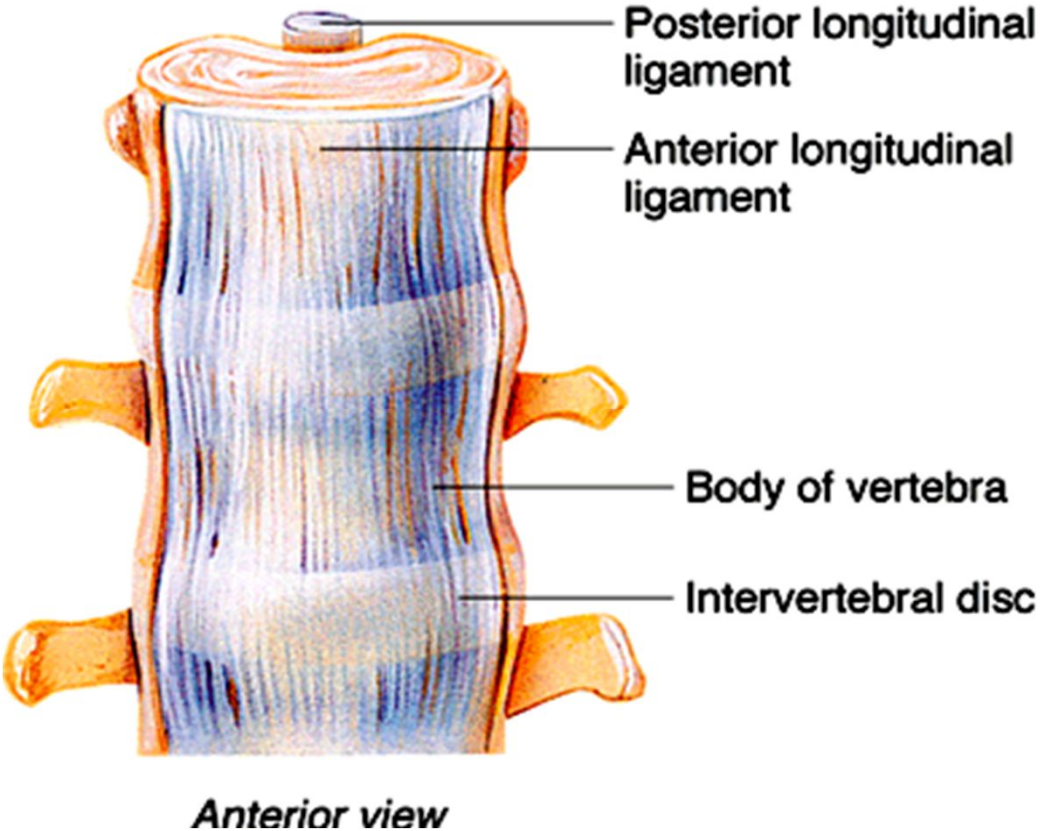
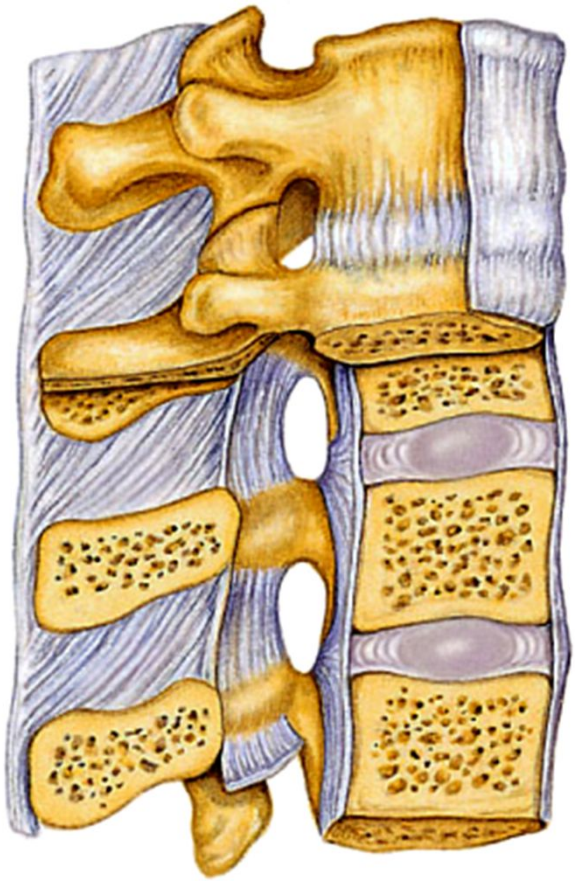


Fig.7.17b

2. Intervertebral Discs:

- cushioning between bony vertebral bodies - shock absorbers - 25% of total length of vertebral column
- each is circular with **nucleus pulposus** in centre & **annulus fibrosus** around periphery
  - ring of fibre cartilage, ie. pillow that absorbs compressive shock
- **nucleus pulposus** is like a rubber ball »» elasticity & compressibility
- **annulus fibrosus** holds together successive vertebrae & resists tension in spine
- discs thickest in **lumbar**/**cervical** regions » flexibility



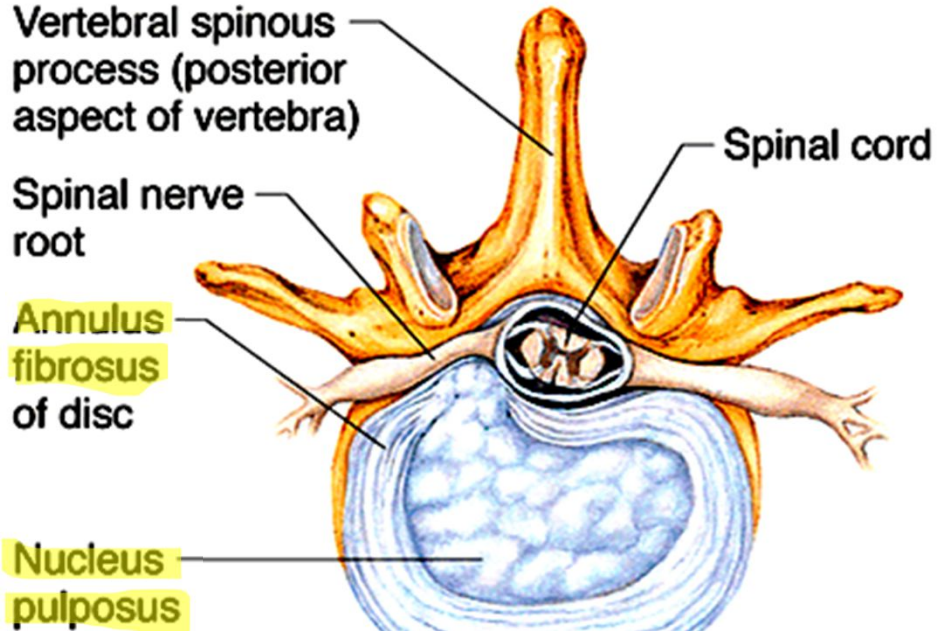


Fig. 7.17a,c

What is a herniated disc?

TYPICAL VERTEBRA:

get larger as one descends column

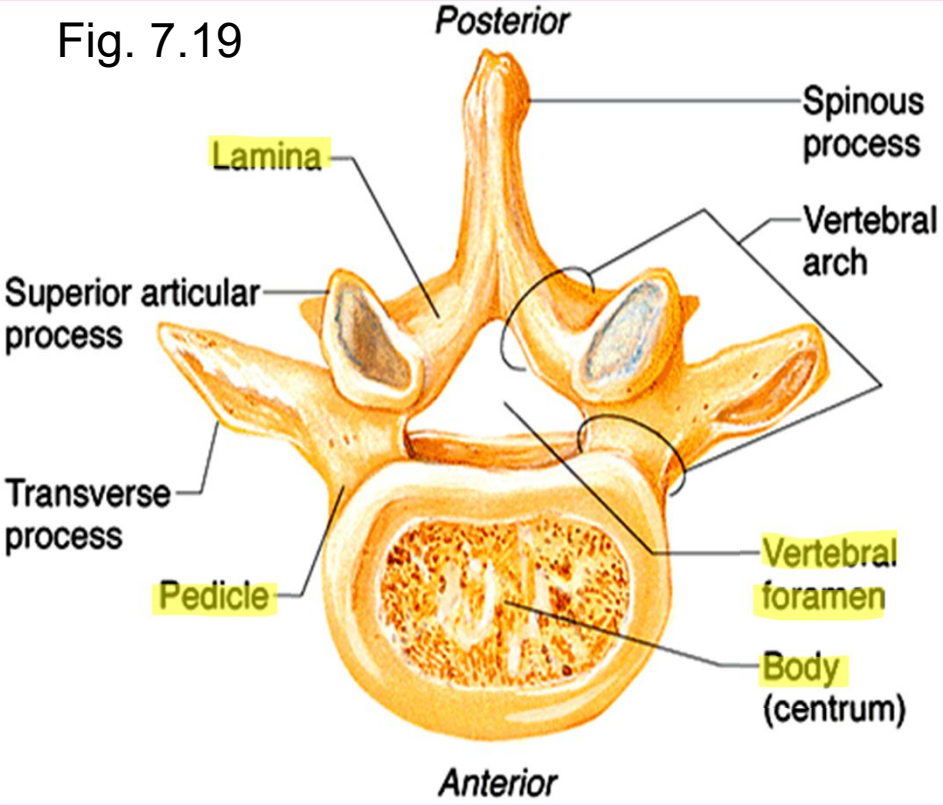
weight-bearing **body** + **vertebral arch**

arch + body enclose **vertebral foramen** (*What passes through here? What forms the **vertebral canal**?)*

- 2 **pedicles** + 2 **laminae** make up each **vertebral arch**

pedicles have notches on superior & inferior surfaces »» lateral openings between adjacent vertebrae called **intervertebral foramina** (*nerves pass through here)*

Fig. 7.19



7 processes from each vertebral arch:

- **1 spinous process** • muscle attachment
- **2 transverse processes** - 1 per side for muscle attachment
- **paired superior & inferior articular processes** - link vertebrae above & below; smooth, collagen-coated facets for articulation between vertebrae

CERVICAL VERTEBRAE

7 total; #1 & 2 have unusual structure & no intervertebral disc

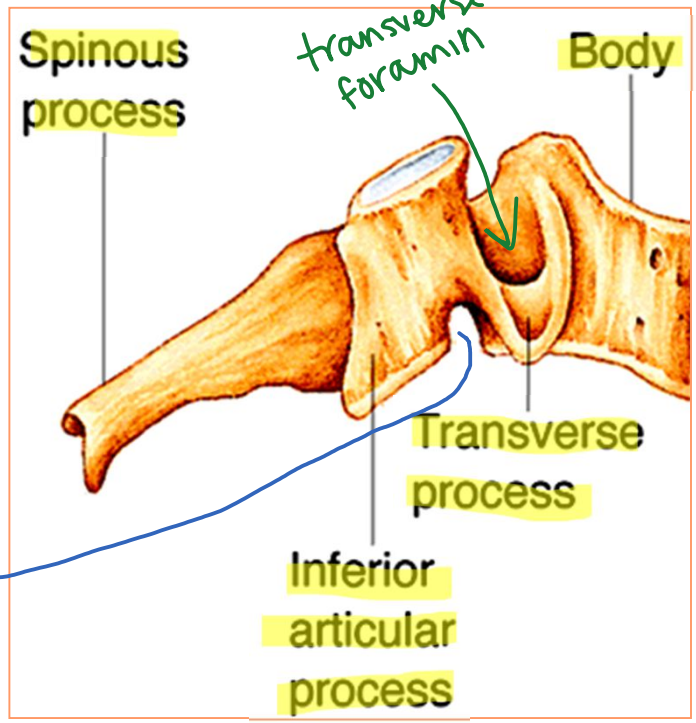
#3-7 considered *typical*:

(1) body oval, broader side-to-side than front-to-back

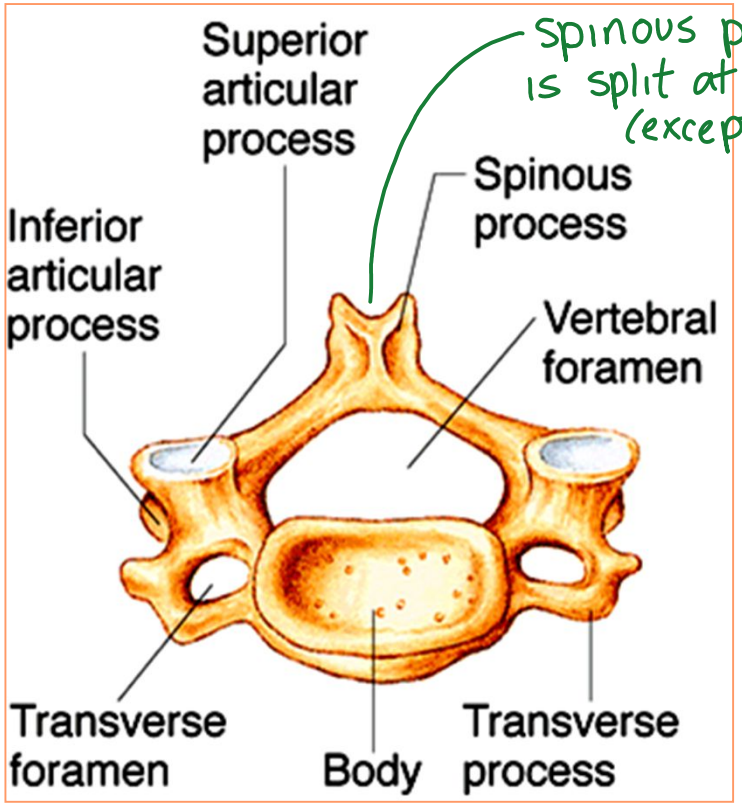
(2) spinous process short & split at end (except #7 - sticks out/not split)

(3) vertebral foramen relatively large ▲

(4) each transverse process contains transverse foramen for passage of vertebral artery to brain



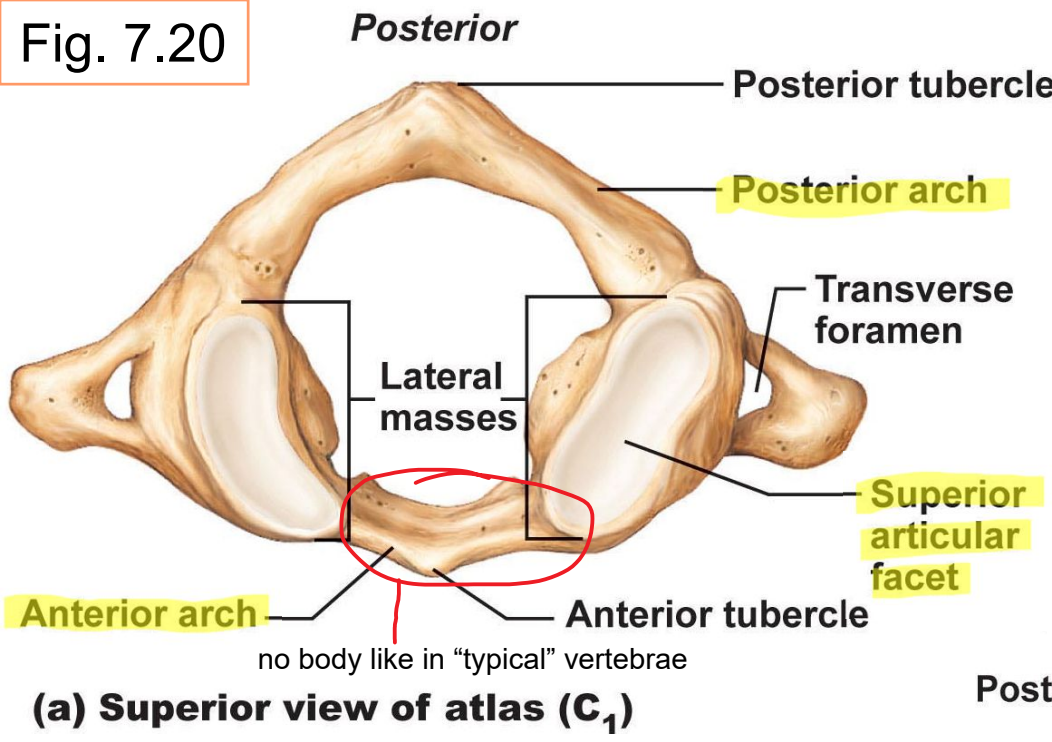
tches in pedicle
at form
ervertebral
amina (that nerves
ss through)



Typical Cervical Vertebrae (C3-C7):

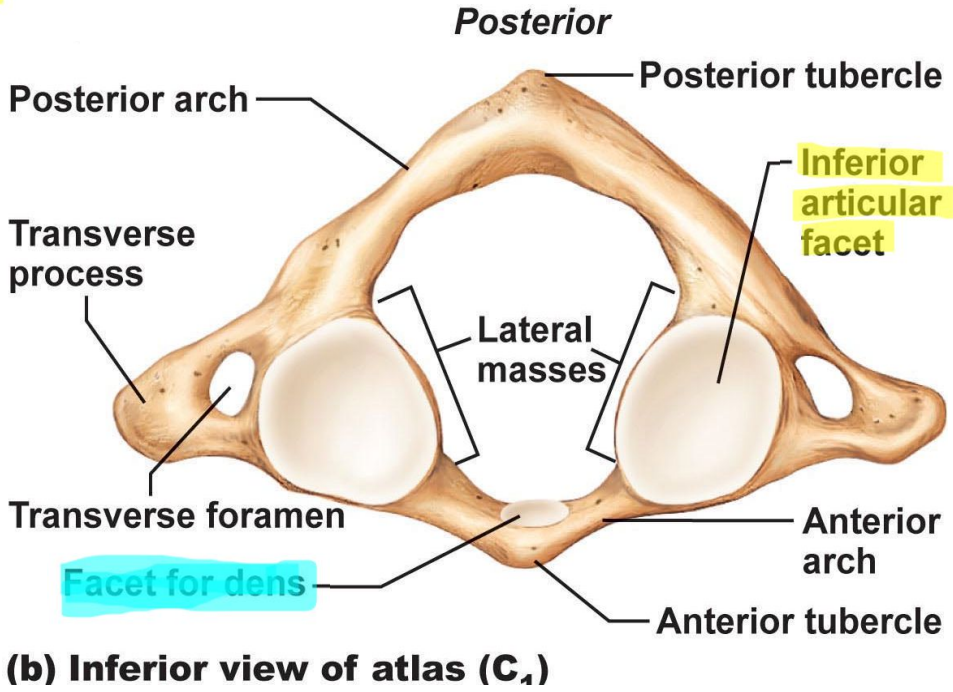
Table 7.2a

Fig. 7.20



(a) Superior view of atlas (C_1)

no body, no spinous process, no pedicles or laminae, only posterior and anterior arches



(b) Inferior view of atlas (C_1)

Atlas (C_1):

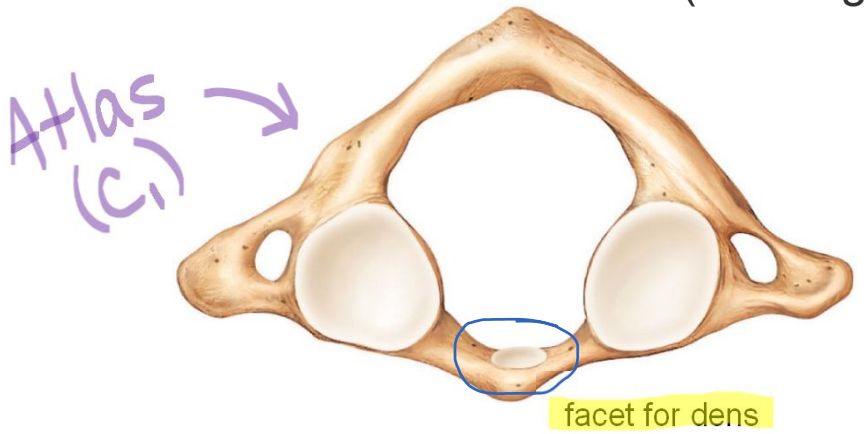
- no body & no spinous process
- posterior & anterior **neural arches**
- lateral masses with **superior** & **inferior articular facets –**

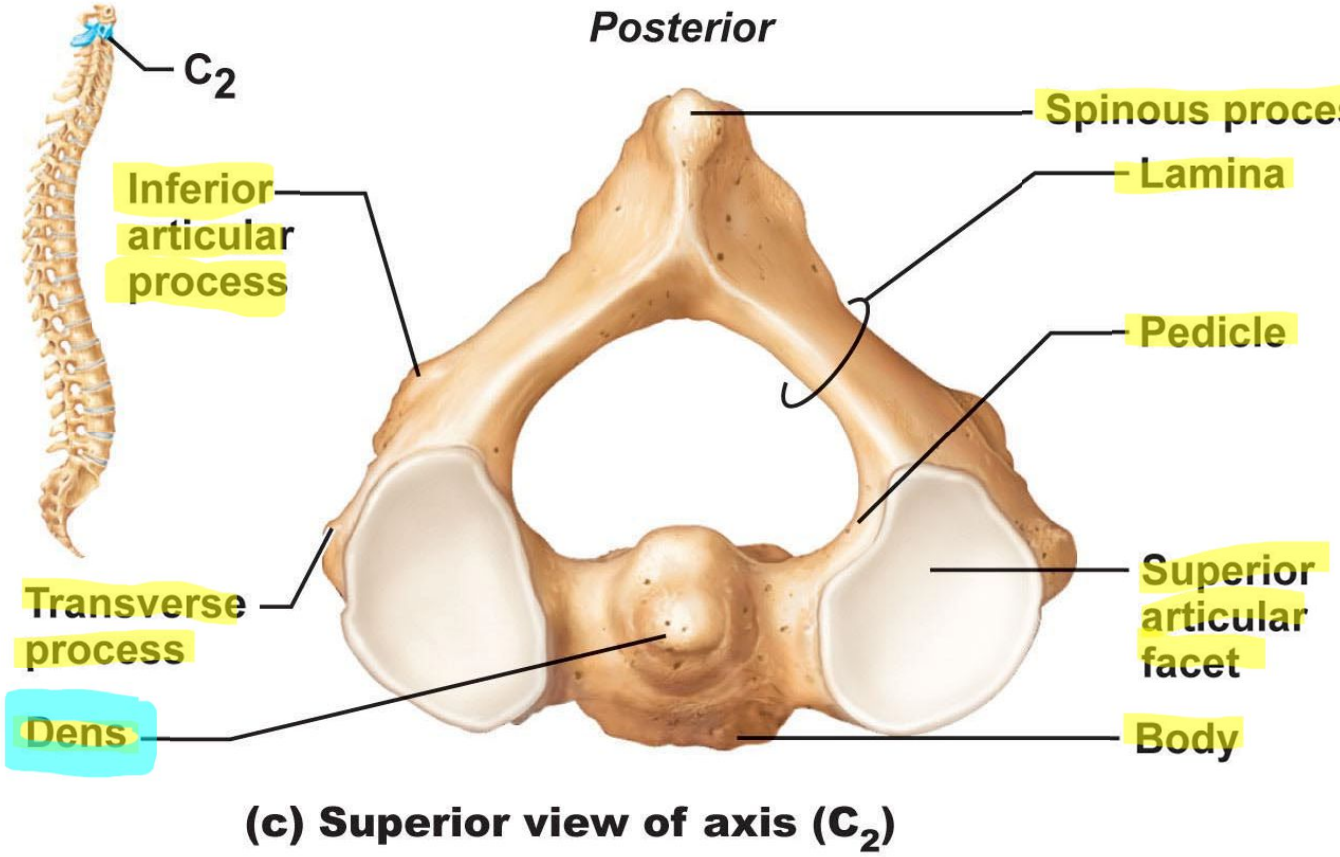
articulation with brain and with C2 (allows movement of the neck up and

occipi
articul

Axis:

- more like others, except for **dens or odontoid process** = pivot → allows for mo (nodding)





(c) Superior view of axis (C_2)

dens inserts here in order to shake your head, C1 intera with C2

facet for dens will tell you whether you're looking at in or superior view of Atlas/C1

THORACIC VERTEBRAE

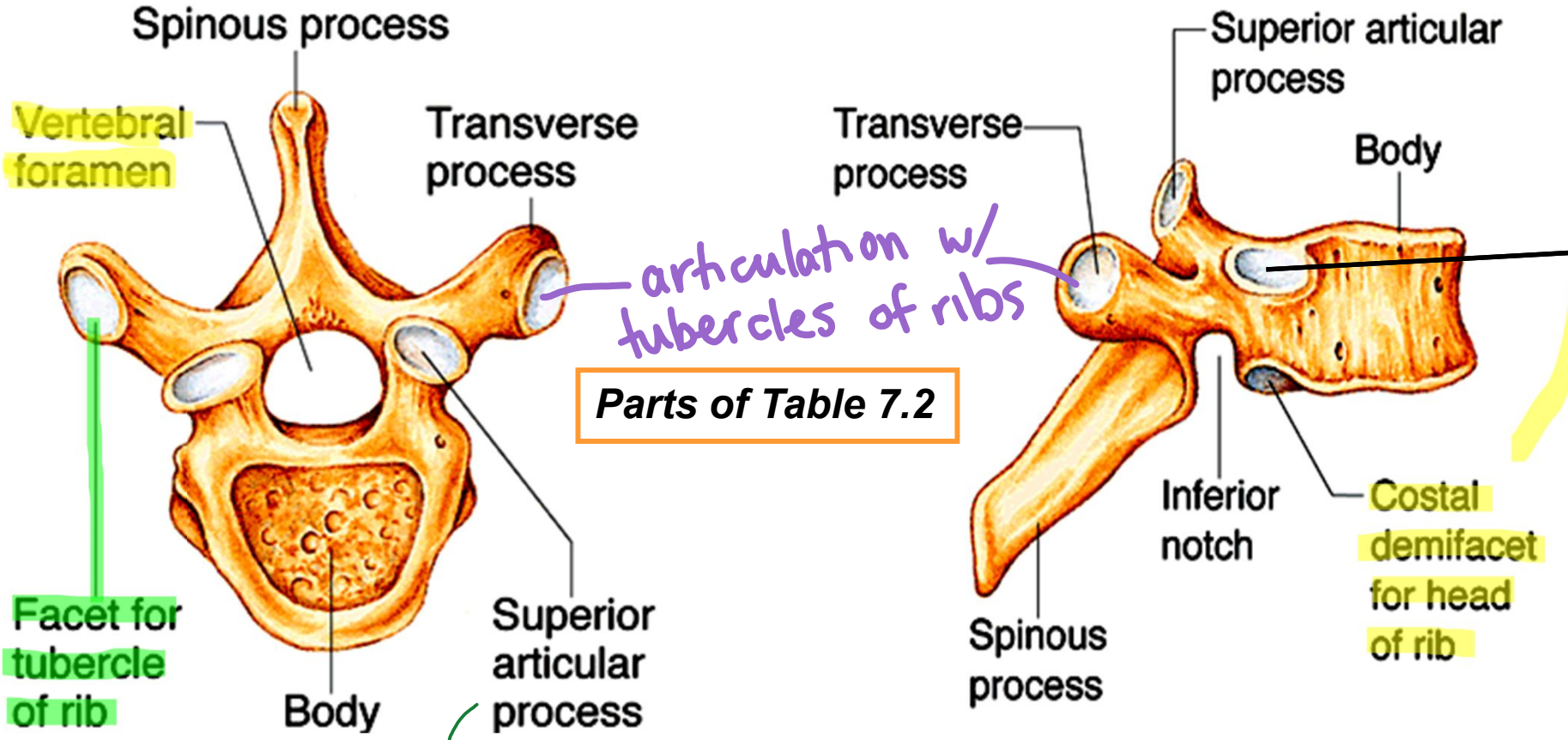
- **12** in all; all have ribs attached; increase in size from first to last

(1) body roughly heart-shaped & bears facets for ribs (paired **demi-facets**)

(2) **vertebral foramen** is circular

(3) **spinous process** long, points ⇓

(4) transverse processes have facets for articulation with **tubercles** of ribs (except nos. 11 & 12)



LUMBAR VERTEBRAE

lower back » major weight-bearing function, must be strong and sturdy

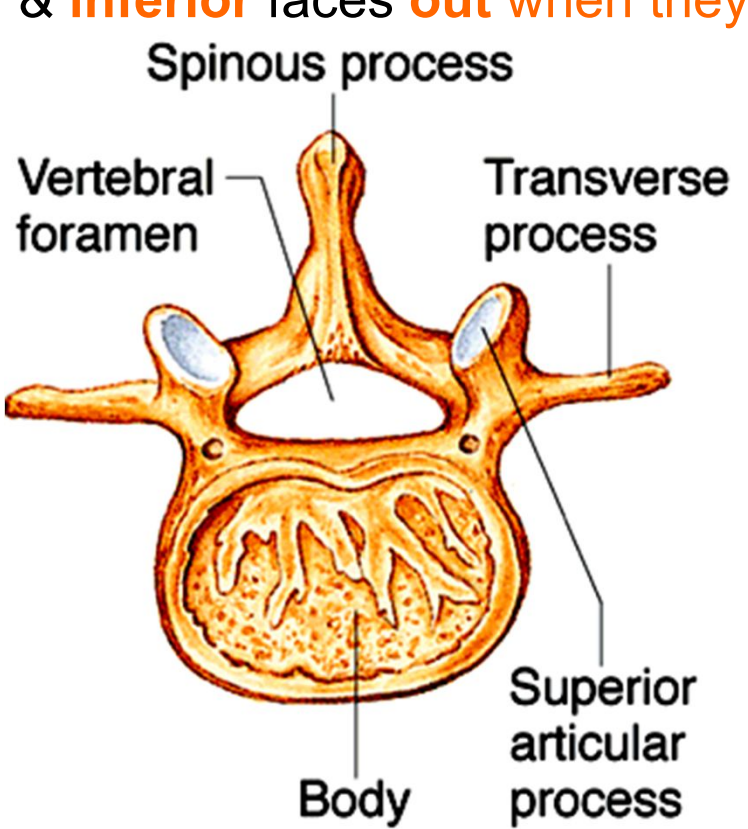
- bodies are kidney-shaped & increase in size from top to bottom

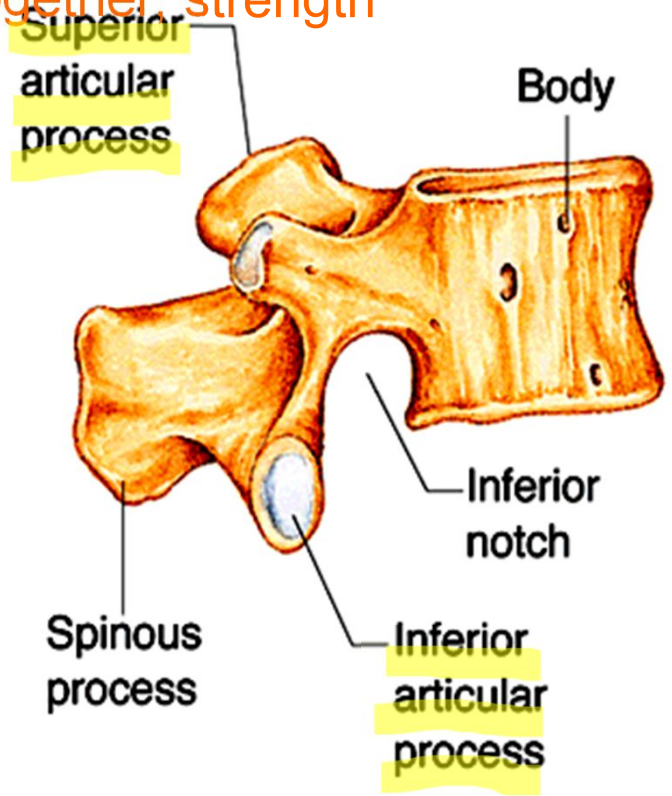
(1) **pedicles** & **laminae** shorter & thicker than those of other vertebrae

(2) **spinous processes** are flat & short - project directly back, chunky because lots of large muscles attach

(3) **vertebral foramen** is triangular

(4) orientation of inferior & superior facets unique - curved; **superior** faces **in** & **inferior** faces **out** when they fit together; strength





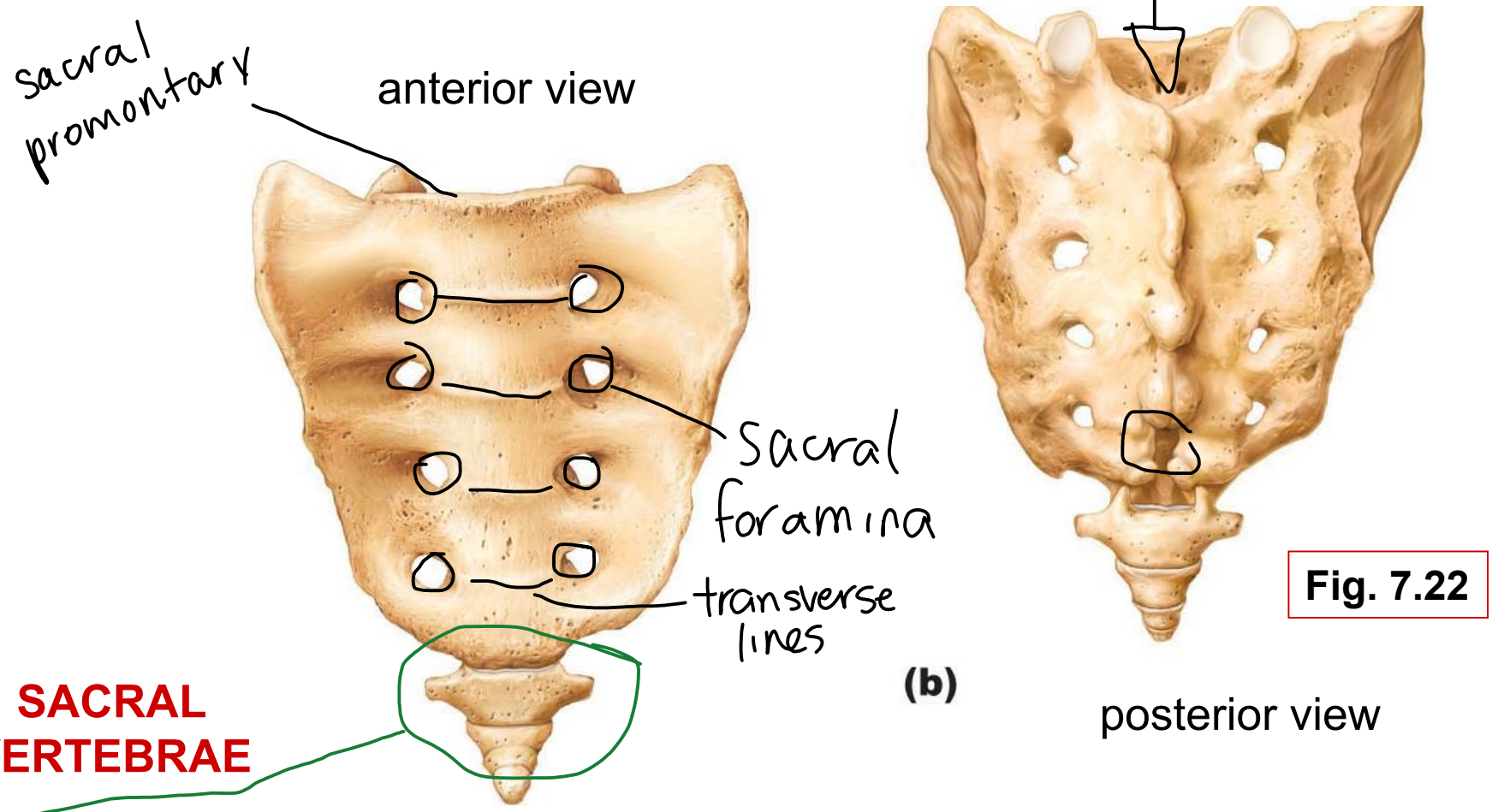


Fig. 7.22

SACRAL VERTEBRAE

starts as 5 separate vertebrae »» <u>fuse in adolescents</u> = **sacrum**

articulates with 5th lumbar & laterally with hip bones (**sacroiliac joint**)

- *<u>note (anterior)</u>*: **sacral promontory, transverse lines** & **sacral foramina**
- *<u>note (superior):</u>* median **sacral crest**, **sacral canal**, **sacral hiatus**

COCCYGEAL VERTEBRAE

- tailbone = 3 or 4 fused coccygeal vertebrae
- attachment area for some pelvic ligaments, but otherwise quite useless

BONY THORAX

- thoracic vertebrae + ribs + costal cartilage + sternum
- protective cage around heart, lungs & major blood vessels
- supports shoulder girdle & upper limbs
- provides area of muscle attachment for back, chest & shoulders

STERNUM

- anterior midline of thorax
- fusion of 3 bones: **manubrium**, **body**, **xiphoid process**
- **manubrium** articulates with **clavicles** via **clavicular notches**; **also with 1st pr of ribs**
- **body** has notches for articulation with 2nd to 7th ribs
- attachment of some abdominal muscles to **xiphoid process**

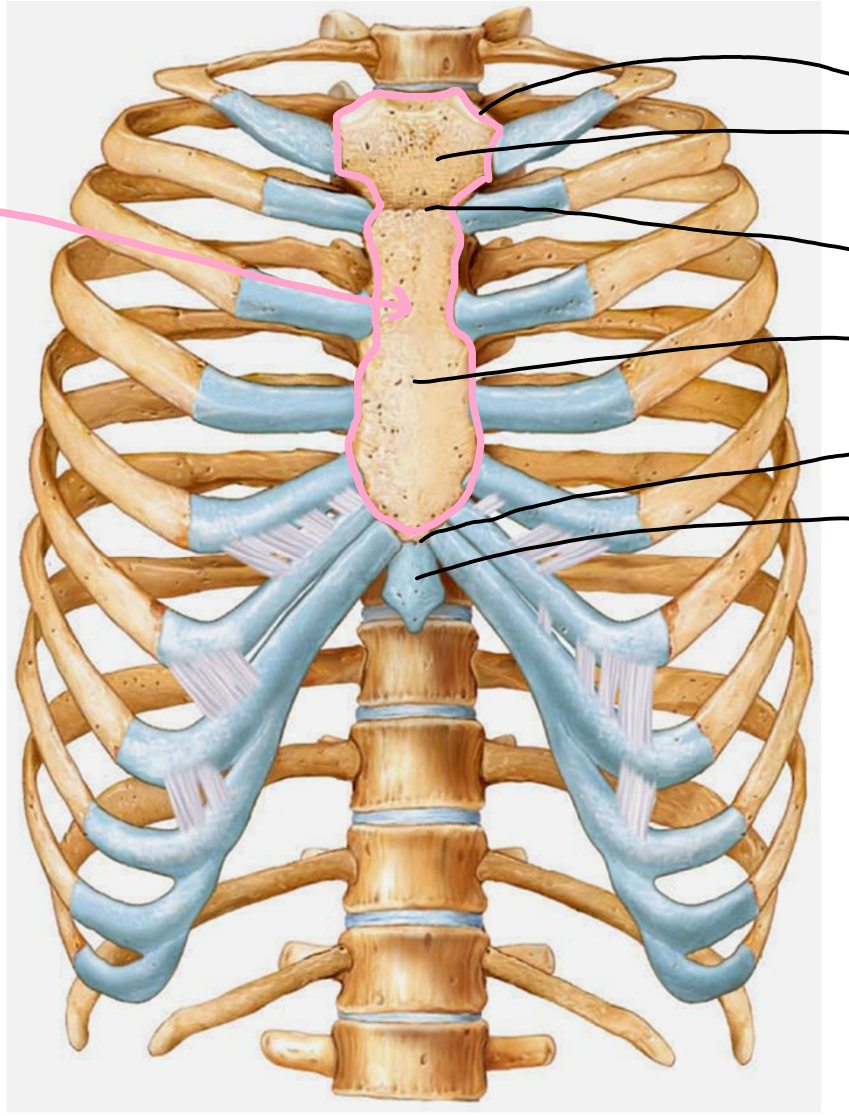


Fig. 7.23

3 important anatomical landmarks:

(1) **Jugular notch**: indentation you can palpate; in line with disc between T_2 & T_3;left common carotid artery from aorta

(2) **Sternal angle:** cartilaginous hinge between manubrium & body of sternum

(3) **Xiphisternal joint:** fusion of sternal body & xiphoid process - opposite T_9

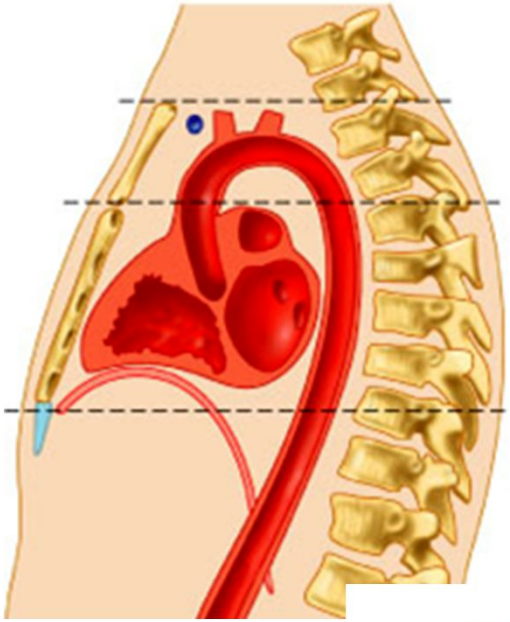
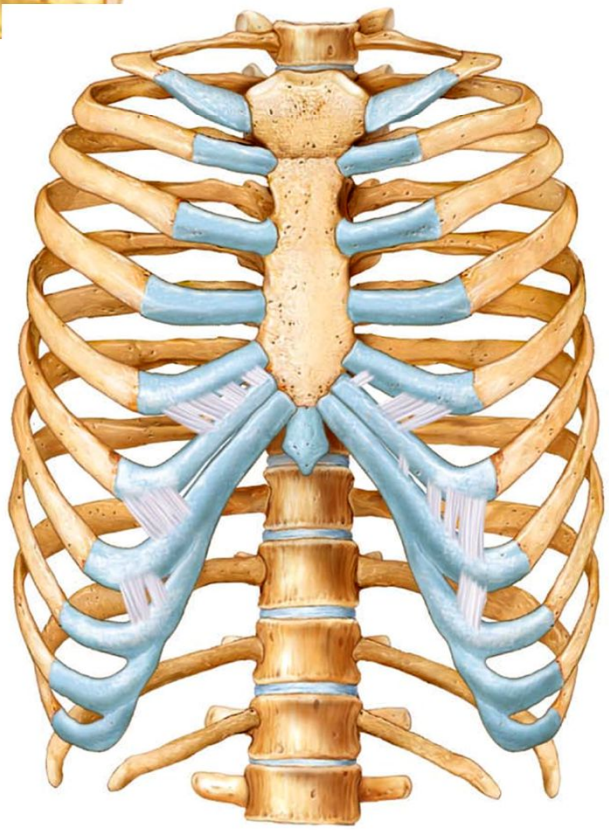


Fig. 7.19 (7th ed)



RIBS

- 12/side; all attach at back to vertebral column
- curve inferiorly & anteriorly
- **7 true ribs** attach to sternum directly; remaining **5** are **false ribs**
  - » **ribs 8-10** attach to sternum indirectly via costal cartilages & rib 7
  - » **ribs 11 & 12** are not attached anteriorly = **floating ribs**

RIBS (cont.)

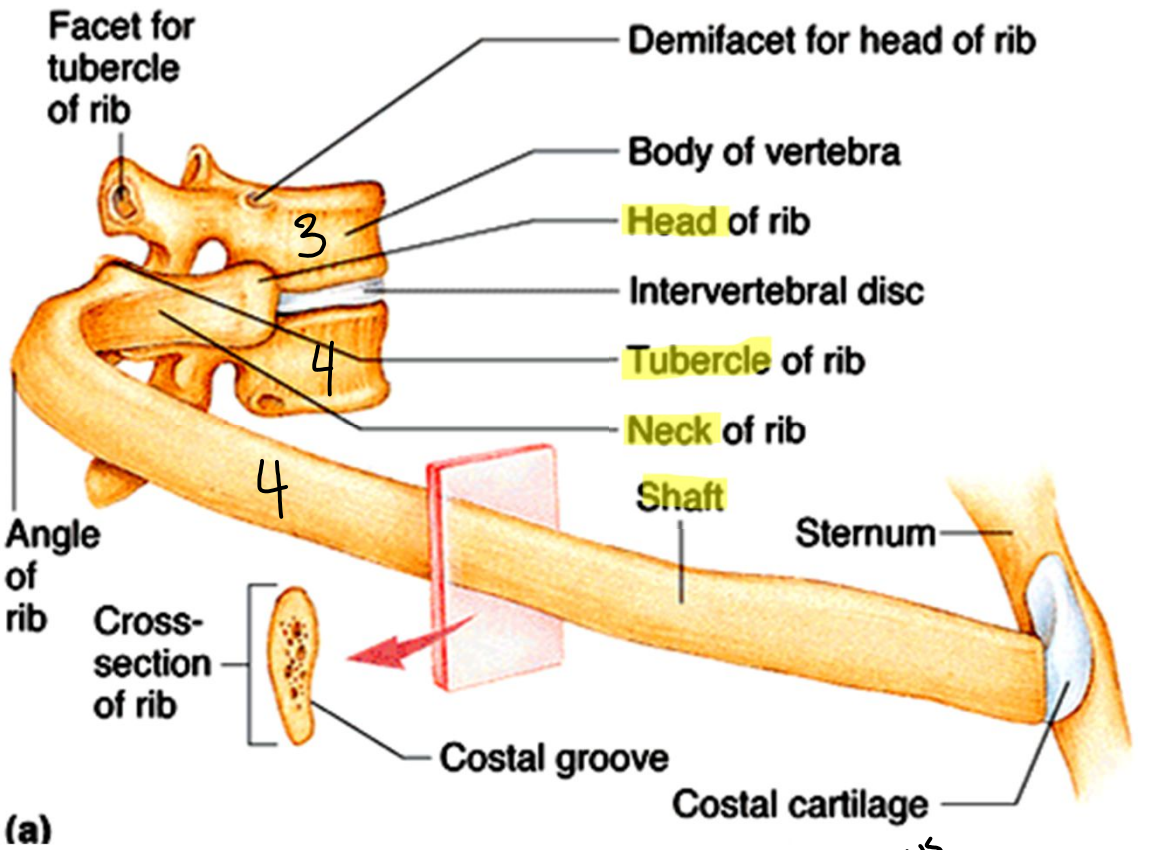
typical rib is a bowed, flat bone

shaft, head, neck, tubercle

- main portion is **shaft** – what is the **costal groove?**

note head with **2 facets** - one articulates with the demi-facet on the body of the **same-numbered** thoracic vertebra, other with that on the body of **superior** vertebra

tubercle articulates with **transverse process** of same-numbered thoracic vertebra



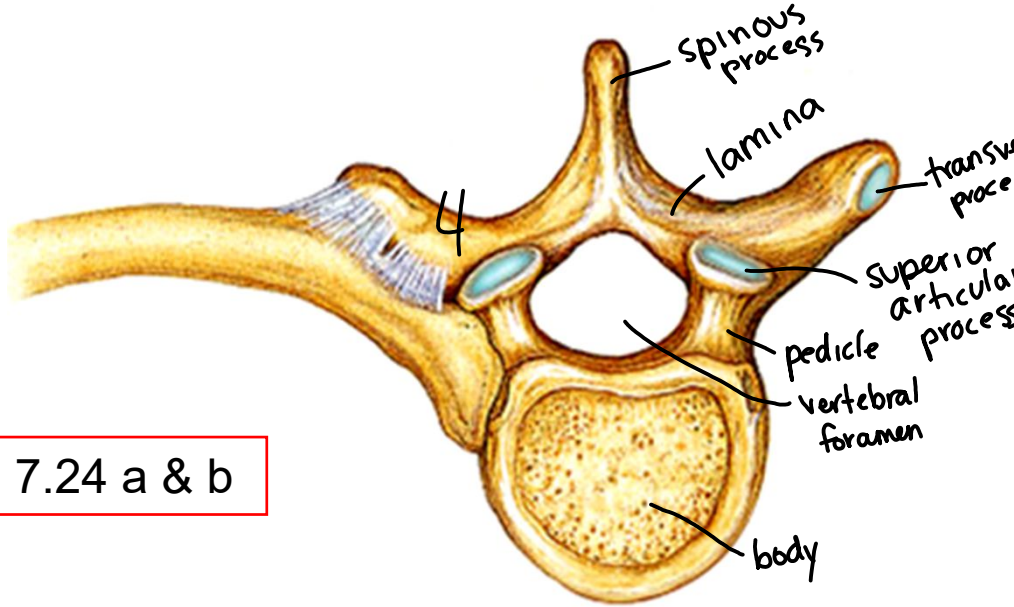


Fig. 7.24 a & b

APPENDICULAR SKELETON

- **pectoral girdle; pelvic girdle**

PECTORAL GIRDLE

2 pairs of bones: **clavicles** (flat bones) & **scapulae - almost** a complete circle around upper trunk to make shoulders:

» anteriorly: clavicle attaches to 'menubrium' of the sternum

» laterally: clavicle attaches to acromion

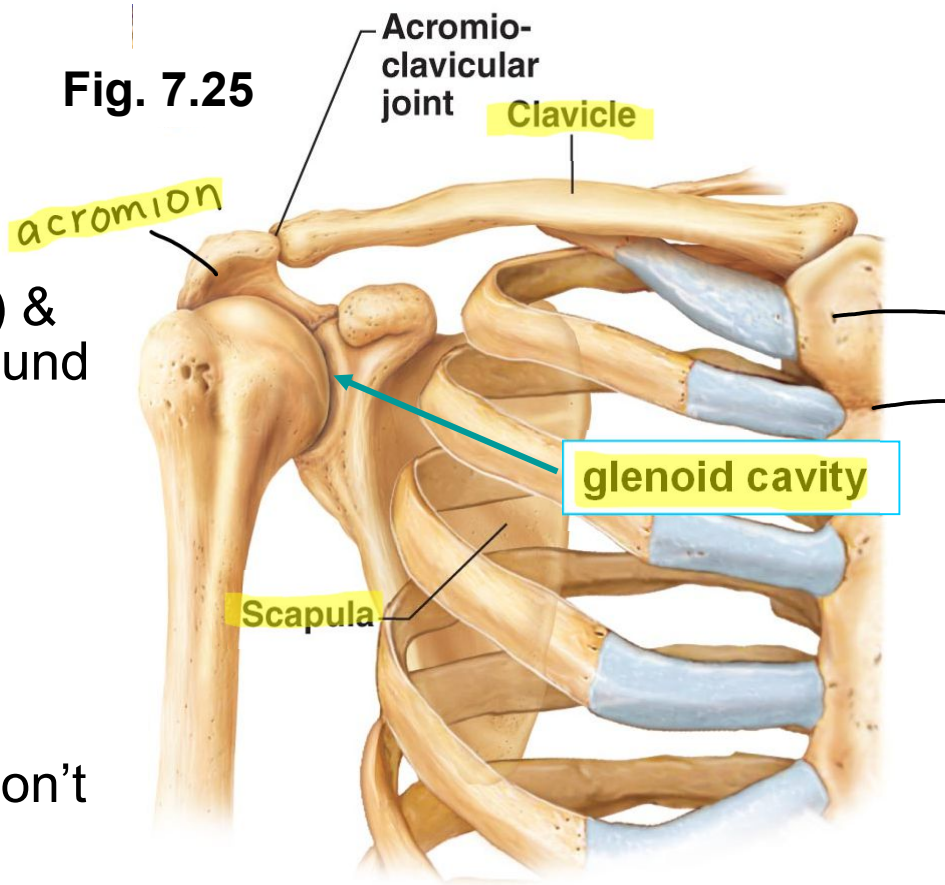
» posteriorly: no bones attached, just muscles, 2 scapulae come around and don't attach to any bones

bones are light & very movable - attachment points of muscles to move upper limbs

(1) scapulae only attached laterally, otherwise only attached to muscles which allows for huge range of movement

(2) socket of shoulder joint (**glenoid cavity**) is shallow & poorly reinforced:

Fig. 7.25



Clavicles: (= collarbones)

S-shaped (barely, but there *is* curvature)

insertion points for muscles, also a brace to push arms laterally

curvature ensures **outward** fracture, away from subclavian artery to avoid blood loss

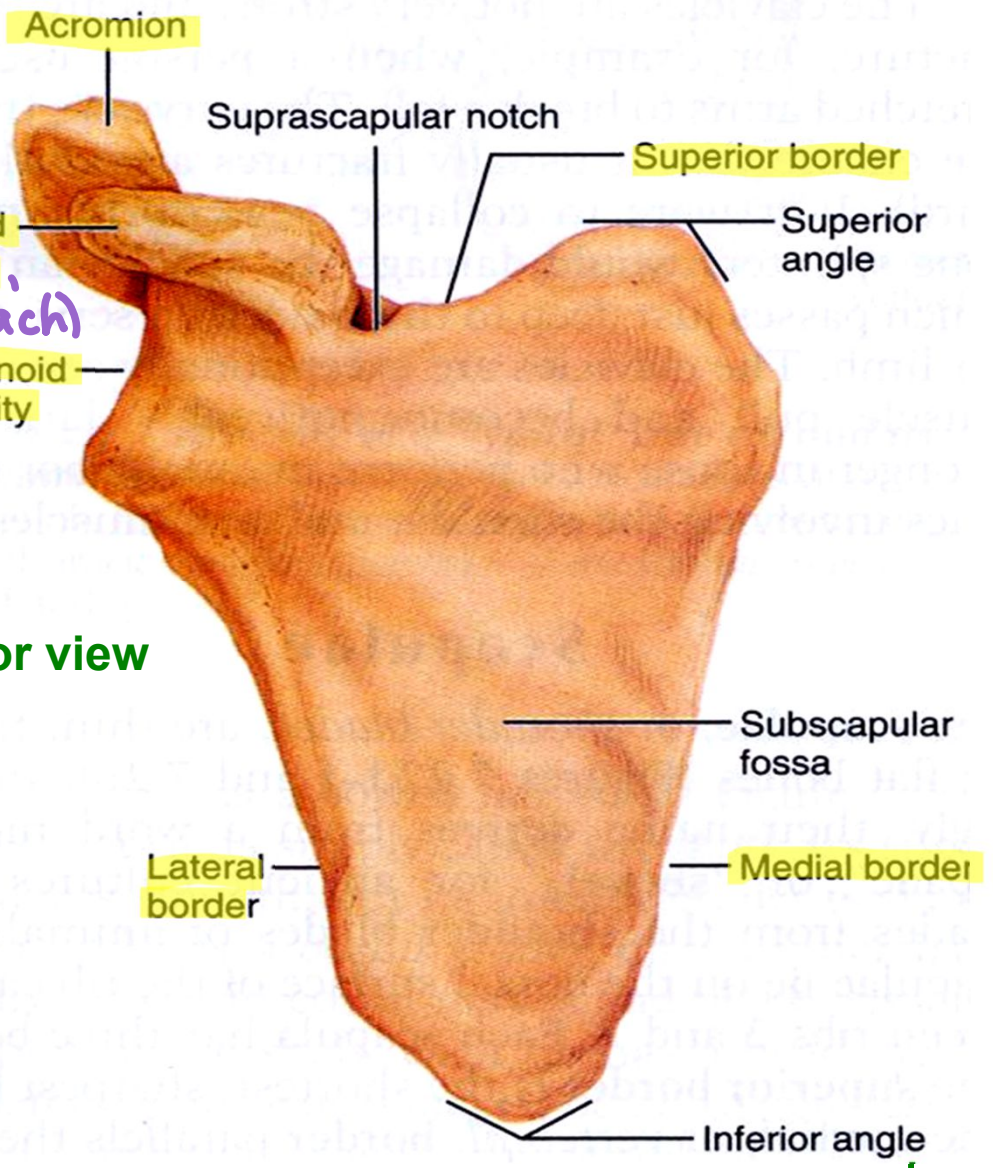


Fig. 7.27a

right scapula; anterior view

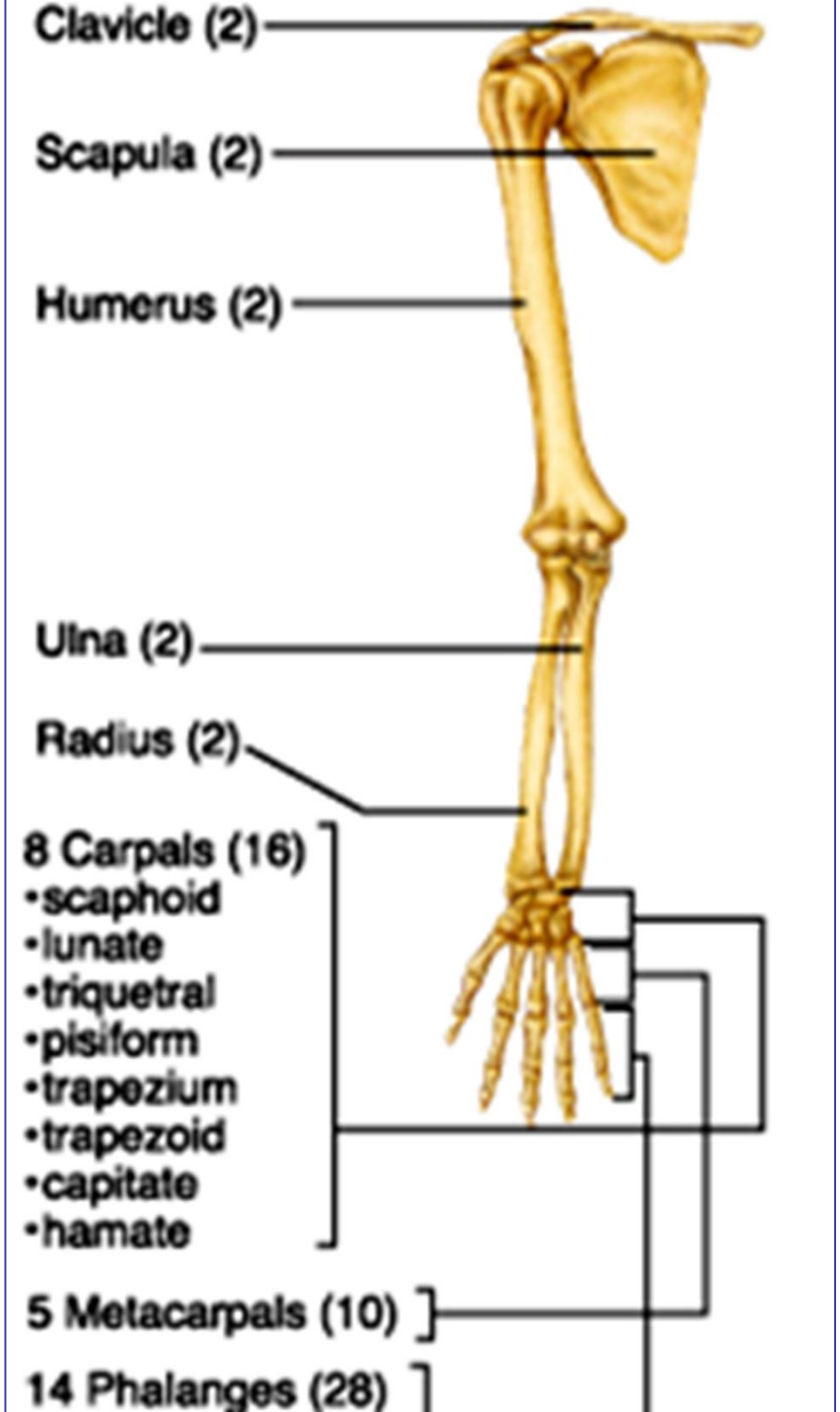
Scapulae (= shoulder blades)

- thin, triangular, flat bones
- dorsally, between ribs 2 & 7
- note superior, medial & lateral borders
- note **spine acromion** (articulates with acromial end of clavicle), **coracoid process** (attachment site for biceps muscle)

(RIGHT) UPPER LIMB

30 separate bones: arm, forearm, hand

Table 7.3



Humerus:

- longest bone of upper limb/only bone of "arm"
- articulates with **scapula** & **radius** + **ulna**

NOTE: head (inserts into glenoid cavity - *in what way?*), anatomical neck, greater tubercle, lesser tubercle (*what attach here?*), intertubercular sulcus, surgical neck (*what happens here?*)

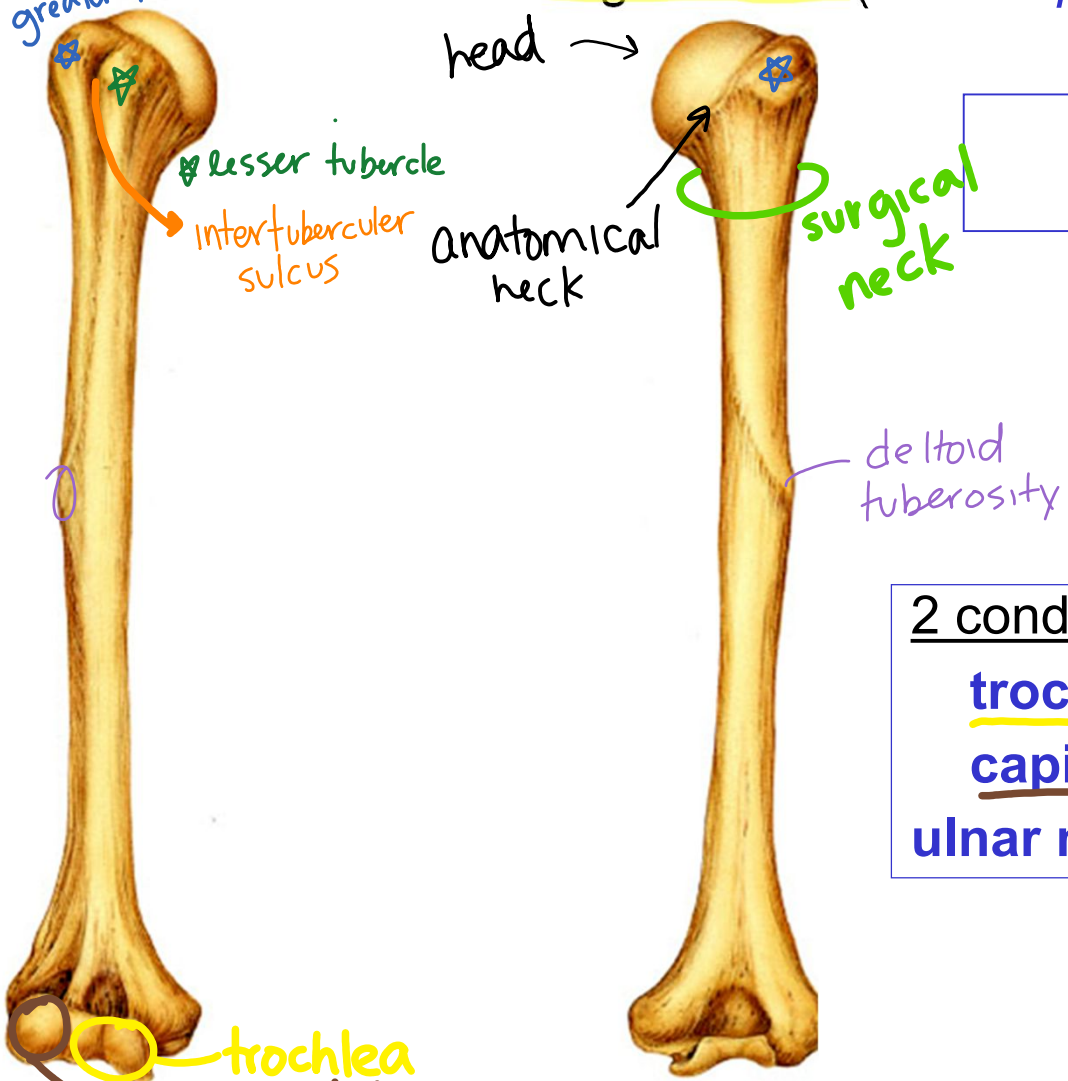


Fig. 7.28: right humerus (anterior and posterior)

2 condyles:

trochlea: articulates with **ulna**

capitulum: articulates with **radius**

ulnar nerve behind medial epicondyle

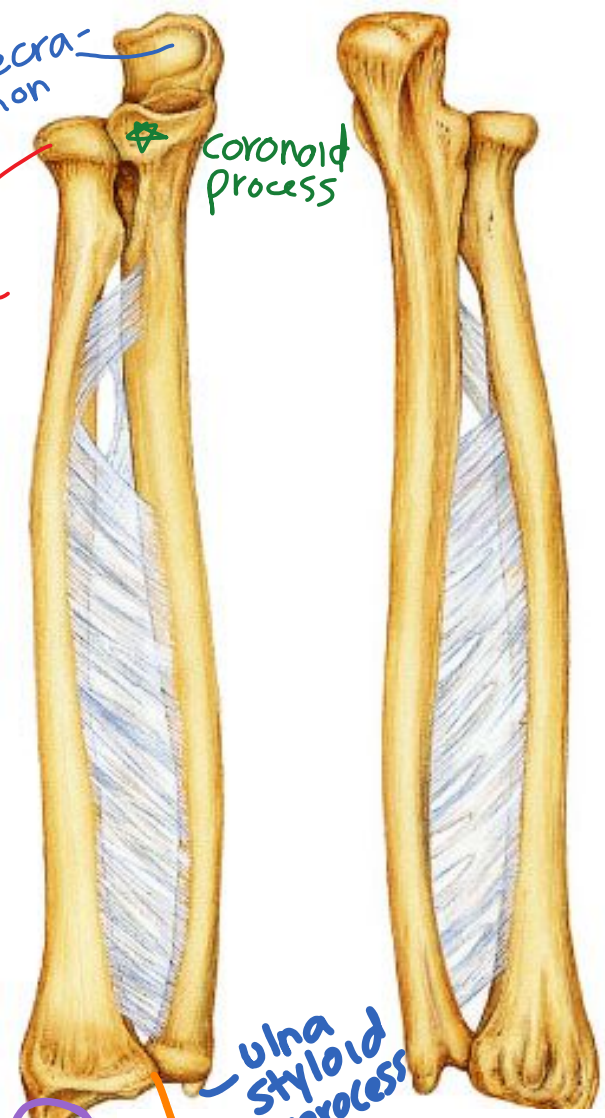


Fig. 7.29: Right forearm

Forearm:

2 parallel long bones: **radius** & **ulna**

articulates with humerus & wrist bones; also articulate with each other at proximal & distal radio-ulnar joints

what is the interosseous membrane?

Ulna: (elbow joint!)

slightly longer than radius

olecranon & **coronoid** processes

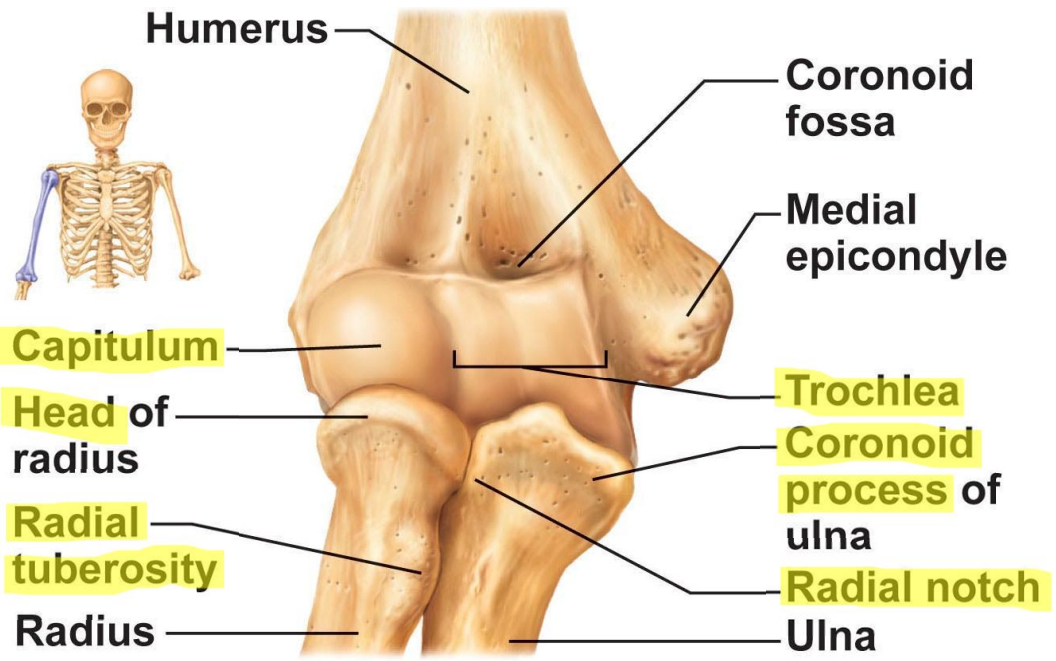
locking of olecranon process prevents elbow hyperextension

radial notch on coronoid process

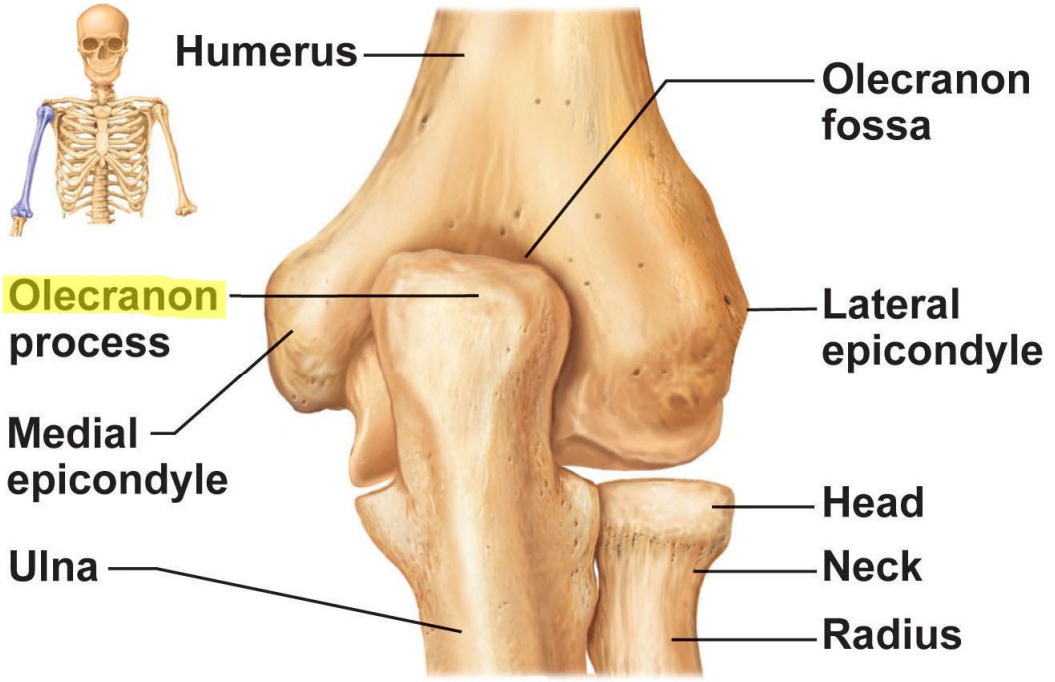
styloid process has ligament to wrist

Radius: (wrist joint!)

- **head** at proximal end; **distal end** is the wider end
- distal end has medial **ulnar notch** & lateral **styloid process**

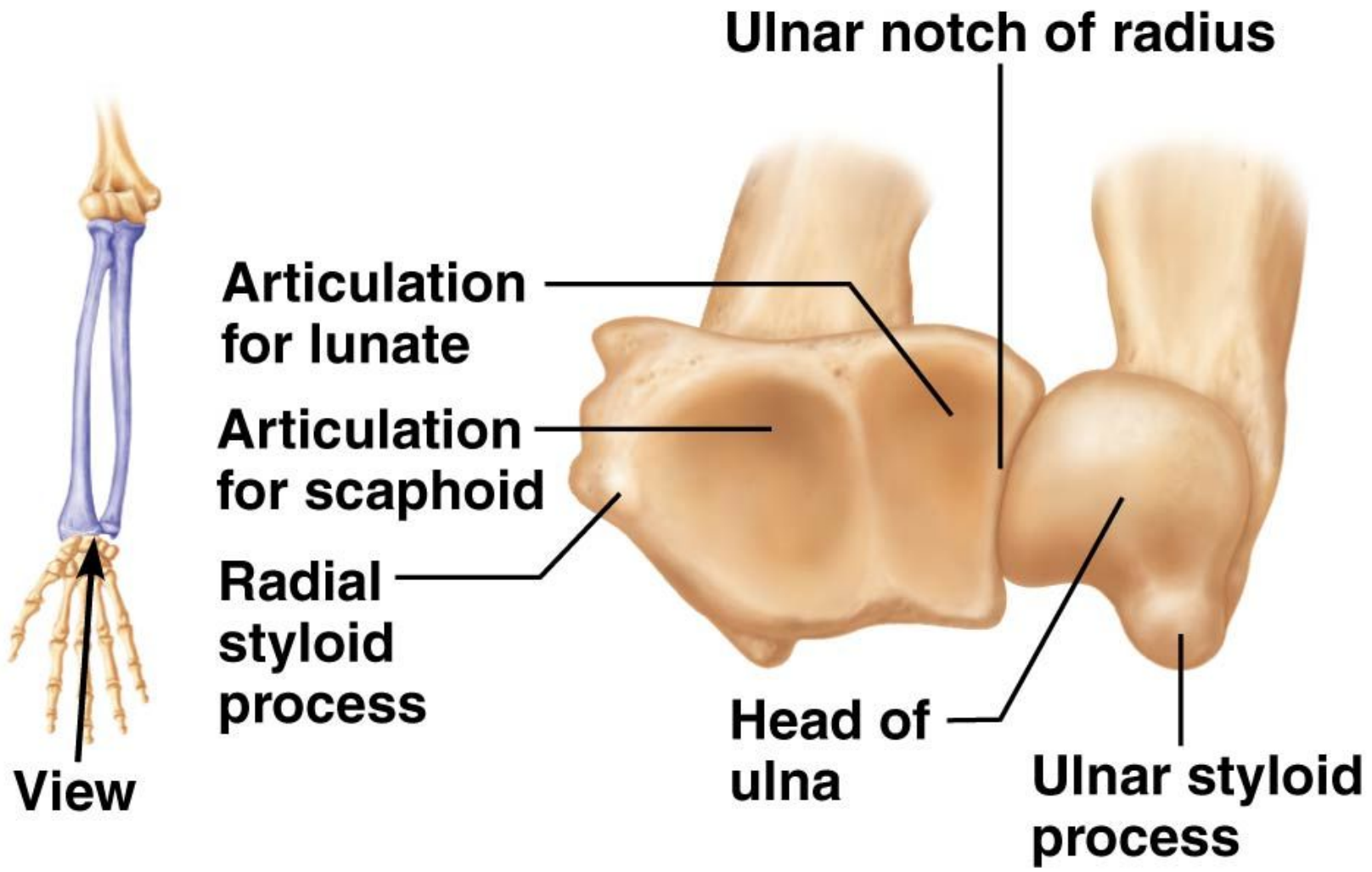


(c) Anterior view at the elbow region



(d) Posterior view of extended elbow

Fig. 7.28c & d:
Articulation at the elbow



(e) Distal ends of the radius and ulna at the wrist

Fig. 7.29e

Anterior view of right hand

Fig. 7.30

HAND

27 bones in total

includes bones of **carpus**, **metacarpus** & **phalanges**

Carpus (wrist)

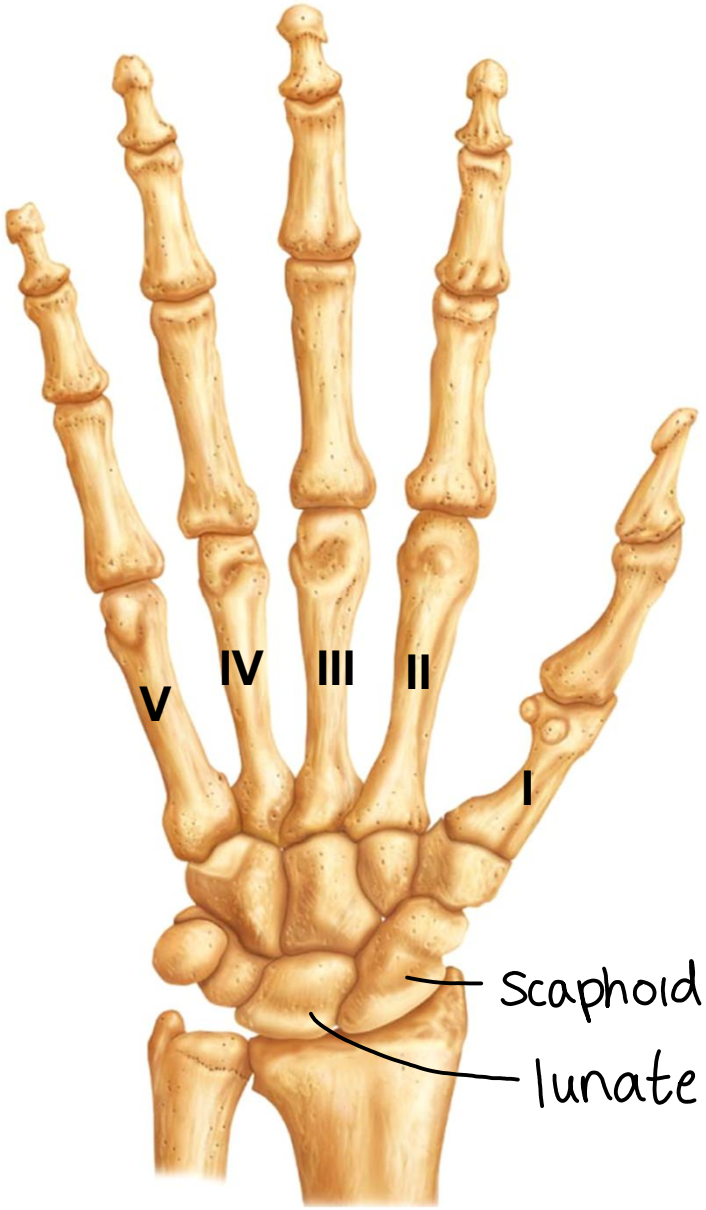
- 8 carpels
- only scaphoid & lunate articulate with radius

"So Long To Pittsburgh" (scaphoid, lunate, triquetrum, pisiform)

"Time To Call Home" (trapezium, trapezoid, capitate, hamate)

"Sally Left The Party To Take Cathy Home"

don't say thumb, proper name is **pollex**



Metacarpus:

- 5 long bones - distal ends are knuckles
- numbered **1-5** from **thumb** to **little finger**
- proximal ends are articulated with wrist bones

Phalanges:

- 3/finger & 2/thumb = miniature long bones
- numbered **1-5** from **thumb** to **little finger**
- **proximal**, **middle** & **distal** *except for thumb* which has only proximal & distal

PELVIC GIRDLE

- attaches lower limbs, transmits weight of upper body to lower limbs, supports visceral organs of pelvis
- forms a complete circle
- left & right hip bones (**coxal bones**) unite anteriorly & with **sacrum** posteriorly
- each **os coxa** consists of 3 bones that fuse at puberty: **ilium**, **ischium**, **pubis**
- **acetabulum** is area where all 3 bones join »» forms socket of hip joint

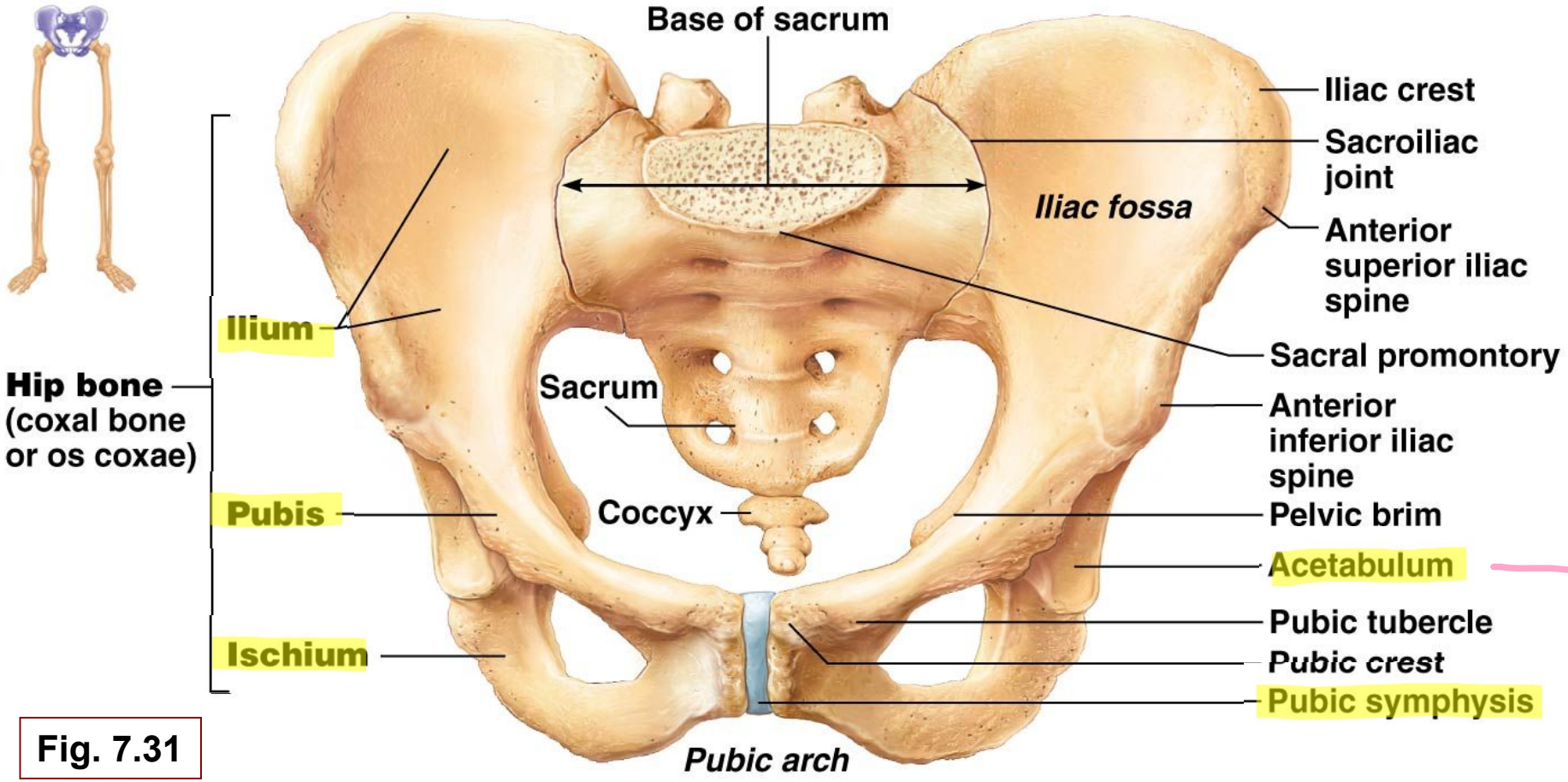
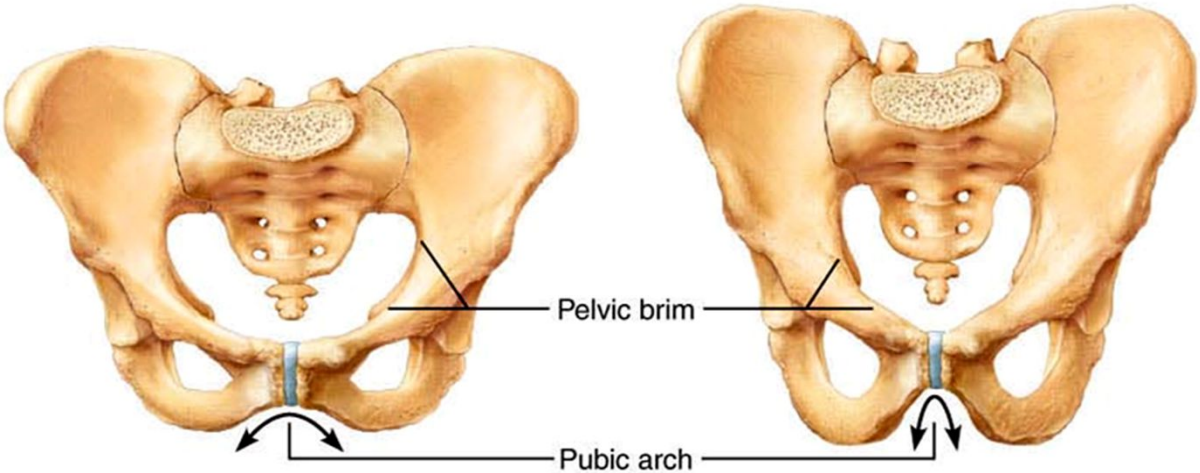


Fig. 7.31

TABLE 7.4 Comparison of the Male and Female Pelves

CHARACTERISTIC	FEMALE	MALE
General structure and functional modifications	Tilted forward; adapted for childbearing; true pelvis defines the birth canal; cavity of the true pelvis is broad, shallow, and has a greater capacity	Tilted less far forward; adapted for support of a male's heavier build and stronger muscles; cavity of the true pelvis is narrow and deep
Bone thickness	Less; bones lighter, thinner, and smoother	Greater; bones heavier and thicker, and markings are more prominent
Acetabula	Smaller; farther apart	Larger; closer
Pubic angle/arch	Broader (80° to 90°); more rounded	Angle is more acute (50° to 60°)
Anterior view		

False (greater) pelvis (outside)

True (lesser) pelvis (space inside)

Ilium:

- large flaring bone that forms most of os coxa
- note **iliac crest** (superior border); **iliac spines** (attachment of muscles)
- **pelvic brim** is superior margin of **true pelvis**
- anteriorly, the body of the ilium joins the **ischium** and the **pubis**

Ischium:

postero-inferior part of hip bone

superior **body** joining ilium and thinner, inferior **ramus**

What is the **ischial tuberosity**?

Pubis:

anterior part of ox cosa

2 pubic bones unite at **pubis symphysis**

note **pubic crest**, **obdurator foramen** (blood vessels & nerves)

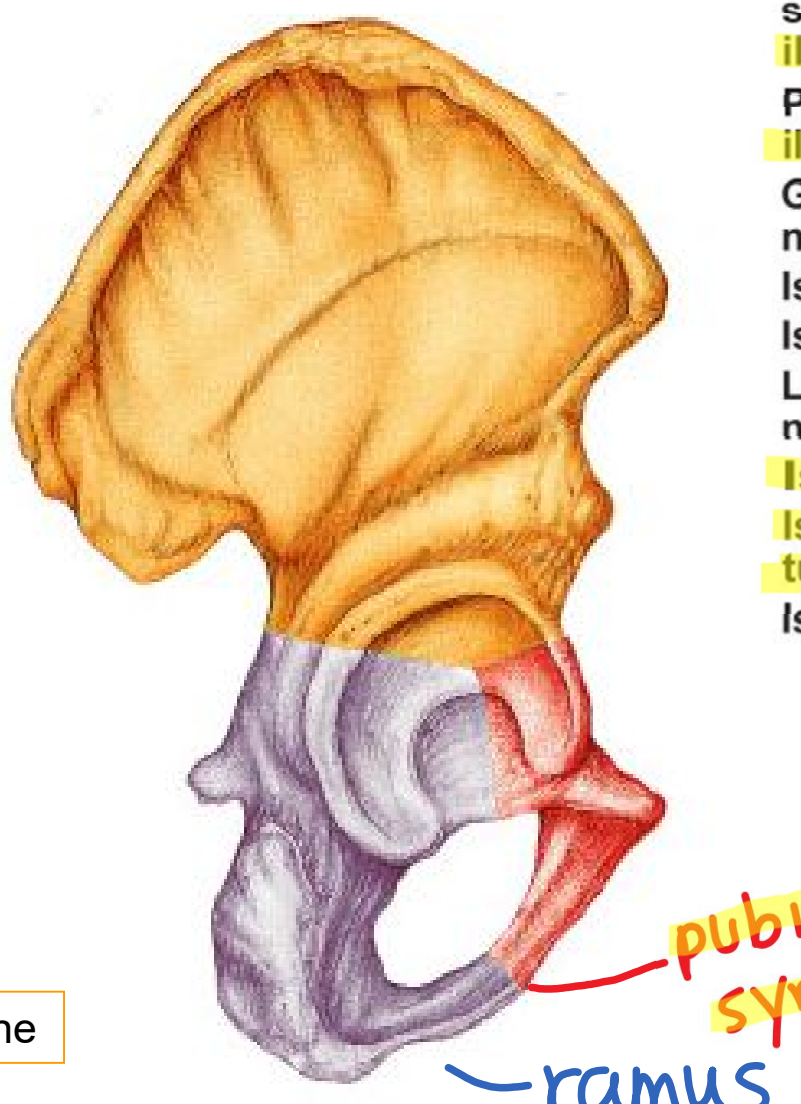


Fig. 7.32: Lateral view of right hip bone

LOWER LIMB: thigh, leg & foot

Thigh:

- **femur** = largest, longest & strongest bone

"head"

Note: **head**, **fovia capitis** (ligament to **acetabulum**) **neck** (angles laterally to shaft; easily fractured) **linea aspera**, lat & med **condyles** (articulate with tibia), lat & med **epicondyles** (muscles attach), **patellar surface** (between condyles) -> knee cap (patella) articulates

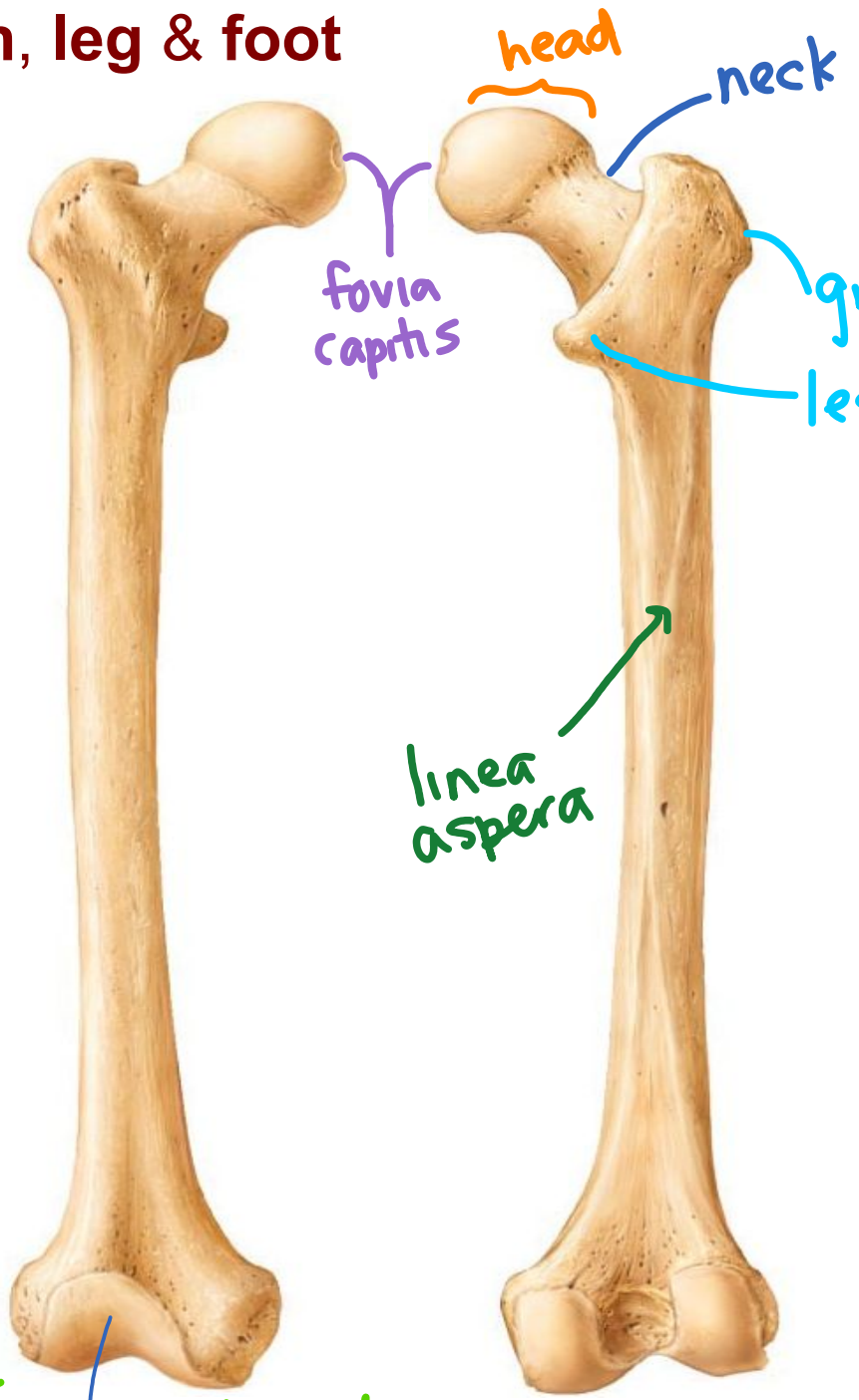


Fig. 7.33: Right femur

Leg: 2 parallel bones: **tibia** & **fibula**

- **interosseus membrane** + proximal & distal **tibiofibular joints** (rigid)
- fibula not contributor to knee joint

Tibia: transfers weight from femur to foot; next largest & strongest bone

NB: med & lat **condyles**, **anterior crest**, tibial **tuberosity** (patellar ligament)

Fibula: note **head** & **lateral malleolus**

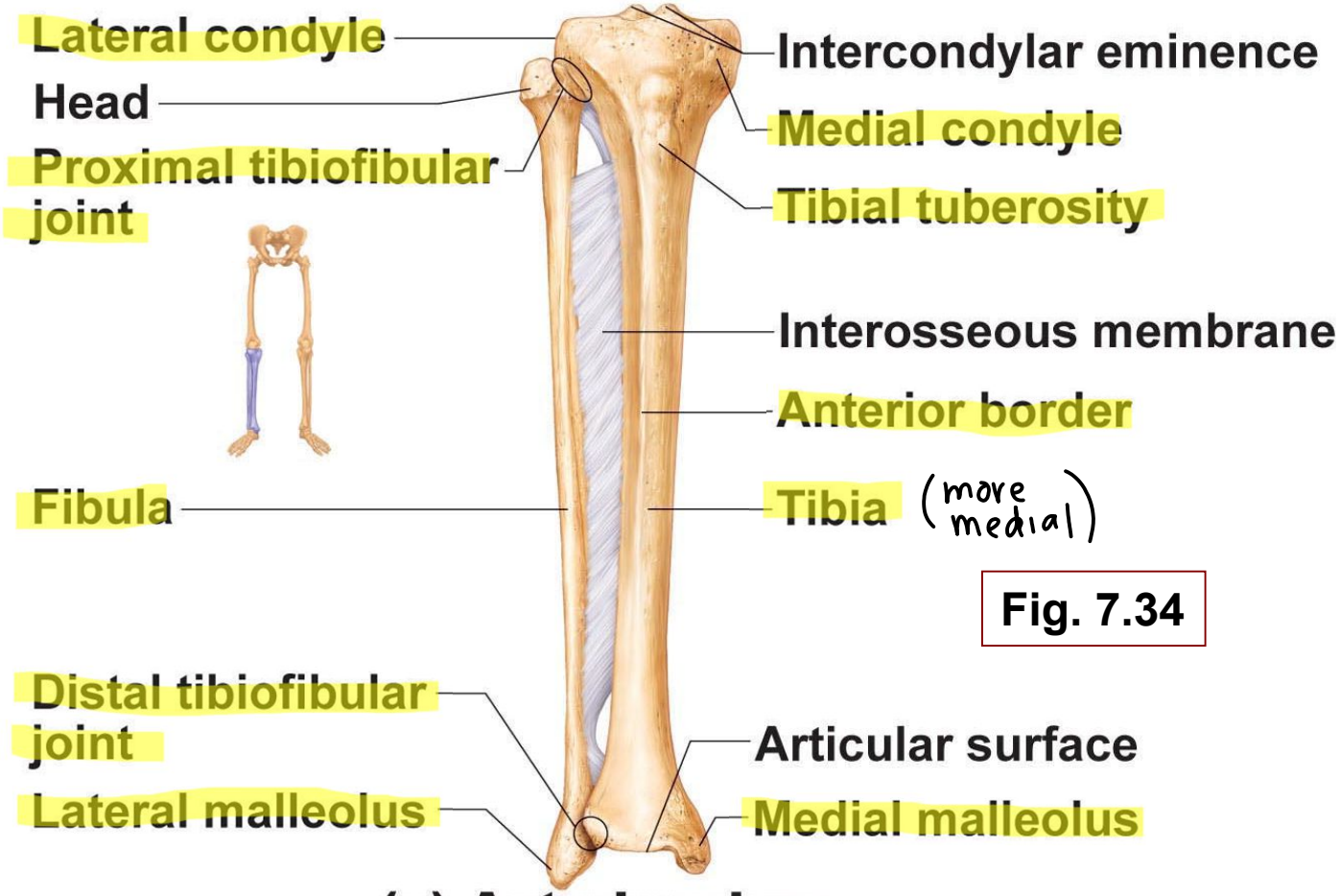


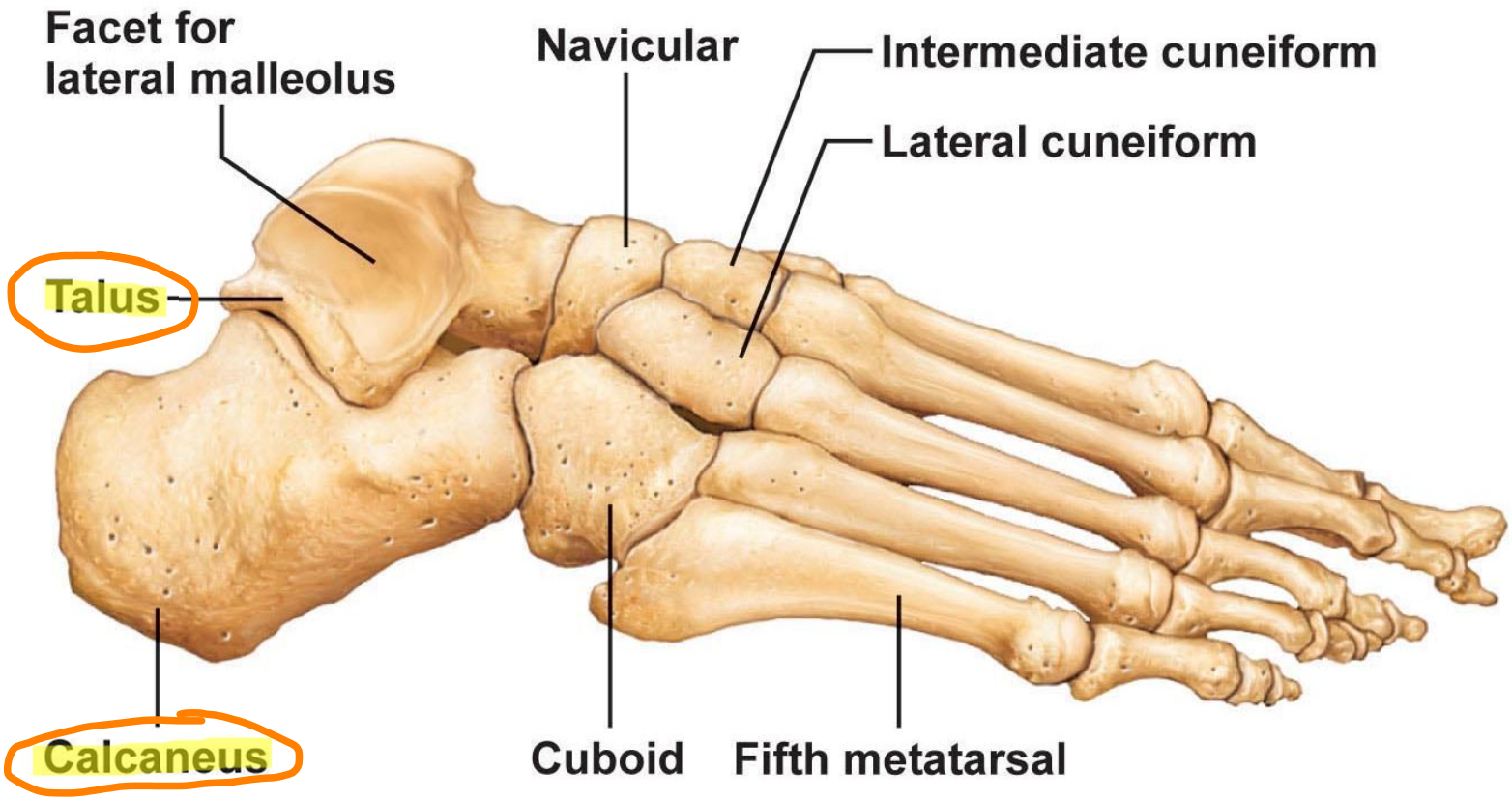
Fig. 7.34

Foot:

- total of 26 bones: **tarsus** (ankle bone), **metatarsus** & **phalanges**

Tarsus:

- 7 tarsal bones: largest is the **calcaneus** (heel bone) and second largest is the **talus** (part of ankle joint)



(c) Lateral view

Fig. 7.35

Metatarsus:

- 5 miniature long bones numbered 1-5 (medial great toe = +1)

Phalanges:

- **hallux** (big toe) has two & remaining toes have 3 each - proximal, middle & distal

Hallux doesn't have a middle phalange

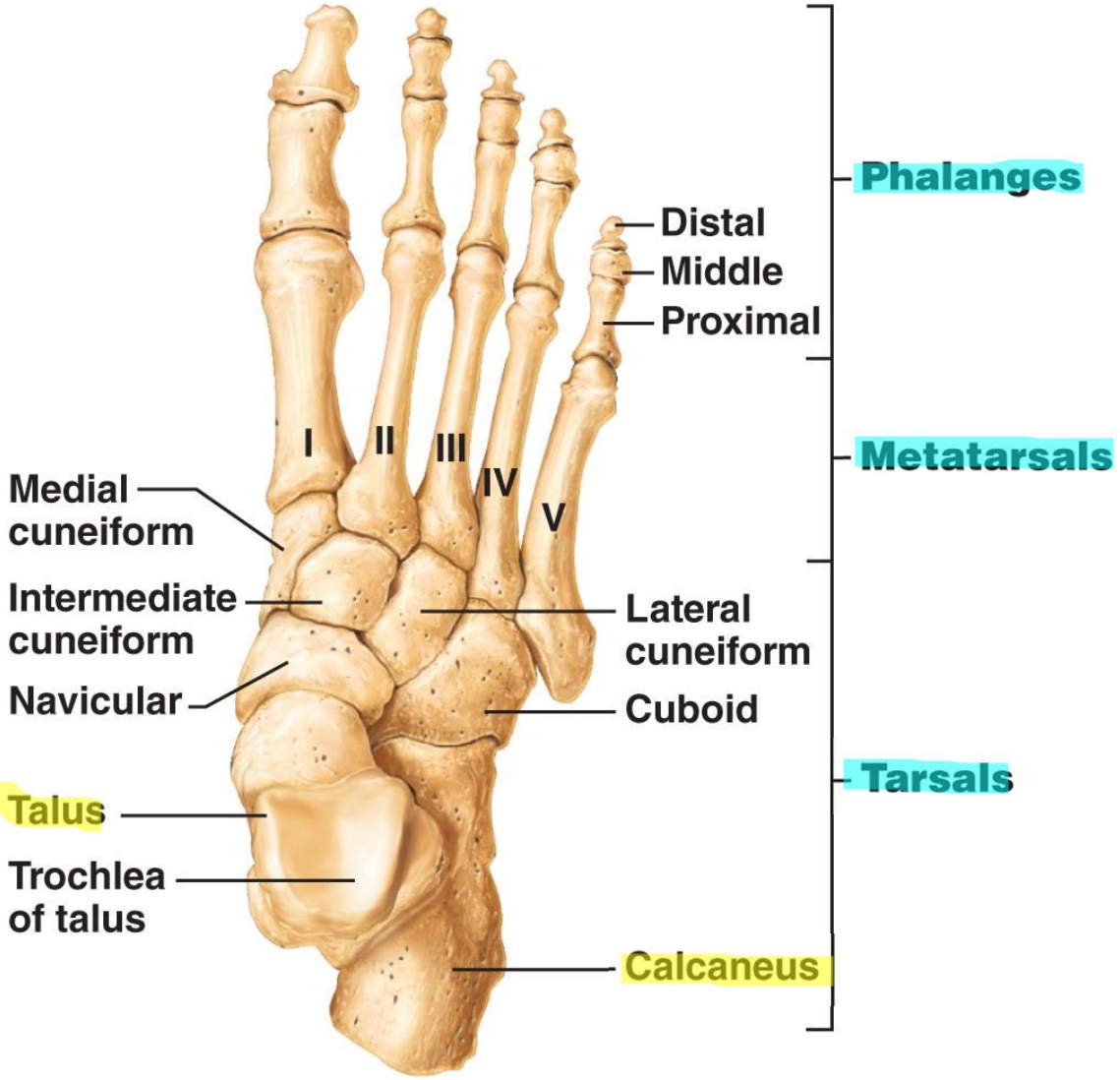


Fig. 7.35a