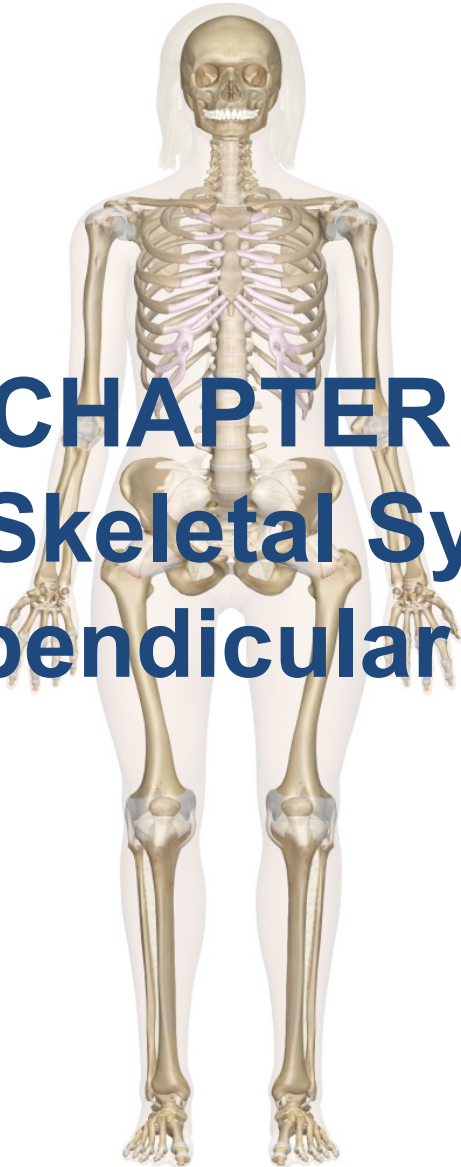




CHAPTER 8

The Skeletal System: The Appendicular Skeleton

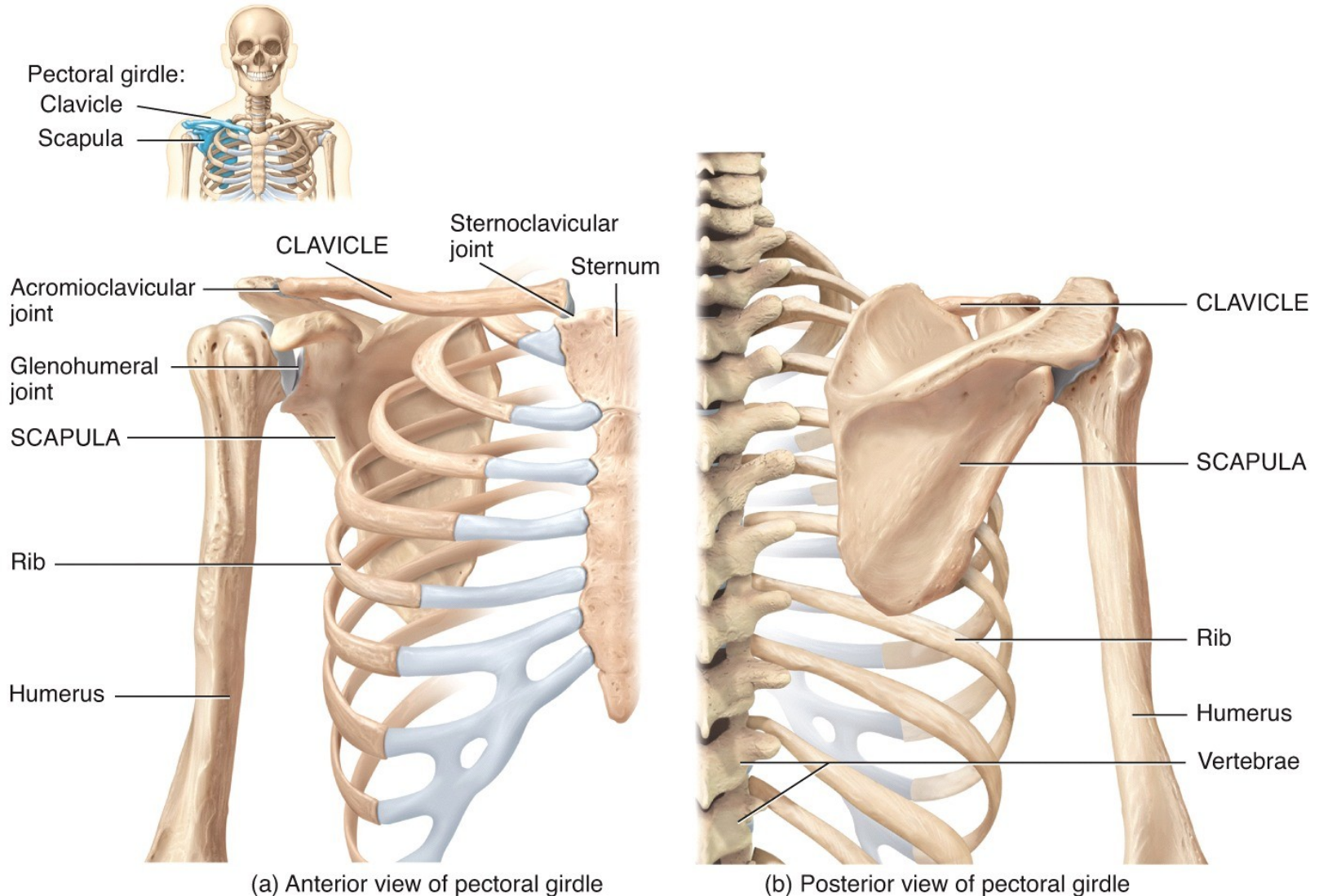
Appendicular Skeleton

- Its primary function is movement.
- It includes bones of the upper and lower limbs.
- Girdles attach the limbs to the axial skeleton.

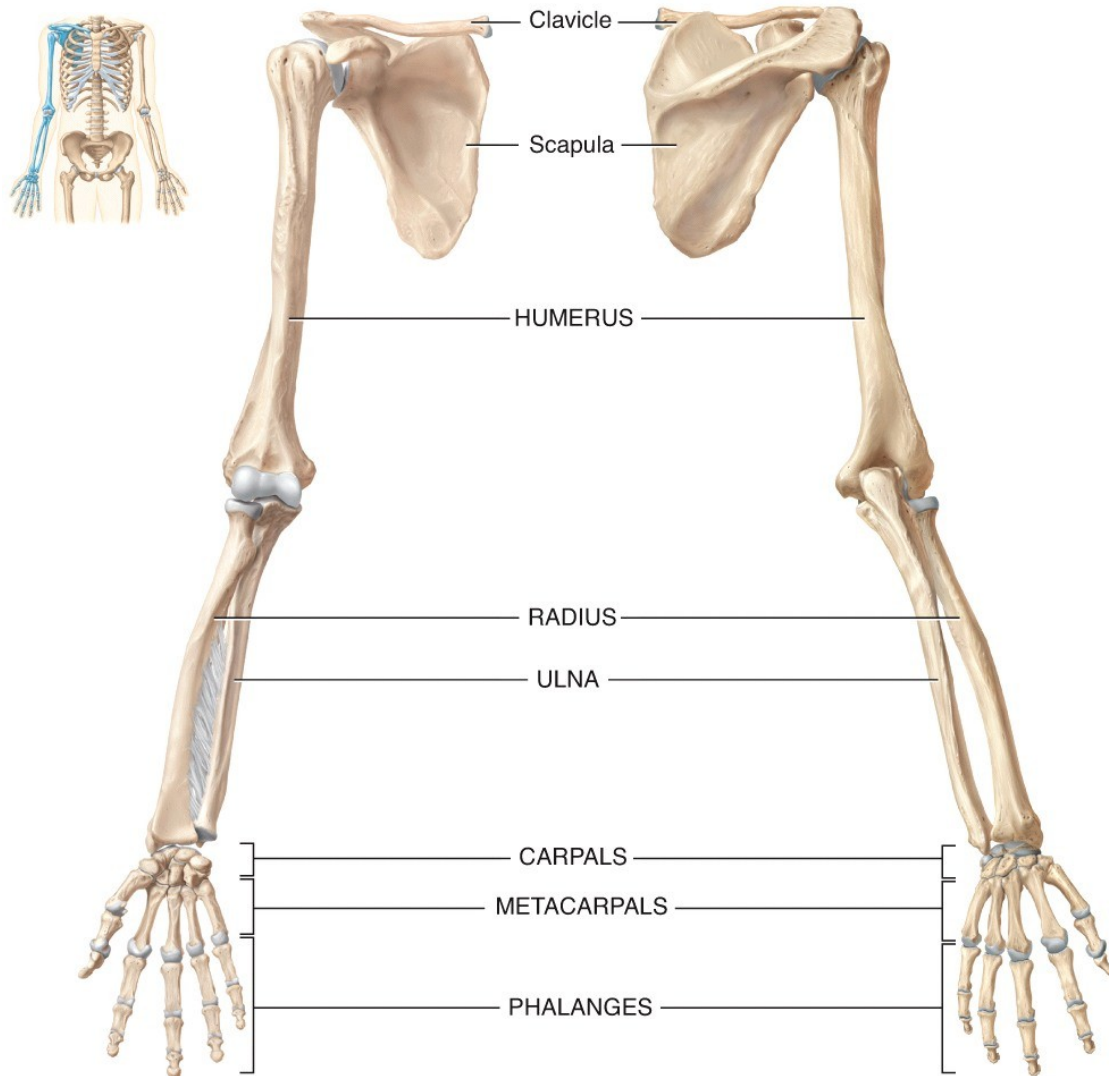
Upper Limb

- The pectoral girdle
- The free upper limb
 - 1 humerus
 - 1 ulna
 - 1 radius
 - 8 carpals
 - 19 metacarpal and phalanges

Skeleton of the Right Upper Limb



Skeleton of the Right Upper Limb

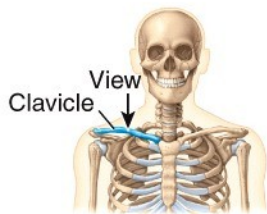
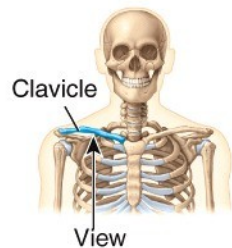


(c) Anterior view of free upper limb

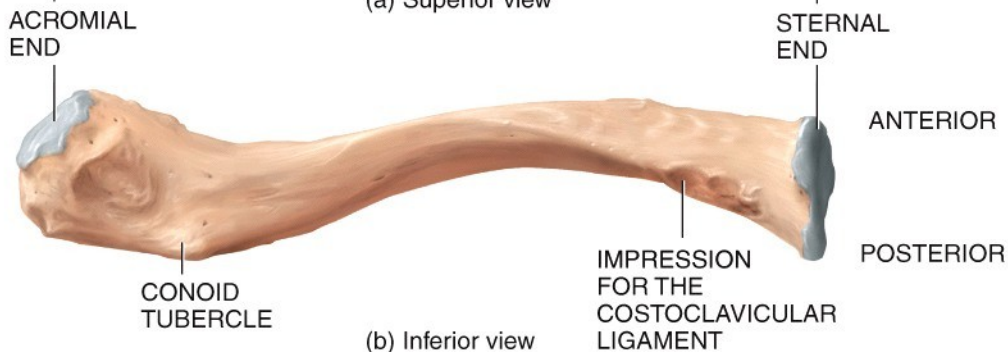
(d) Posterior view of free upper limb

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Right Clavicle



(a) Superior view

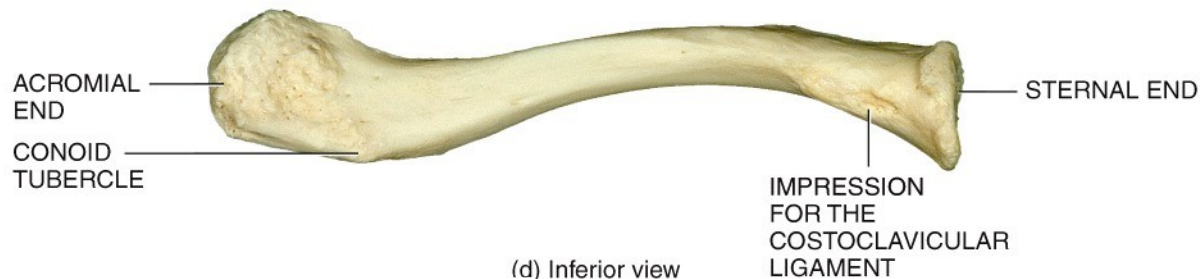


(b) Inferior view



(c) Superior view

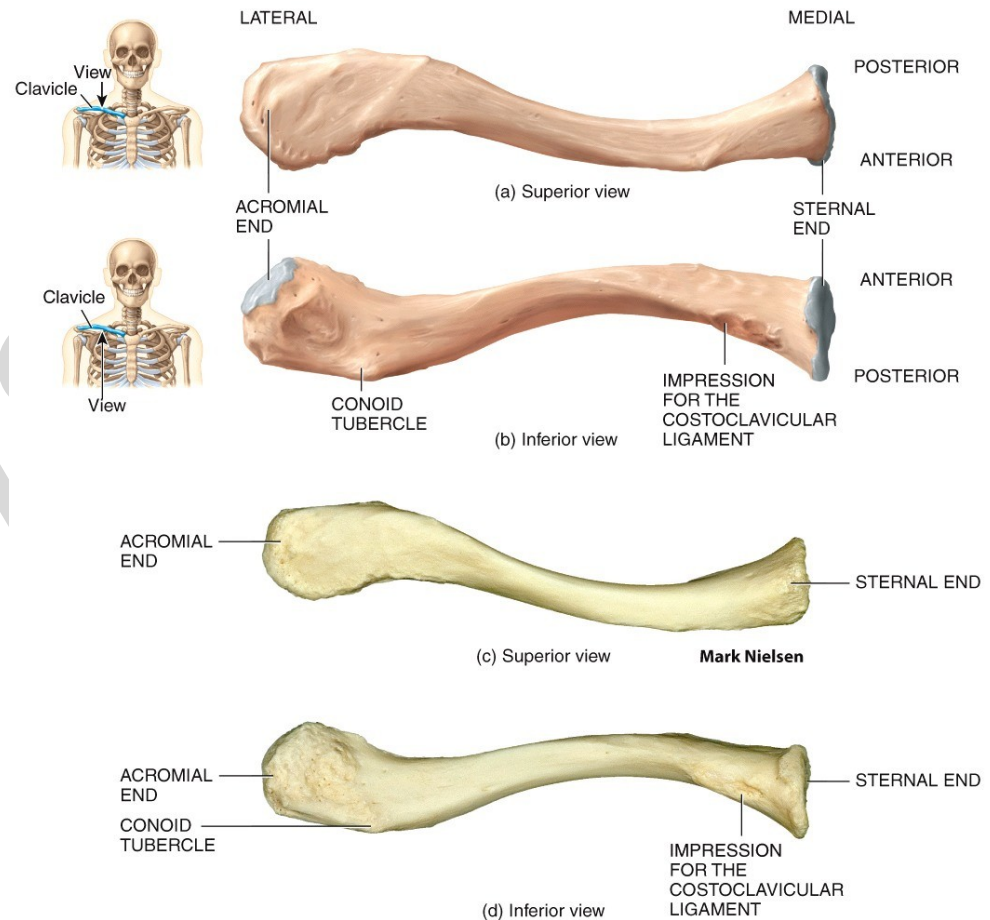
Mark Nielsen



(d) Inferior view

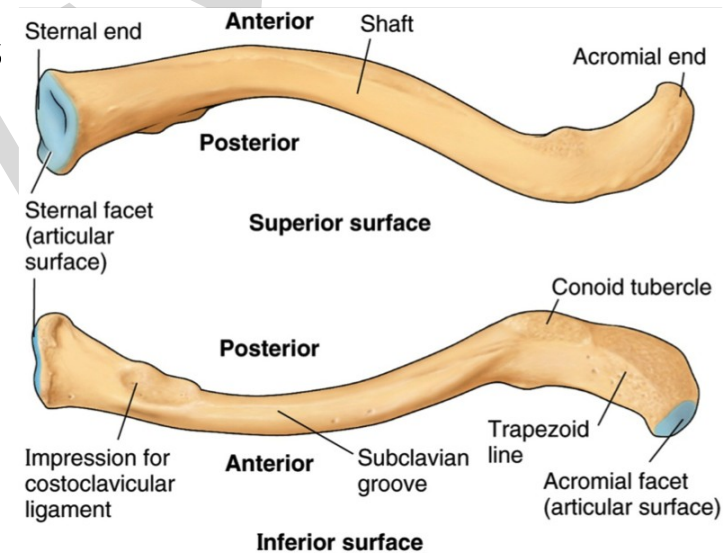
Clavicle

clavicle - slender, S-shaped lies horizontally across the anterior part of the thorax superior to the first rib. forms the anterior *strut* (a rod or bar that resists compression) of the pectoral girdle that props the shoulder joint away from the rib cage
medial half is convex anteriorly (curves toward you when viewed in the anatomical position), lateral half is concave anteriorly (curves away from you).
Typically smoother and straighter in females, and rougher and more curved in males.

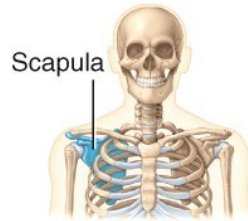


Clavicle Surface Features

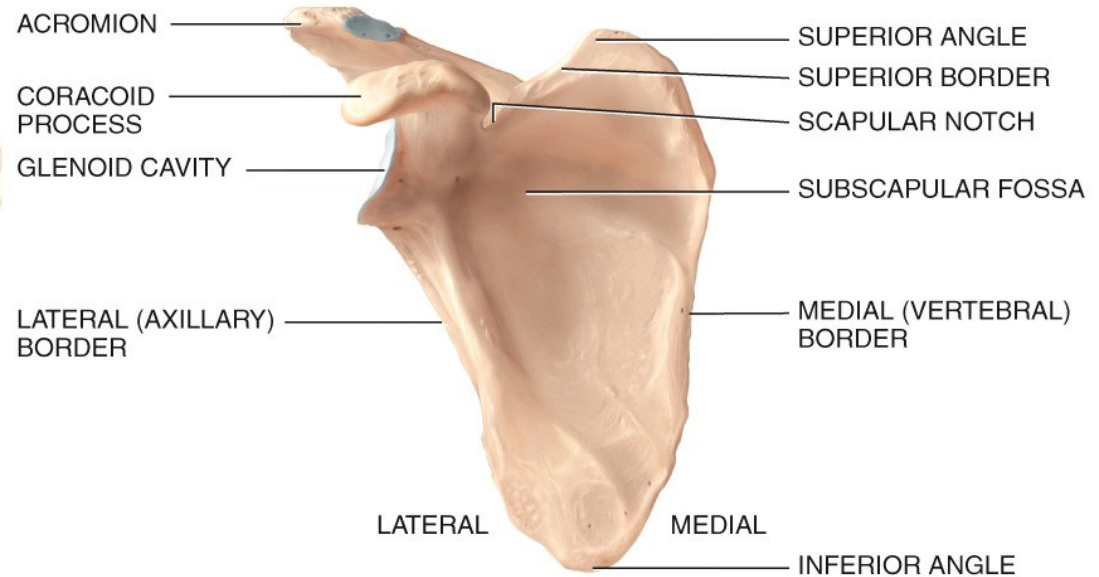
- **Surface Features**
- ***sternal end*** - rounded and articulates with the manubrium of the sternum to form the *sternoclavicular joint*
- ***acromial end*** - broad, flat, lateral end articulates with the acromion of the scapula at the *acromioclavicular joint*
- ***conoid tubercle*** - on the inferior surface of the lateral end of the bone is a point of attachment for the conoid ligament.
- As its name implies, the *impression for the costoclavicular ligament* on the inferior surface of the sternal end is a point of attachment for the costoclavicular ligament, a ligament that connects the first rib to the clavicle.



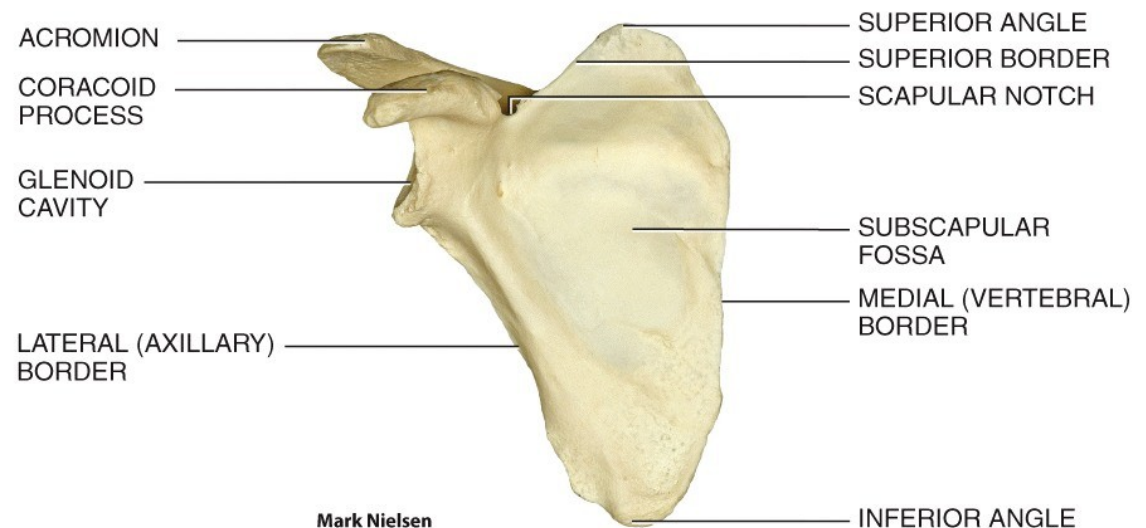
Scapula



large, triangular, flat bone with a ridge on its posterior surface; occupies the superior part of the posterior thorax between the levels of the 2-7 ribs a few finger breadths lateral to the vertebral column



(a) Anterior view



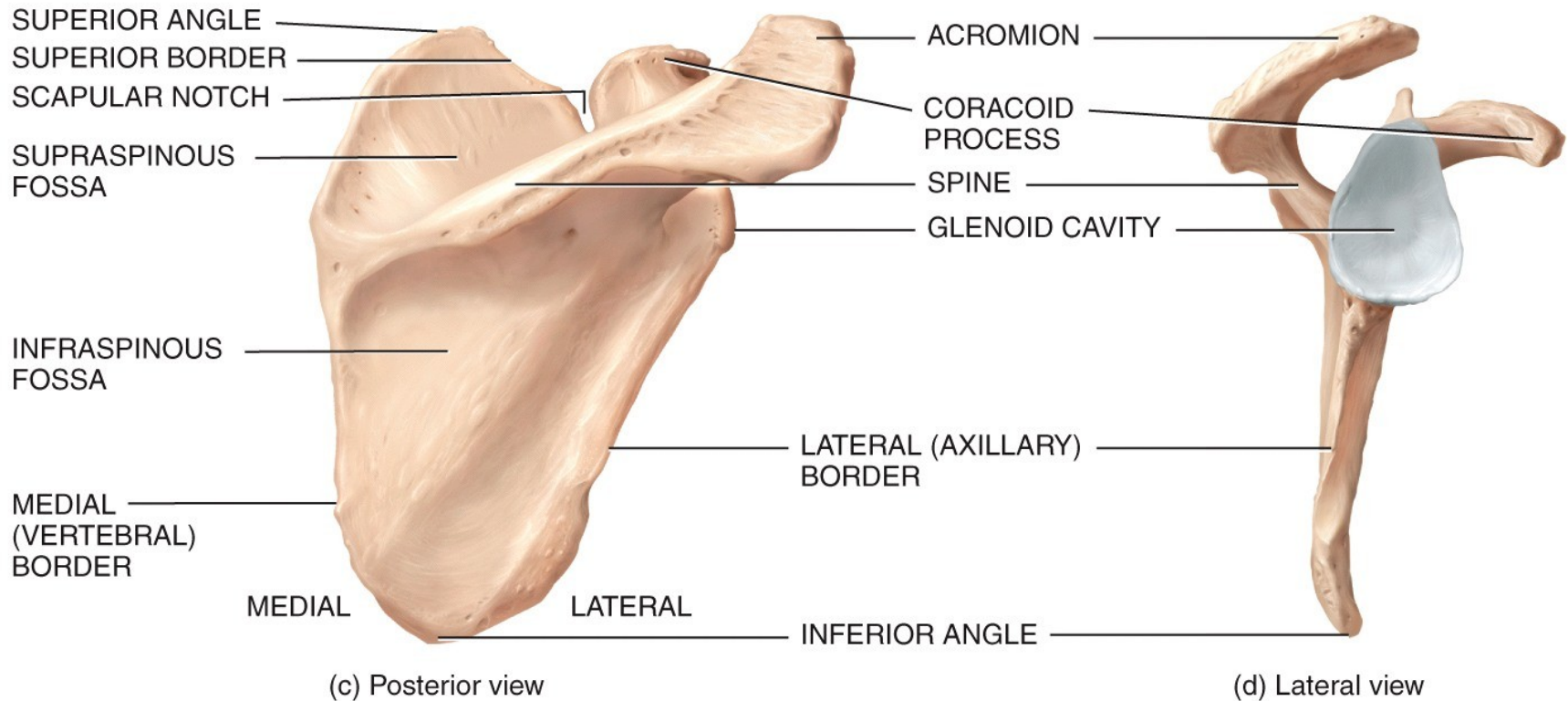
Mark Nielsen

(b) Anterior view

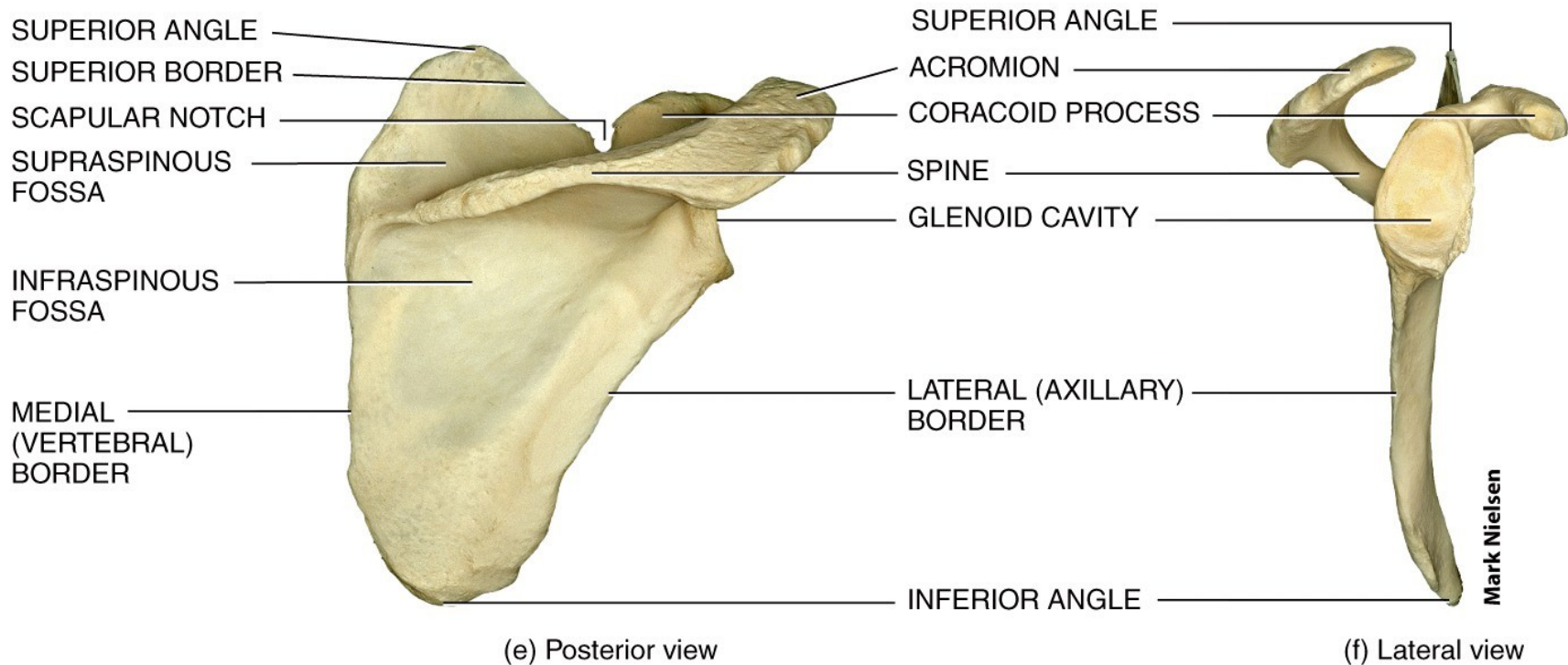
Scapula Surface Features

- Spine
- Acromion
- Coracoid process
- Glenoid cavity
- Medial, lateral, and superior borders
- Superior and inferior angles
- Subscapular, supraspinous, infraspinous fossae

Right Scapula



Right Scapula



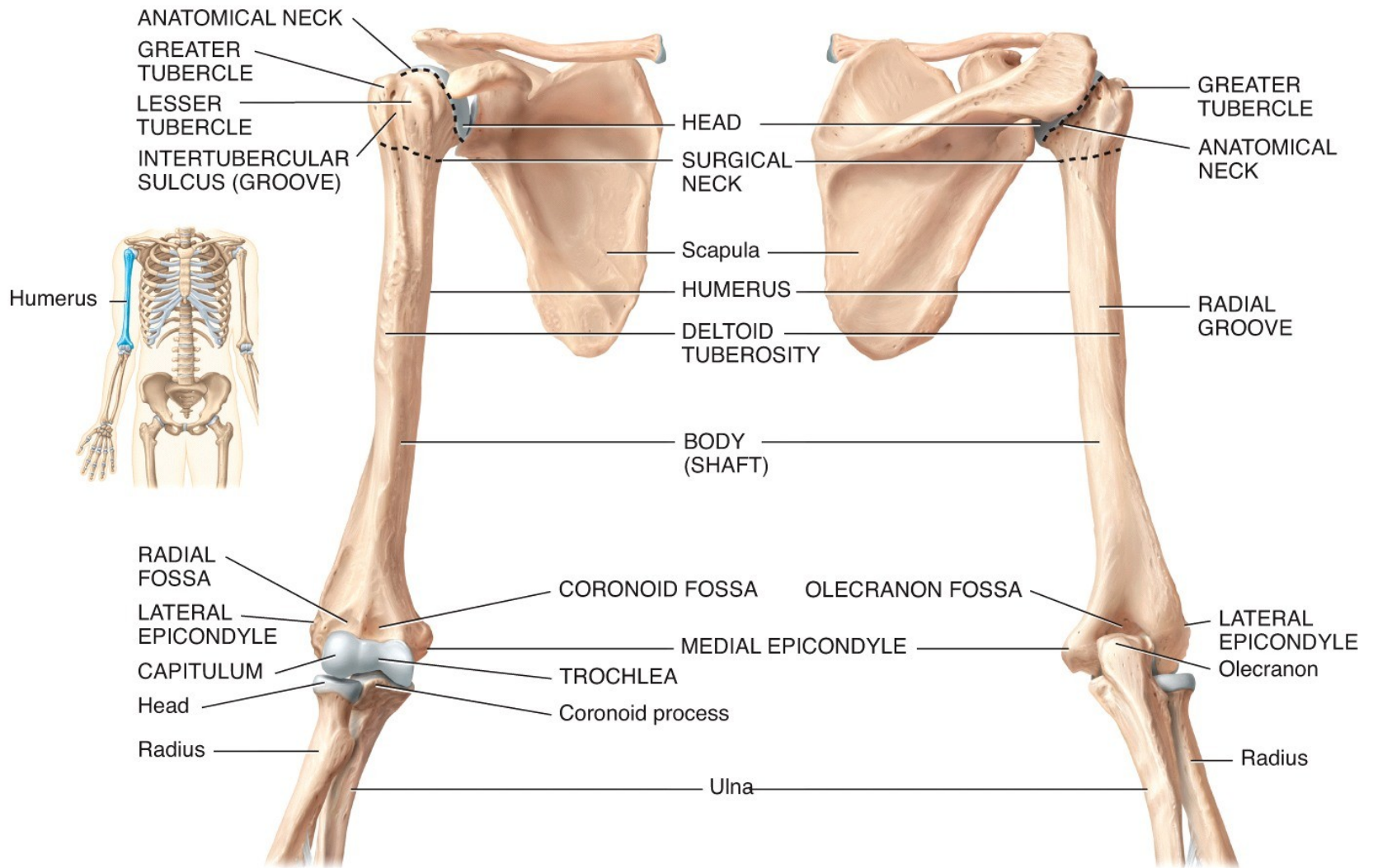
Humerus Surface Features

- Head
- Anatomical neck
- Greater and lesser tubercle
- Intertubercular sulcus or groove
- Surgical neck
- Body

Features of Humerus

- Deltoid tuberosity
- Capitulum
- Trochlea
- Coronoid fossa
- Olecranon fossa
- Medial and lateral epicondyles

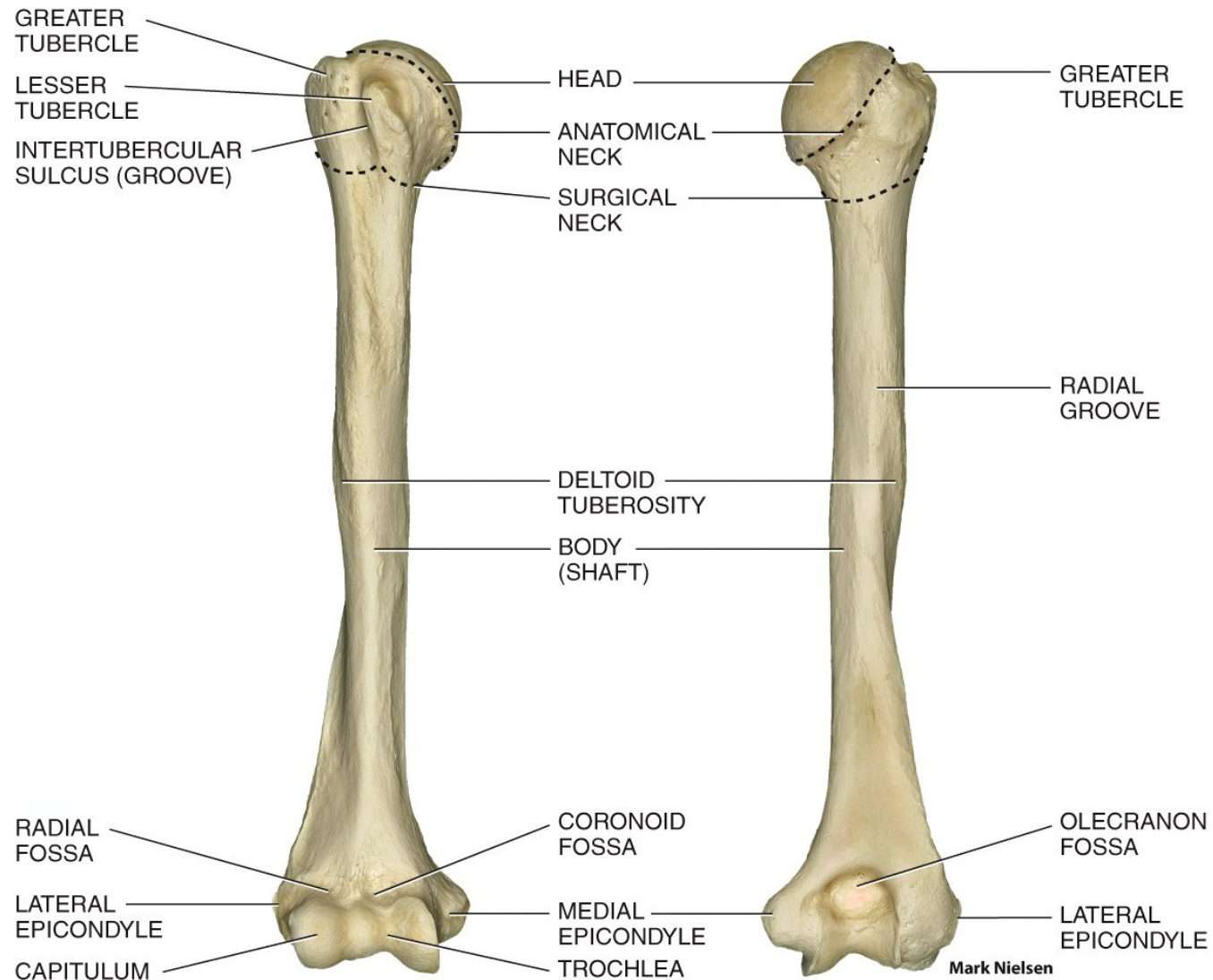
Right Humerus



(a) Anterior view

(b) Posterior view

Right Humerus

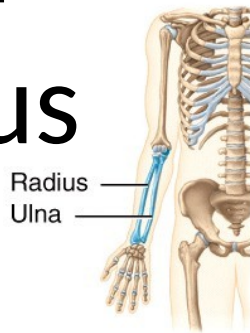
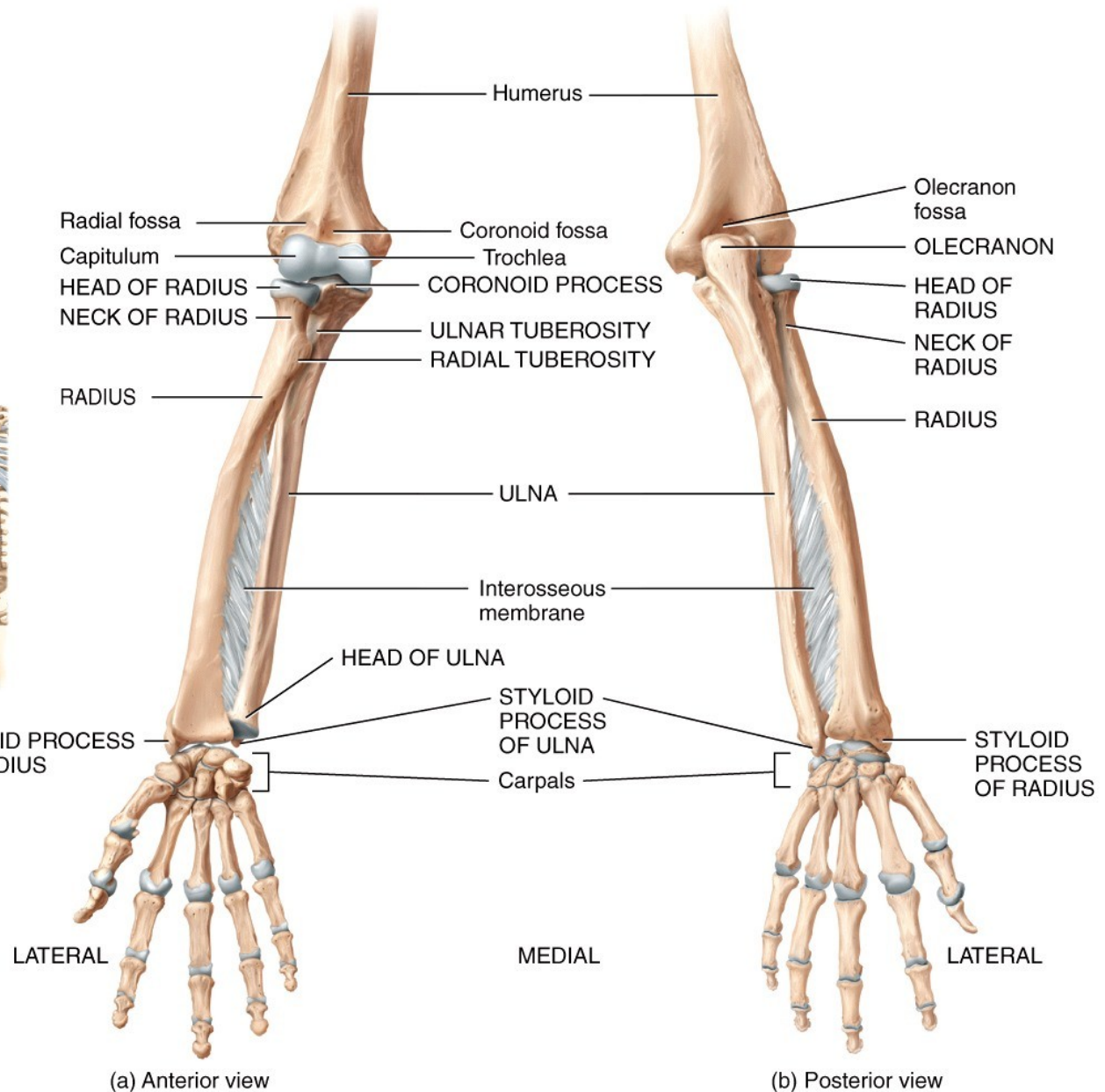


(c) Anterior view (d) Posterior view
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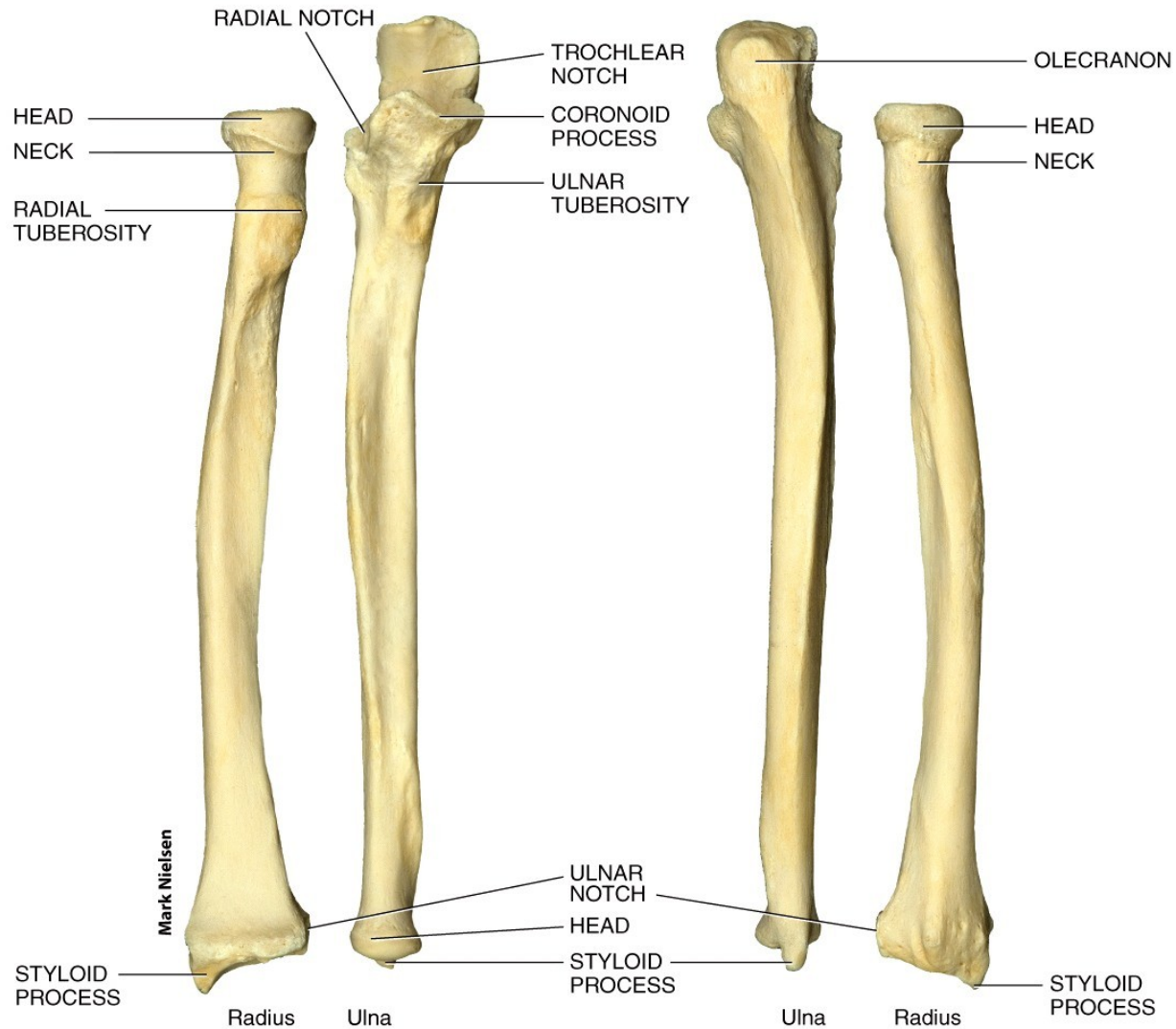
Ulna Surface Features

- Olecranon
- Coronoid process
- Trochlear notch
- Styloid process

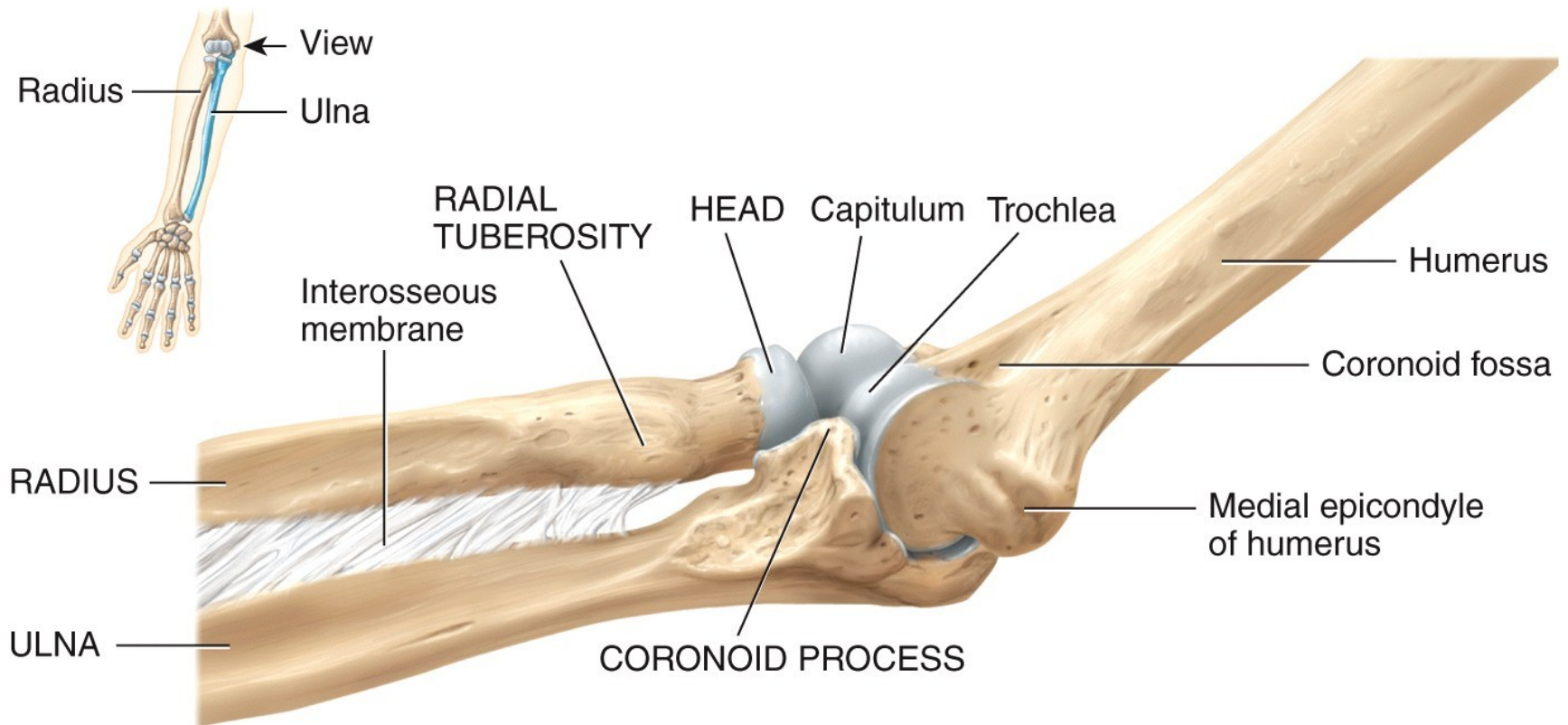
Right Ulna and Radius



Right Ulna and Radius

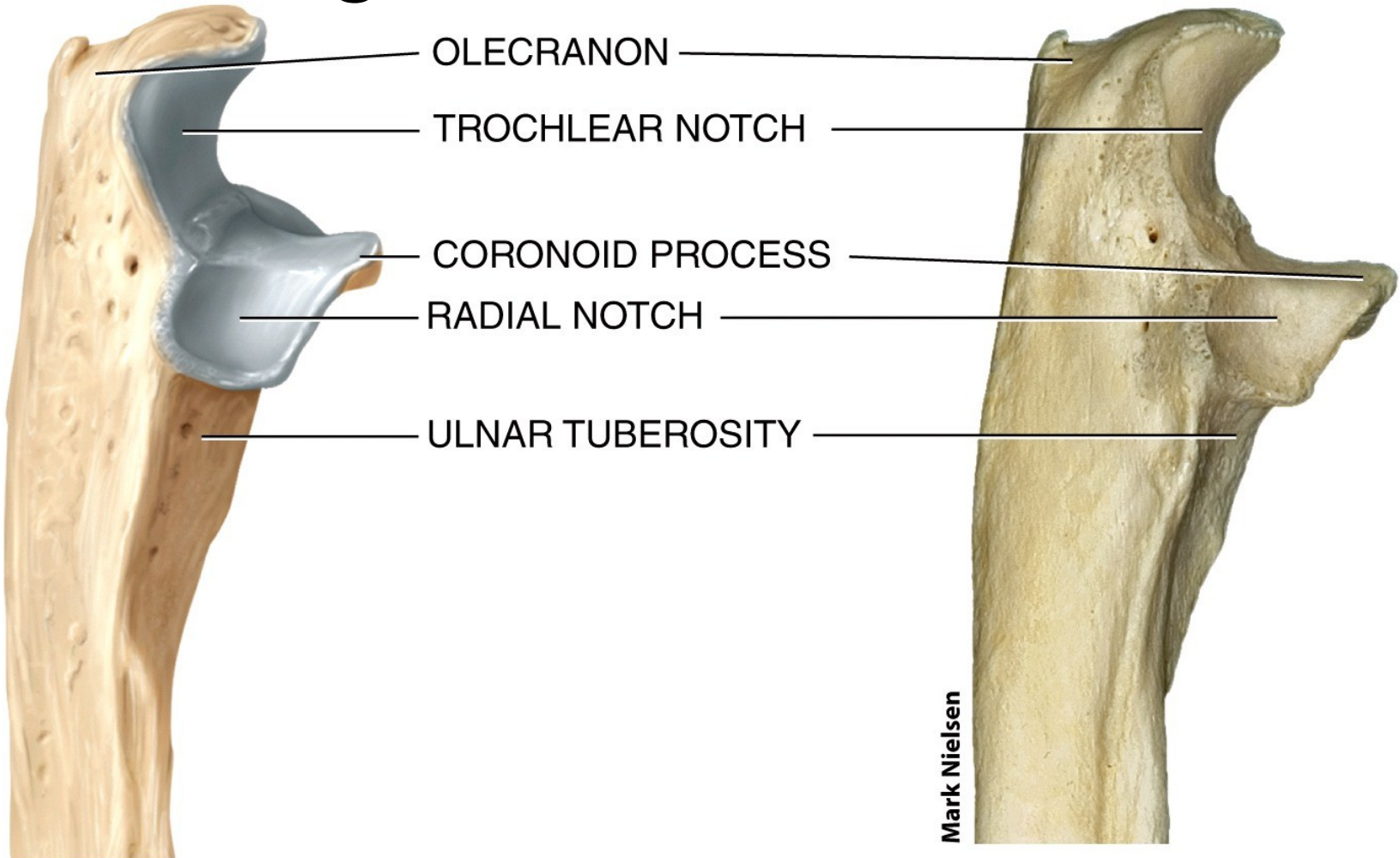


Right Ulna and Radius



(e) Medial view in relation to humerus

Right Ulna and Radius



(f)

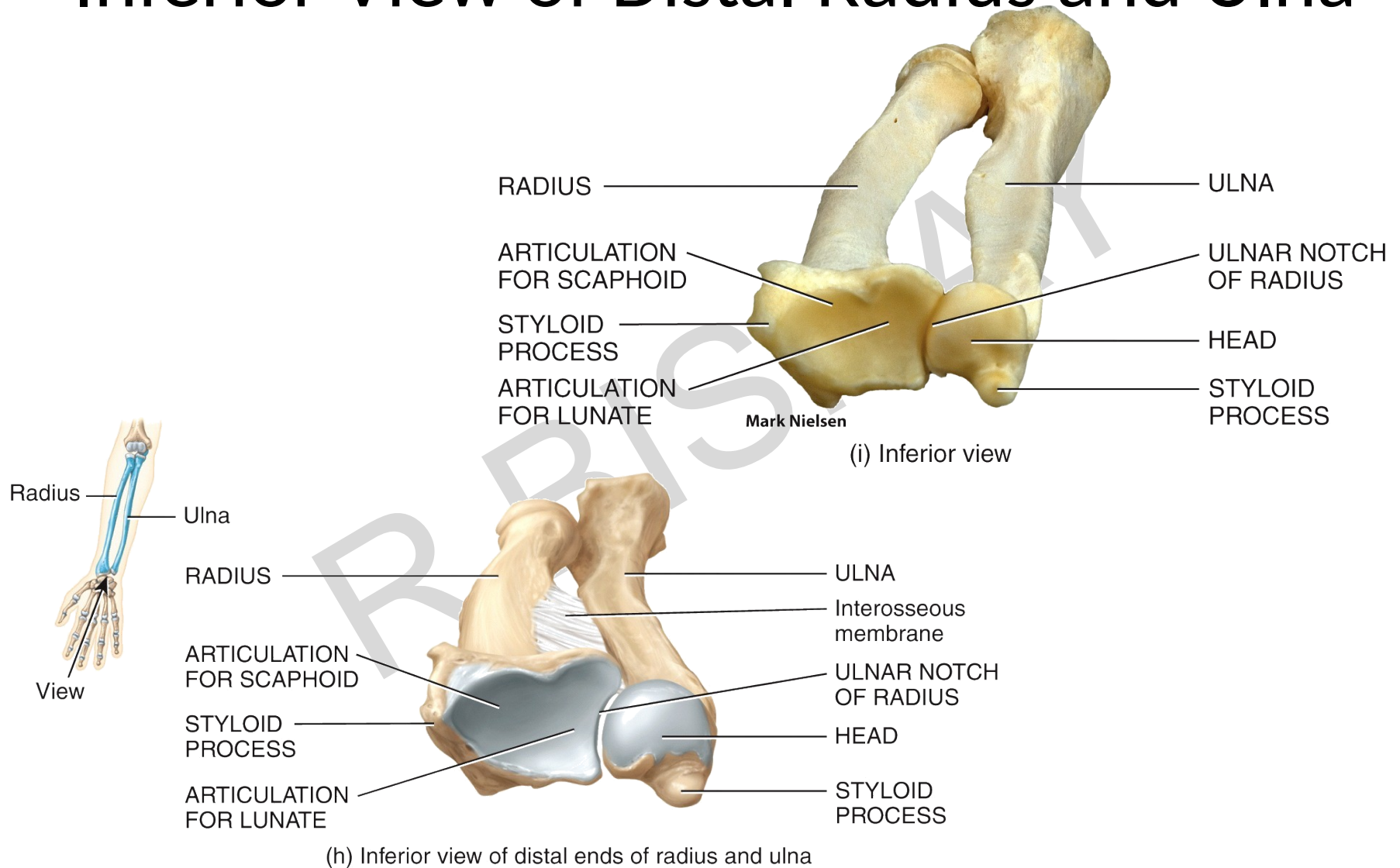
Lateral view of proximal end of ulna

(g)

Radius Surface Features

- The head articulates with the capitulum of the humerus and the radial notch of the ulna.
- Radial tuberosity
- Styloid process
- Interosseous tissue

Inferior View of Distal Radius and Ulna



Skeleton of the Hand

- The carpus (wrist) consists of 8 small bones (carpals).
- Two rows of carpal bones:
 - Proximal row
 - Distal row

Right Wrist and Hand in Relation to Ulna and Radius

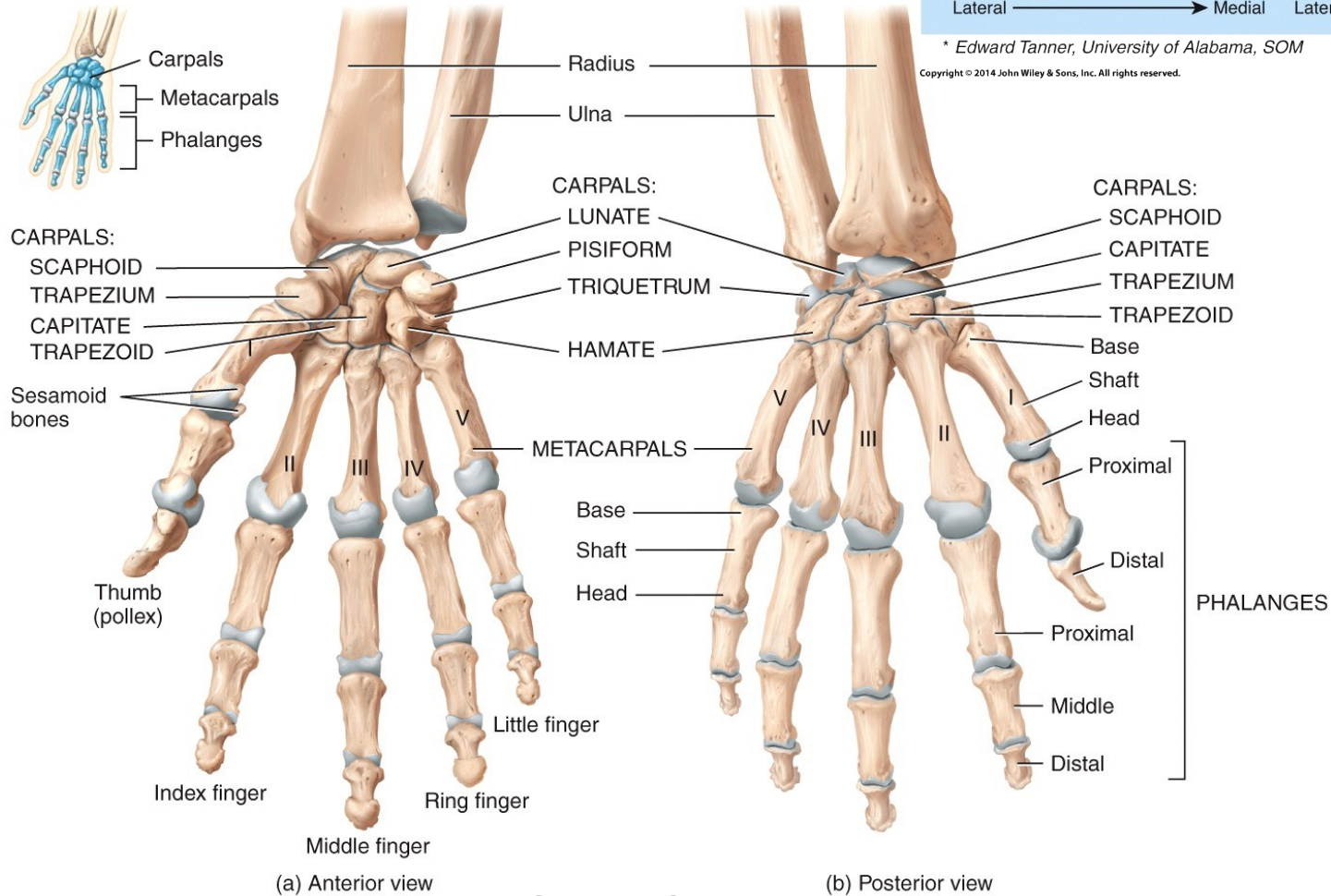
MNEMONIC for carpal bones*:

Stop Letting Those People Touch The Cadaver's Hand.

Scaphoid	Lunate	Triquetrum	Pisiform	Trapezium	Trapezoid	Capitate	Hamate
Proximal row				Distal row			
Lateral → Medial				Lateral → Medial			

* Edward Tanner, University of Alabama, SOM

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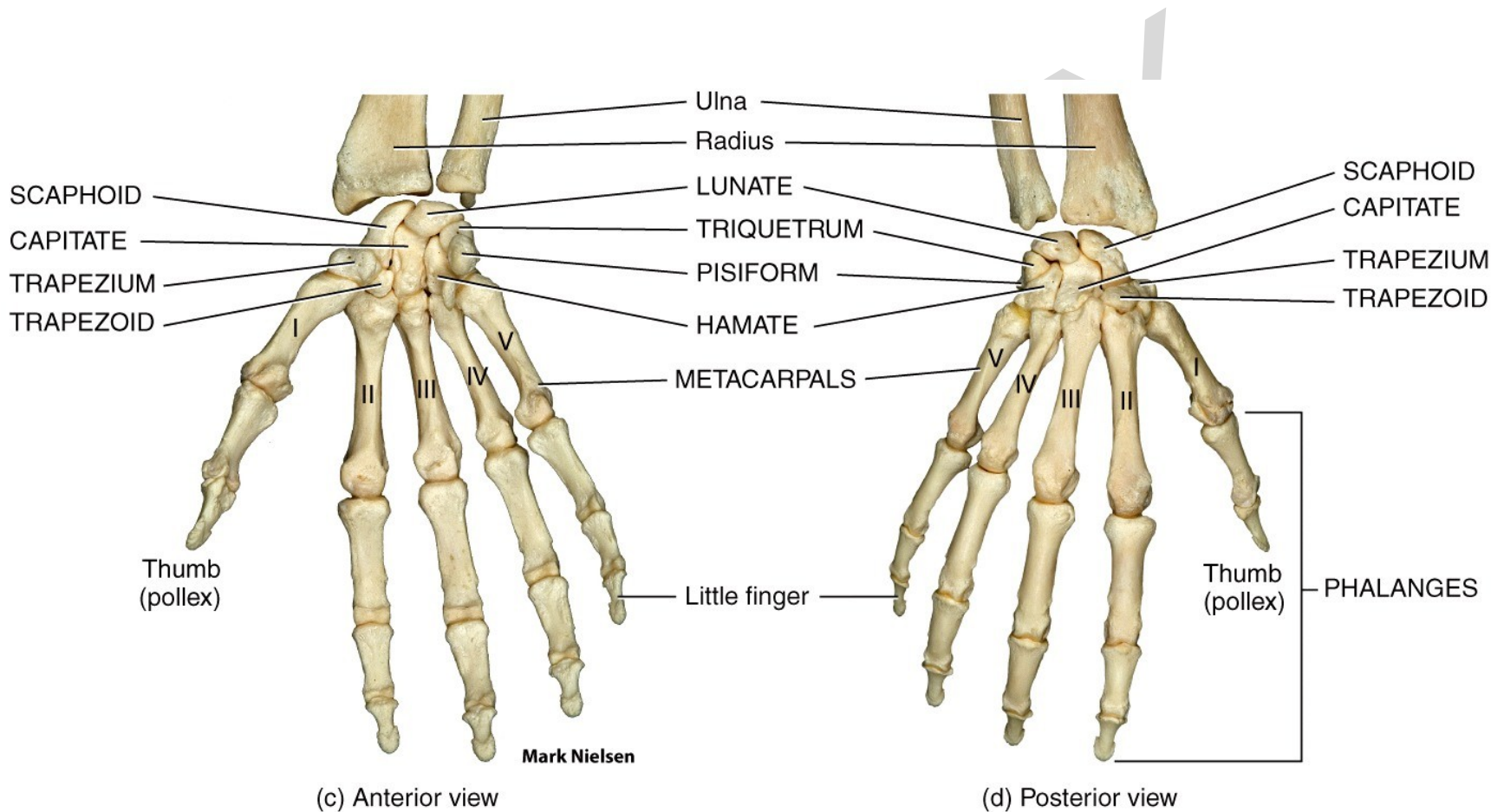


(a) Anterior view

(b) Posterior view

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Right Wrist and Hand in Relation to Ulna and Radius



Clinical Connection

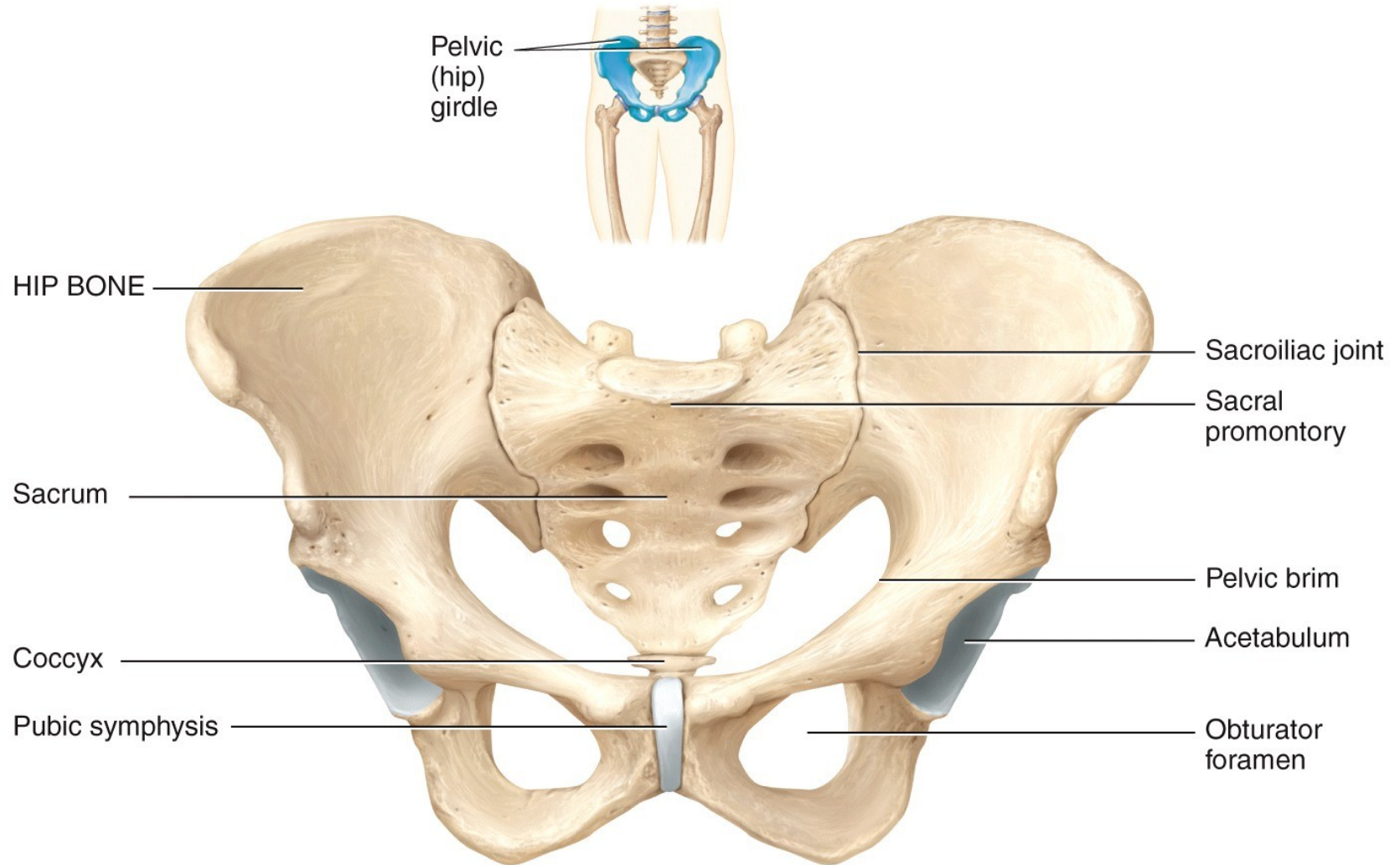
- **Boxer's fracture:**
- is the break of the 5th metacarpal bones of the hand near the knuckle. Occasionally it is used to refer to fractures of the 4th metacarpal as well. Symptoms include pain and a depressed knuckle. Classically, it occurs after a person hits an object with a closed fist.



Skeleton of the Lower Limb

- Two separate regions:
 - Pelvic girdle
 - Free lower limbs

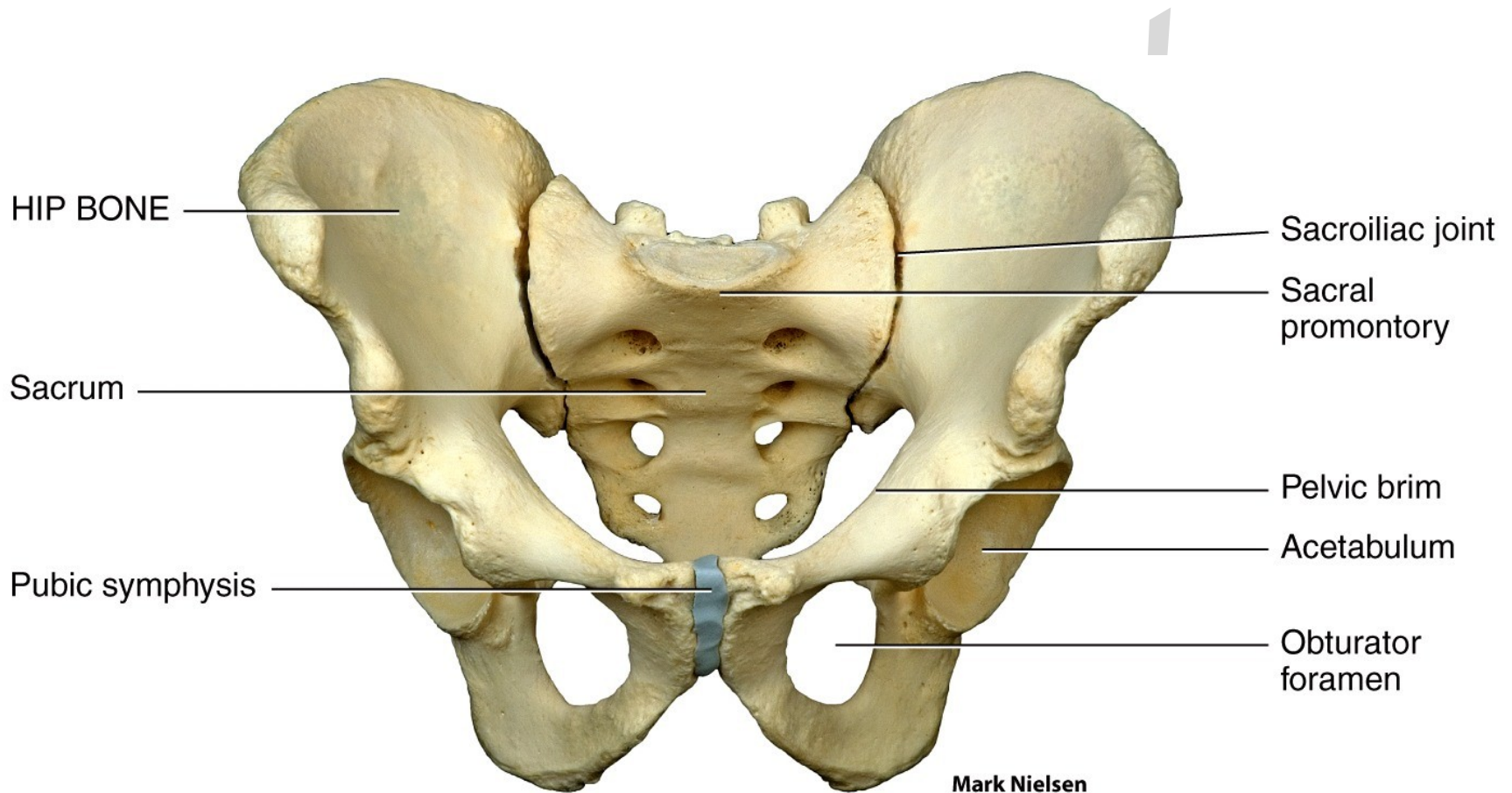
Skeleton of Pelvis and Free Lower Limb



(a) Anterosuperior view of pelvic girdle

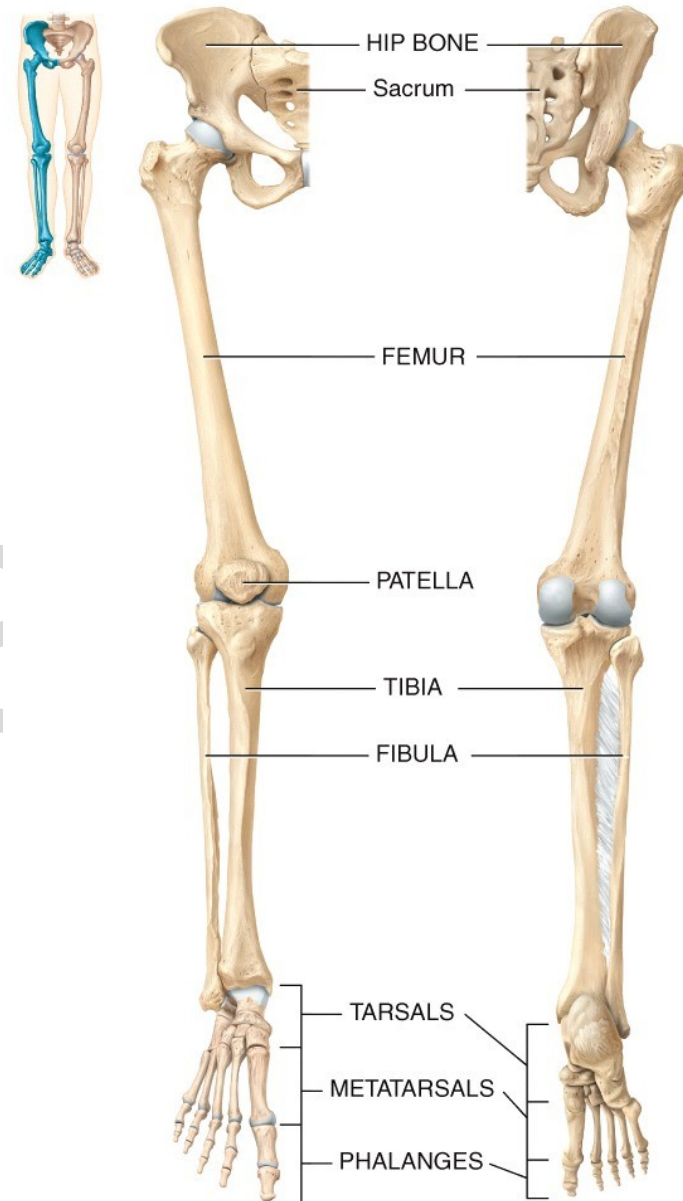
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Skeleton of Pelvis and Free Lower Limb



(b) Anterosuperior view

Skeleton of Pelvis and Free Lower Limb



(c) Anterior view of free lower limb

(d) Posterior view of free lower limb

Ilium Surface Features

- Ilium is the largest of the three hip bones.
- Ala
- Body
- Iliac crest
- Hip pointer
- Greater sciatic notch
- ASIS; AIIS; PSIS; PIIS

Right Hip Bone

POSTERIOR

Gluteal lines

Anterior

Inferior

Posterior

Posterior
superior
iliac spine

Posterior
inferior
iliac spine

Greater sciatic notch

Body of ischium

Ischial spine

Lesser sciatic notch

Ischial tuberosity

Ramus of ischium

ILIUM

ISCHIUM

ANTERIOR

Iliac crest

Ala

Anterior superior
iliac spine

Anterior inferior
iliac spine

Body of ilium

Acetabulum

Acetabular notch

Superior ramus
of pubis

Pubic tubercle

Obturator
foramen

Inferior ramus
of pubis

PUBIS

SUPERIOR

ILIUM

ISCHIUM

PUBIS

POSTERIOR

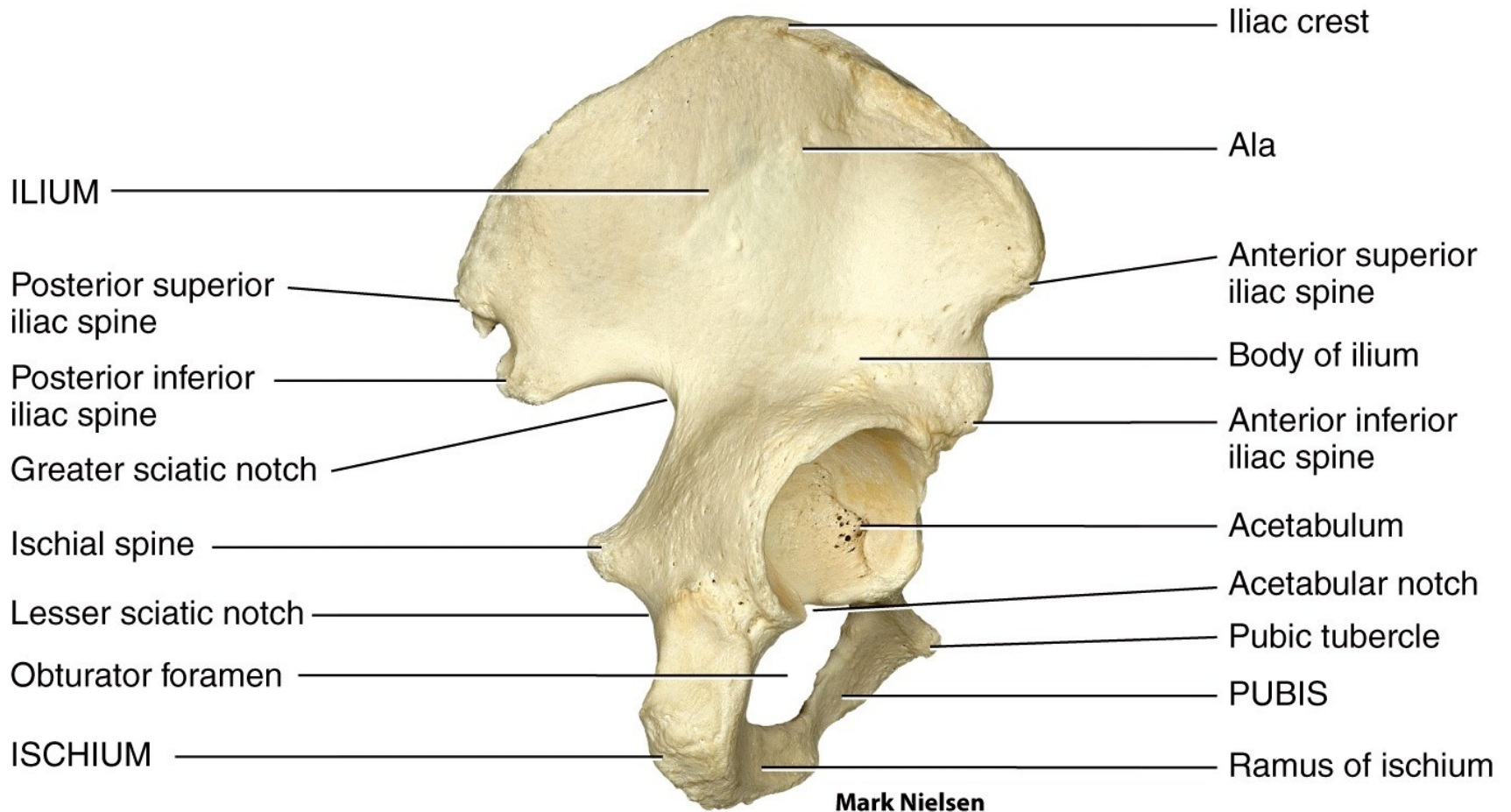
ANTERIOR

(a) Lateral view showing parts of hip bone

(b) Detailed lateral view

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Right Hip Bone

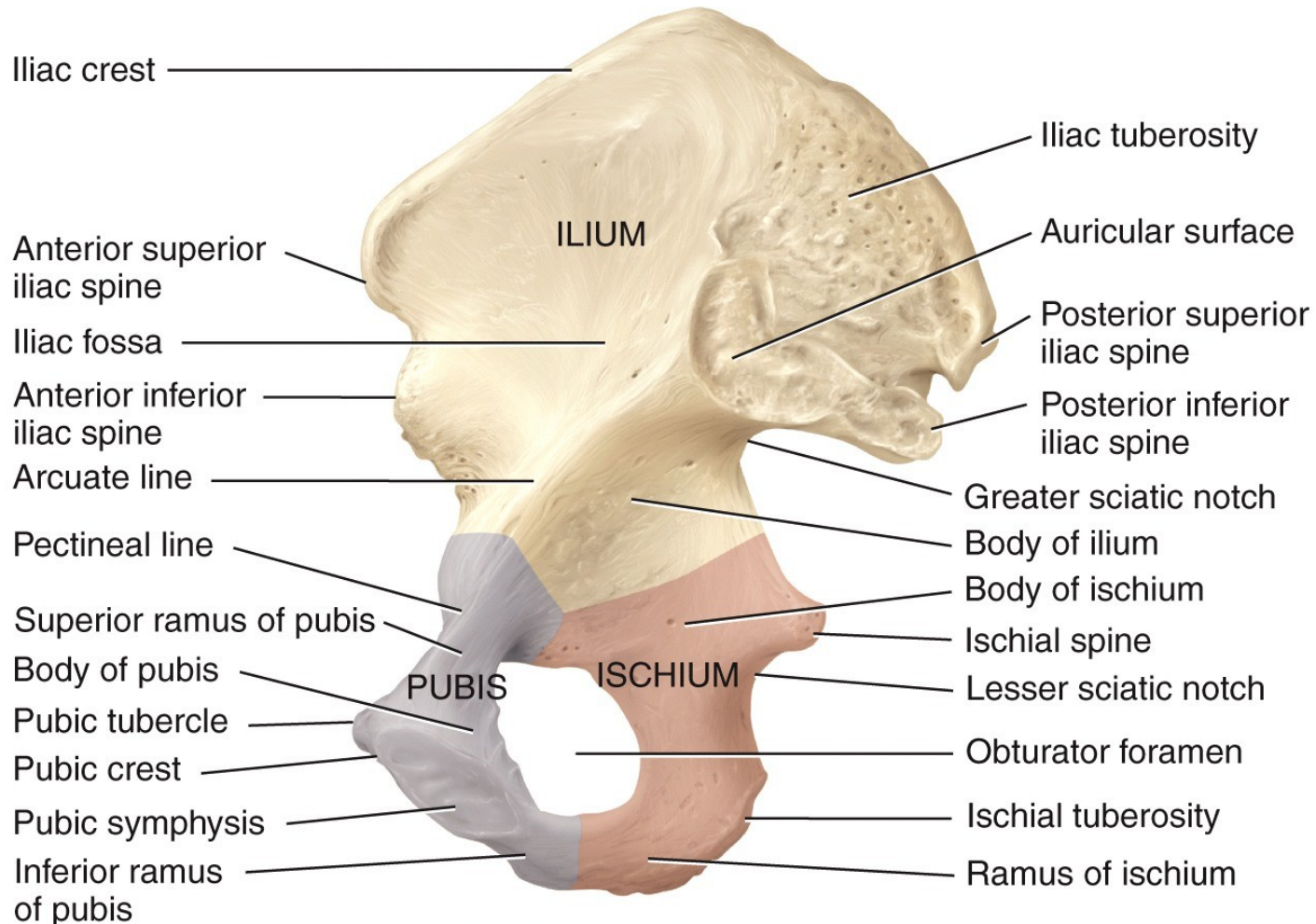


(c) Lateral view

Right Hip Bone

ANTERIOR

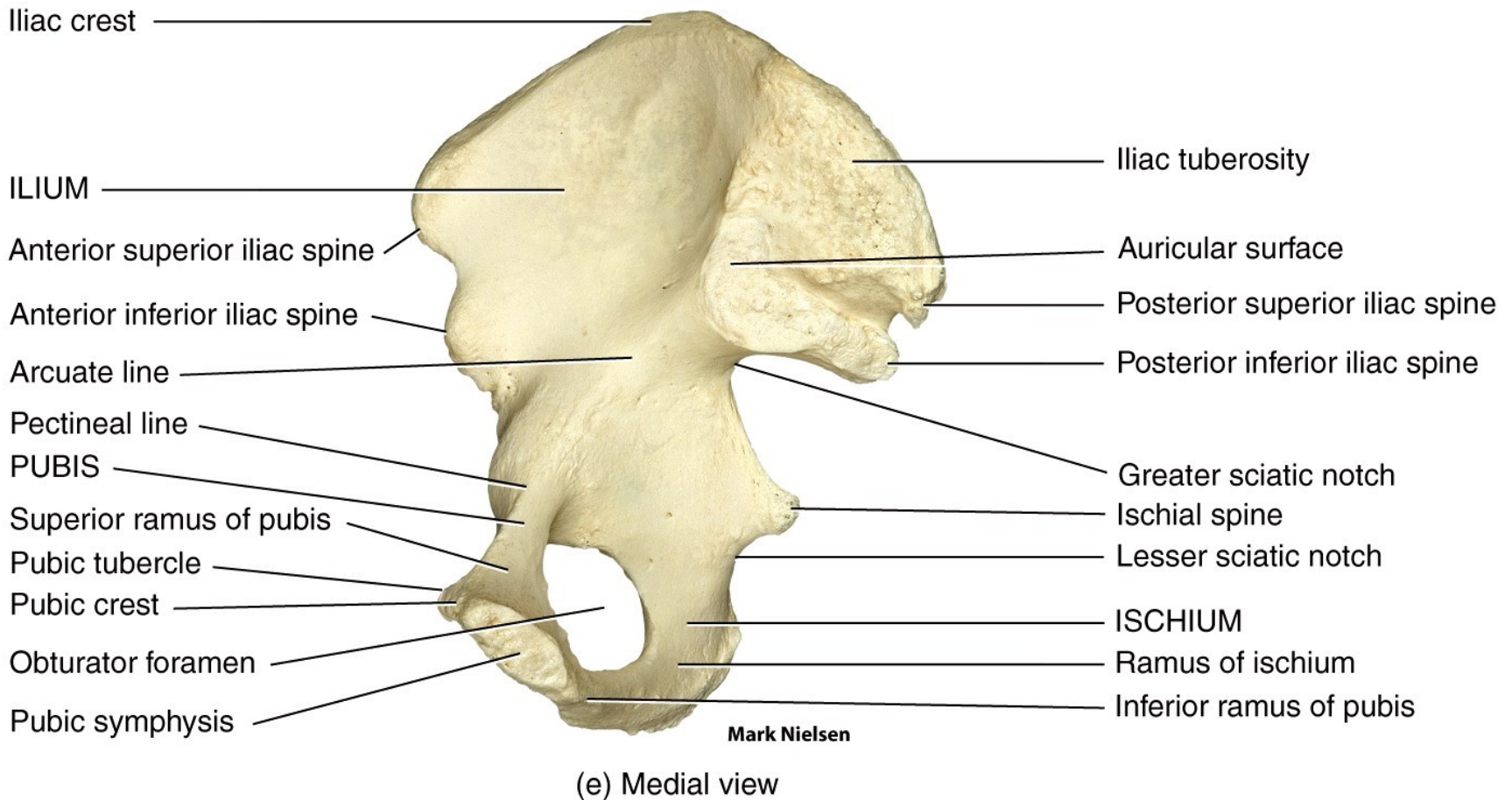
POSTERIOR



(d) Detailed medial view

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Right Hip Bone



Ischium Surface Features

- Ischial spine
- Ischial tuberosity
- Obturator foramen

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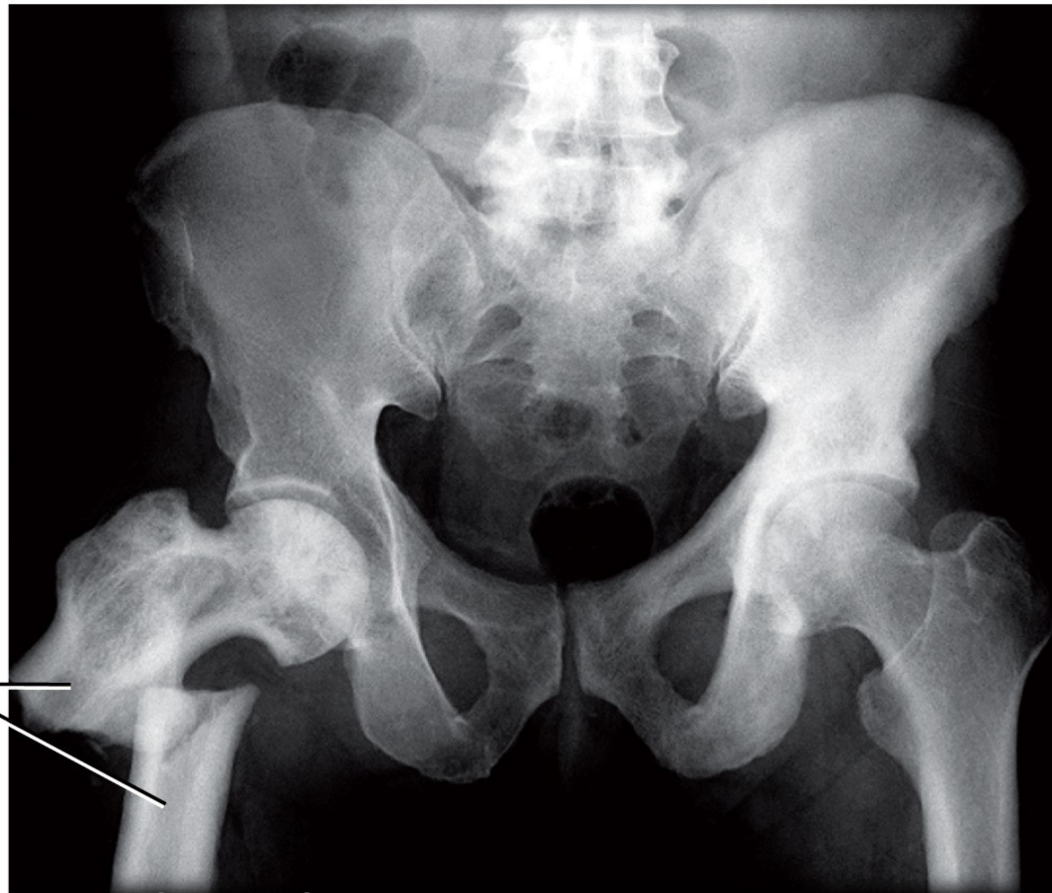
Pubis Surface Features

- Superior ramus
- Inferior ramus
- Body
- Pubic crest
- Pubic symphysis
- Pubic arch
- Acetabulum

Clinical Connection

- Hip fracture

Fractured
femur



Neil Borden/Living Art Enterprises, LLC / Science Source

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False and True Pelves

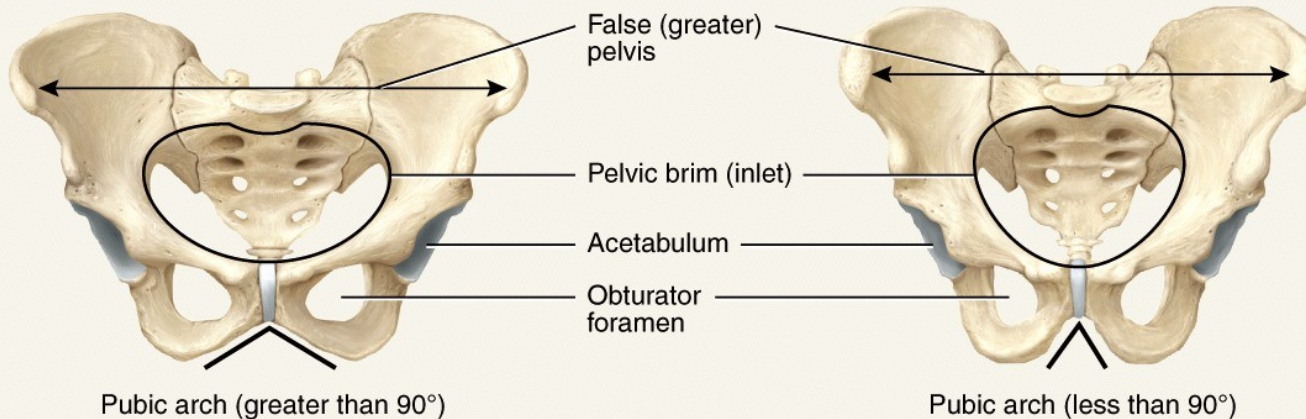
- Pelvic brim
- False pelvis
- True pelvis
- Pelvic axis

Comparison of Female and Male Pelves

TABLE 8.1

Comparison of Female and Male Pelves

POINT OF COMPARISON	FEMALE	MALE
General structure	Light and thin	Heavy and thick
False (greater) pelvis	Shallow	Deep
Pelvic brim (inlet)	Wide and more oval	Narrow and heart-shaped
Acetabulum	Small and faces anteriorly	Large and faces laterally
Obturator foramen	Oval	Round
Pubic arch	Greater than 90° angle	Less than 90° angle



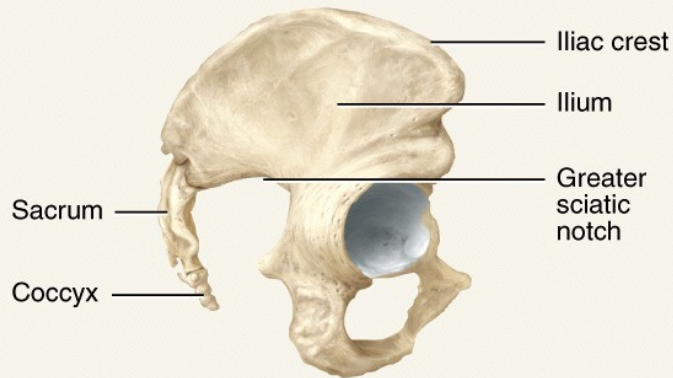
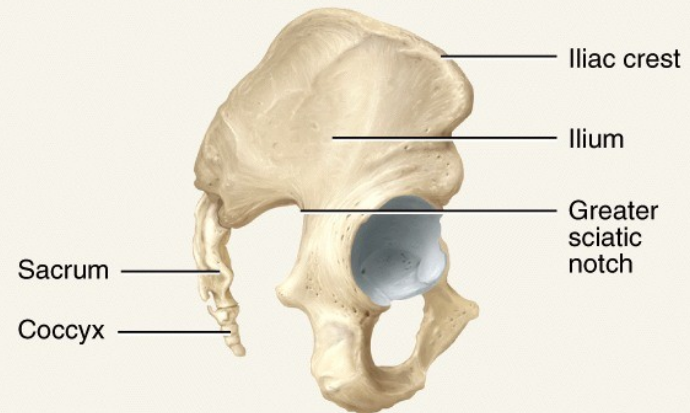
Anterior views

Comparison of Female and Male Pelves

TABLE 8.1

Comparison of Female and Male Pelves

POINT OF COMPARISON	FEMALE	MALE
Iliac crest	Less curved	More curved
Ilium	Less vertical	More vertical
Greater sciatic notch	Wide (almost 90°)	Narrow (about 70°; inverted V)
Coccyx	More movable and more curved anteriorly	Less movable and less curved anteriorly
Sacrum	Shorter, wider (see anterior views), and less curved anteriorly	Longer, narrower (see anterior views), and more curved anteriorly



Right lateral views

Comparison of Female and Male Pelves

TABLE 8.1

Comparison of Female and Male Pelves

POINT OF COMPARISON

FEMALE

MALE

Pelvic outlet

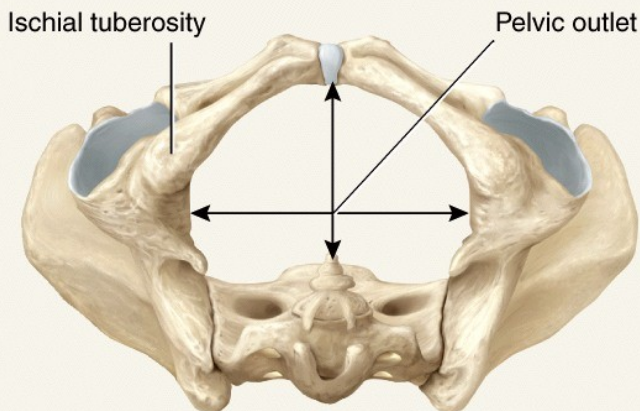
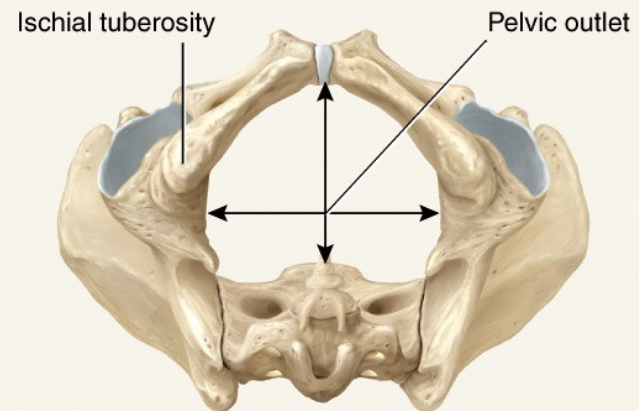
Wider

Narrower

Ischial tuberosity

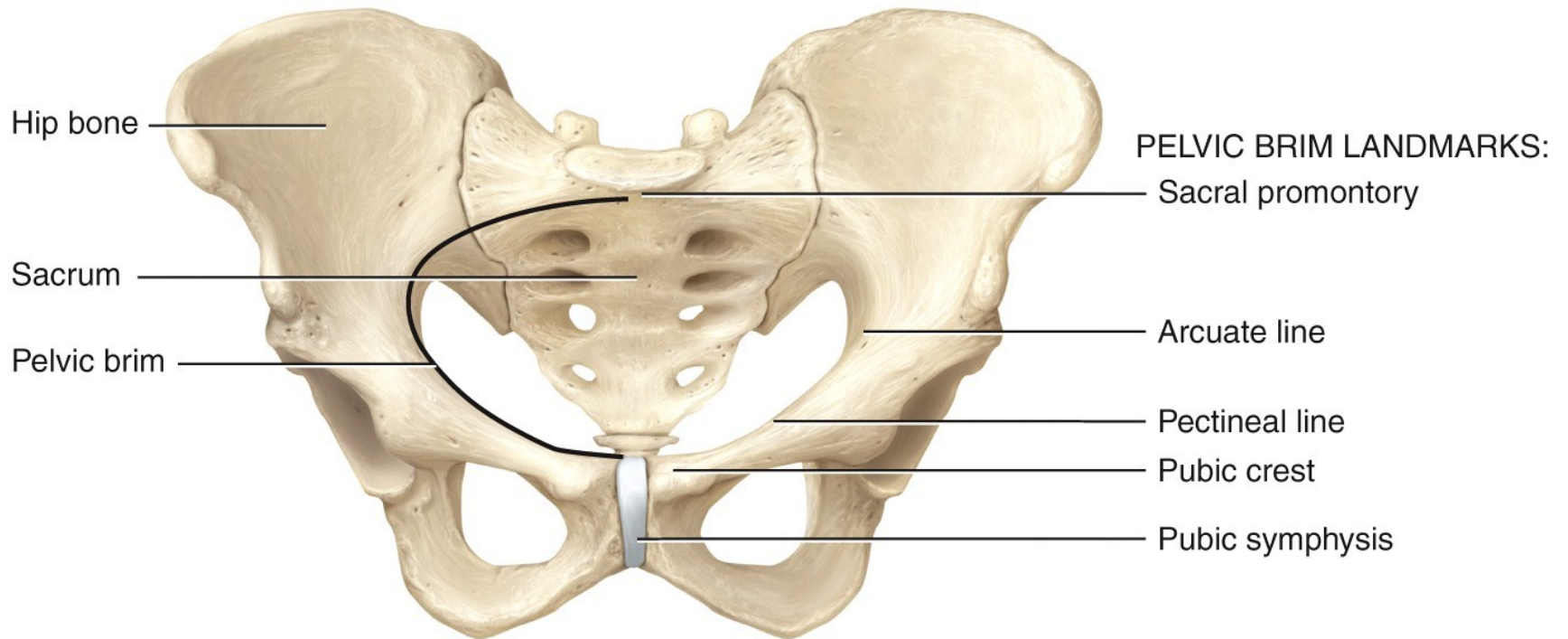
Shorter, farther apart, and more medially projecting

Longer, closer together, and more laterally projecting



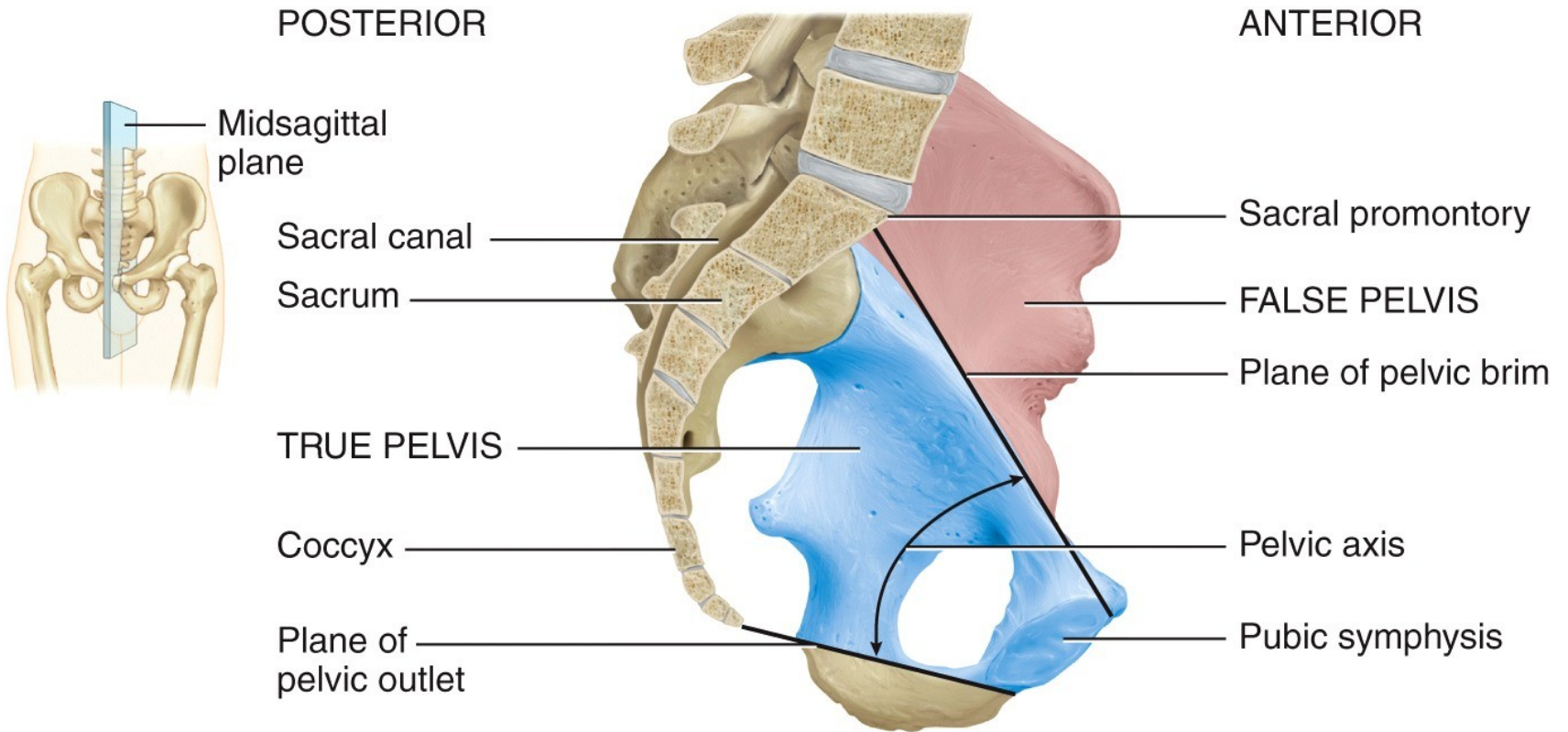
Inferior views

True and False Pelves



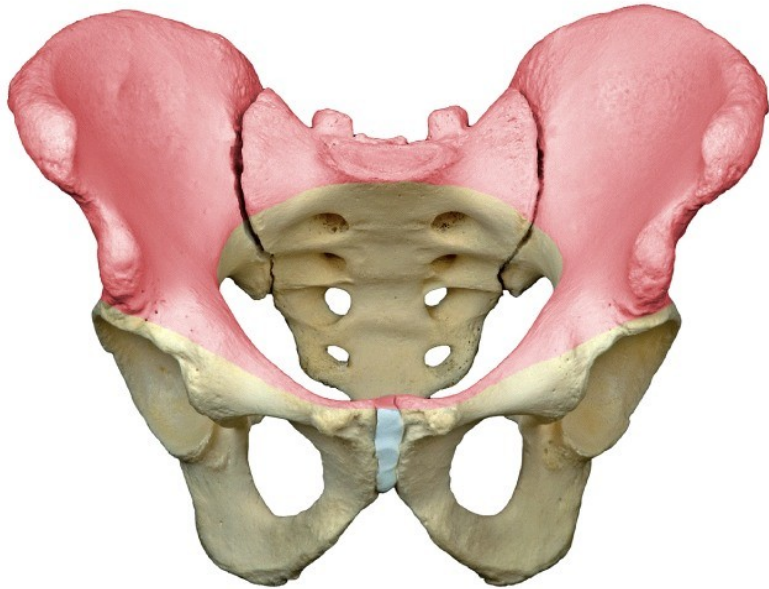
(a) Anterosuperior view of pelvic girdle

True and False Pelves

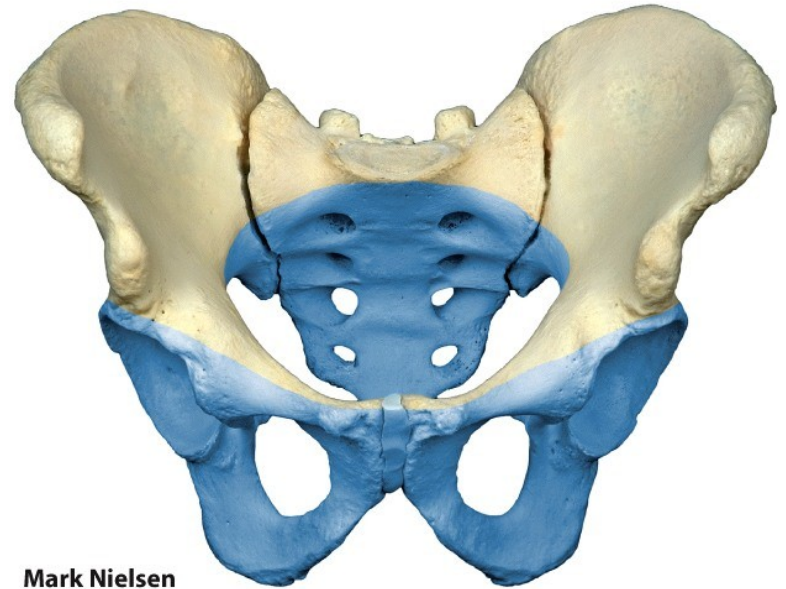


(b) Midsagittal section indicating locations of true (blue) and false (pink) pelvis

True and False Pelves



(c) Anterosuperior view of false pelvis (pink)



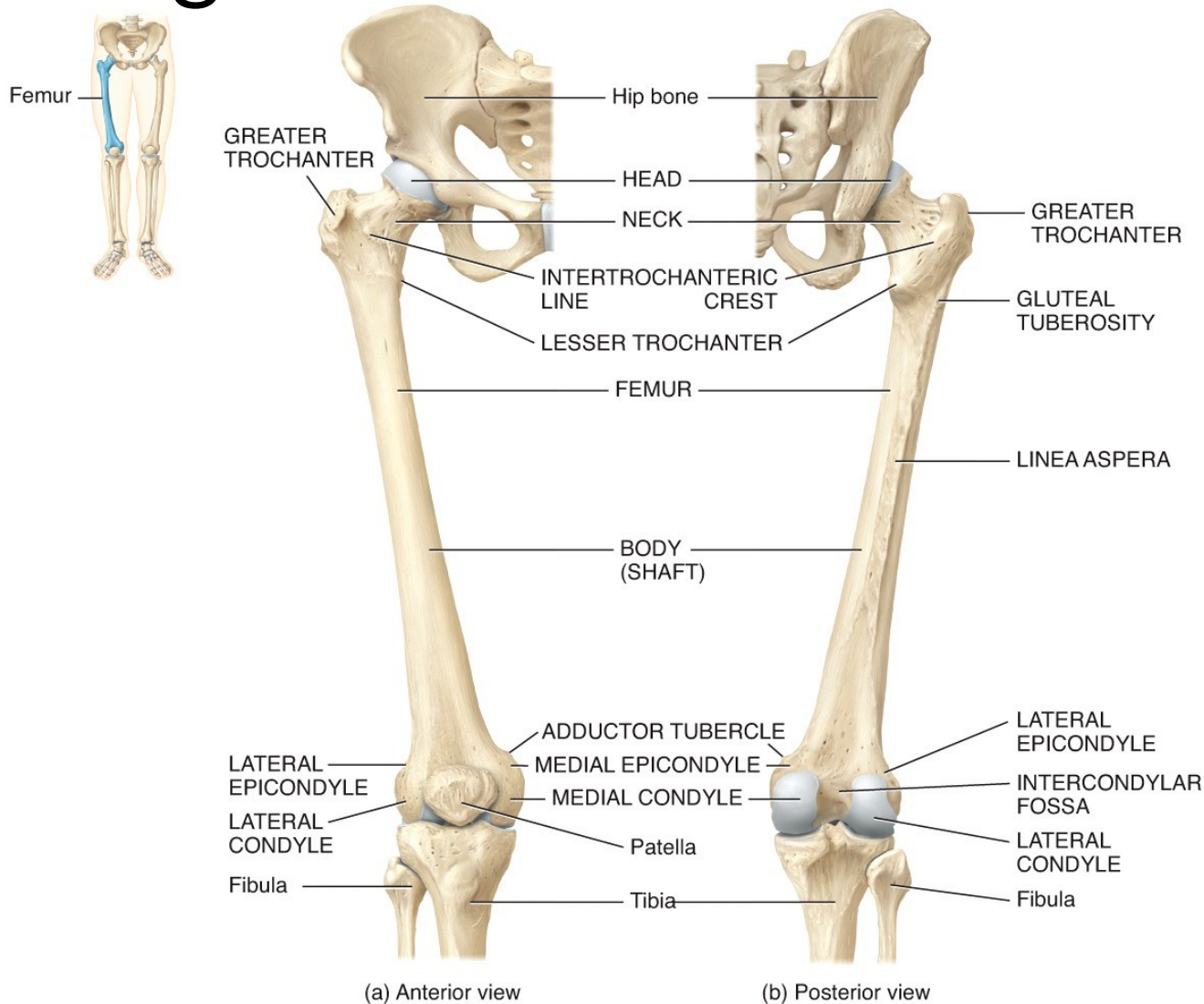
Mark Nielsen

(d) Anterosuperior view of true pelvis (blue)

Femur Surface Features

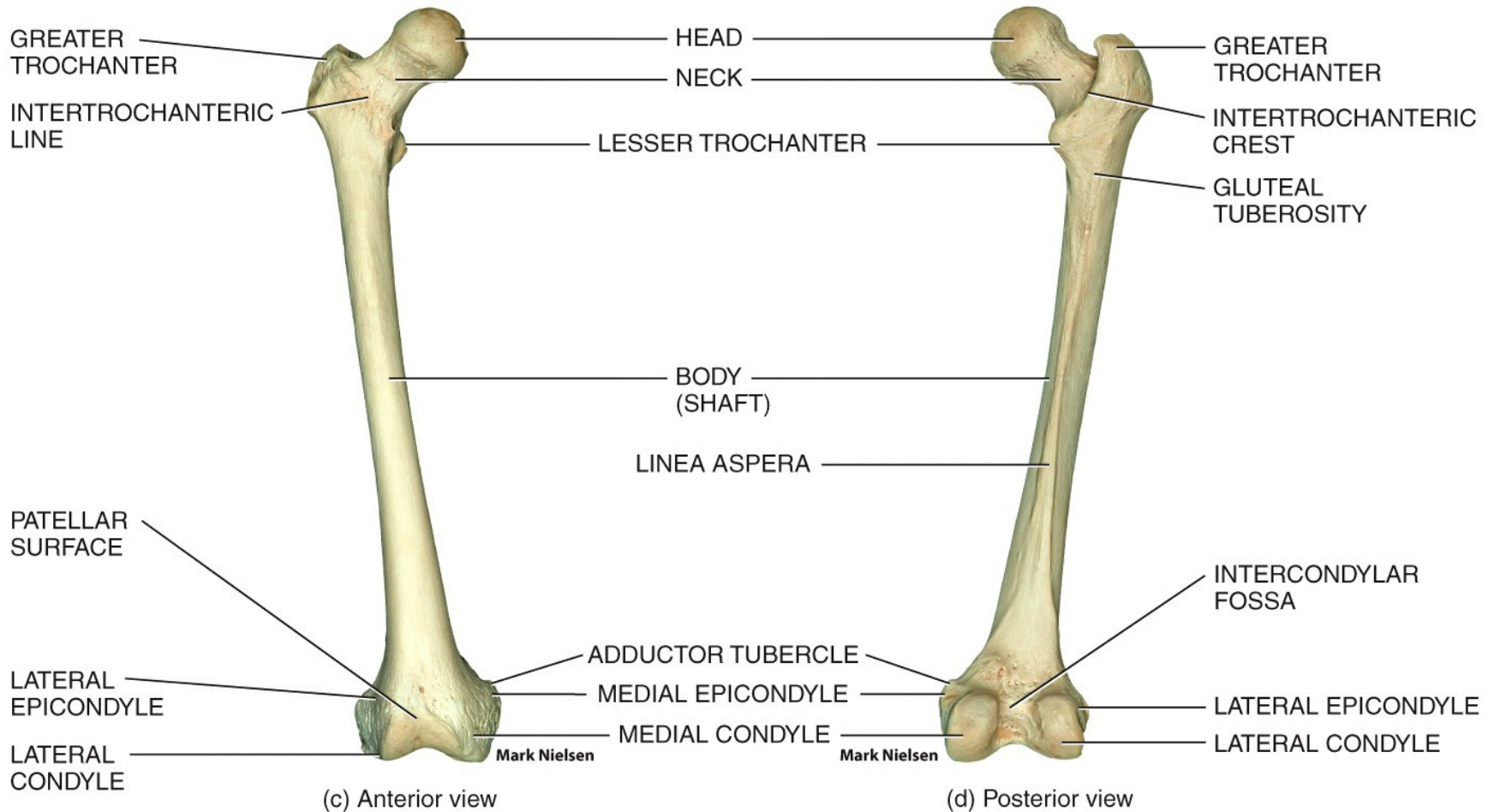
- Head
- Fovea capitis
- Greater and lesser trochanters
- Intertrochanteric crest
- Gluteal tuberosity
- Medial and lateral condyles
- Medial and lateral epicondyles
- Intercondylar fossa

Right Femur and Patella

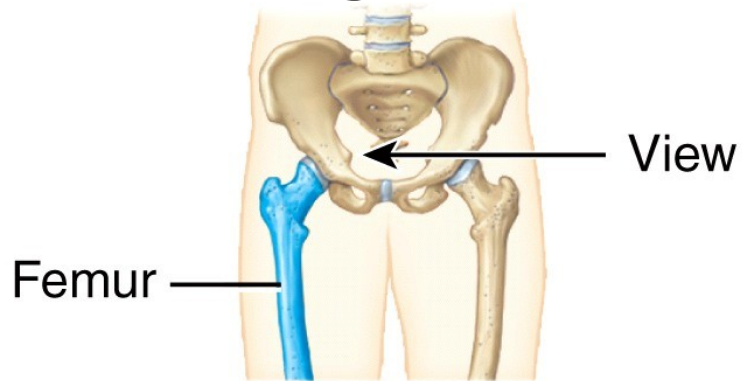
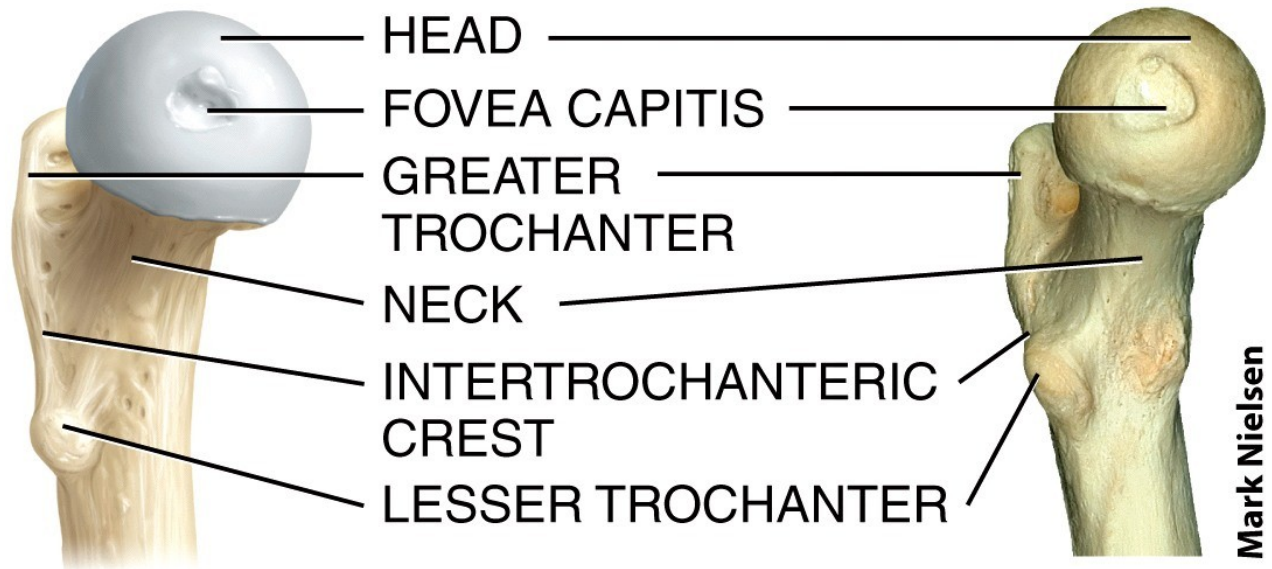


(a) Anterior view
(b) Posterior view
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Right Femur and Patella



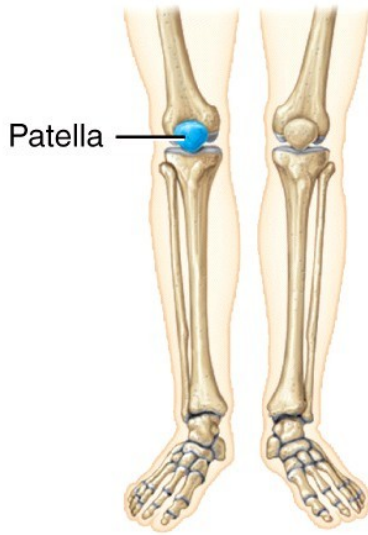
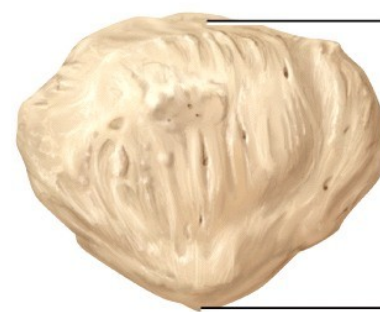
Right Femur and Patella



(e) Medial view of proximal end of femur

(f) Medial view

Right Femur and Patella

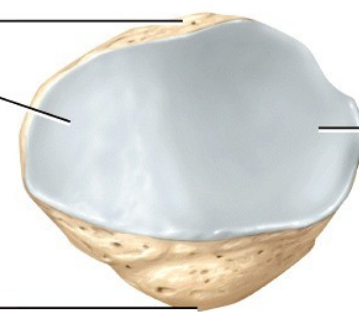


(g) Anterior view

BASE

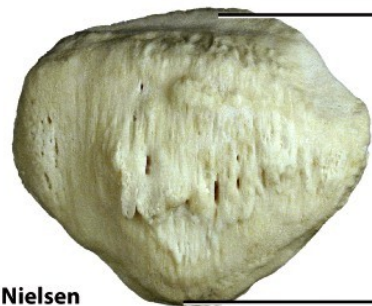
ARTICULAR
FACET
FOR MEDIAL
FEMORAL
CONDYLE

APEX



(h) Posterior view

ARTICULAR
FACET
FOR LATERAL
FEMORAL
CONDYLE

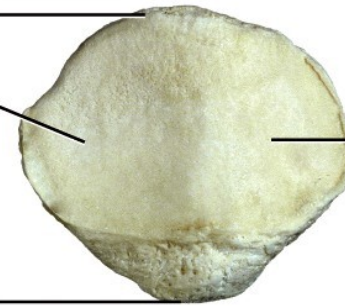


(i) Anterior view

BASE

ARTICULAR
FACET
FOR MEDIAL
FEMORAL
CONDYLE

APEX



(j) Posterior view

ARTICULAR
FACET
FOR LATERAL
FEMORAL
CONDYLE

Mark Nielsen

Patella Surface Features

- Base
- Articular facets
- Forms the patellofemoral joint

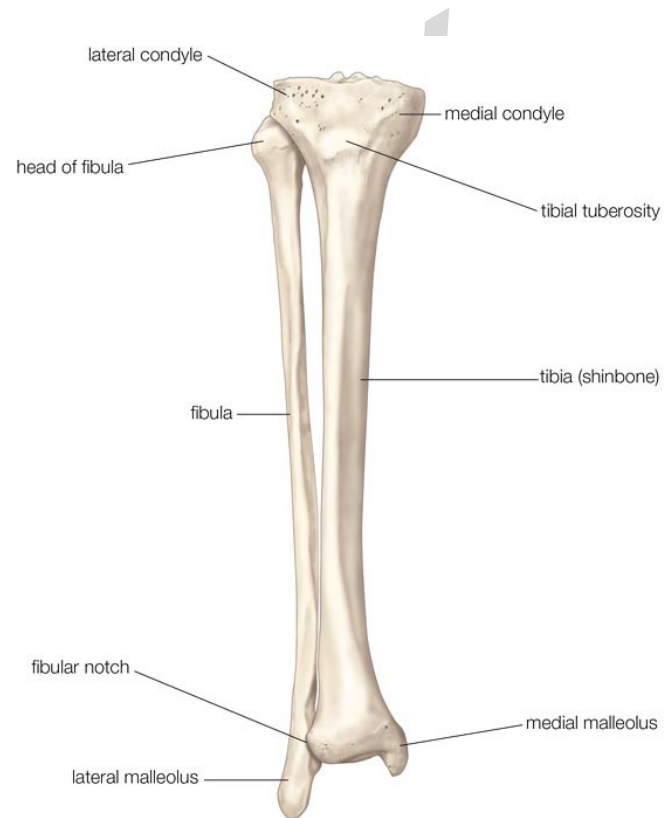
Clinical Connection

- **Patellofemoral stress syndrome (runner's knee):**
- Forty-two percent of all overuse injuries affect the knee joint, and patellofemoral pain syndrome (PFPS), or simply "runner's knee," is the most common overuse injury among runners. It occurs when a mistracking kneecap (patella) irritates the femoral groove in which it rests on the thighbone (femur)



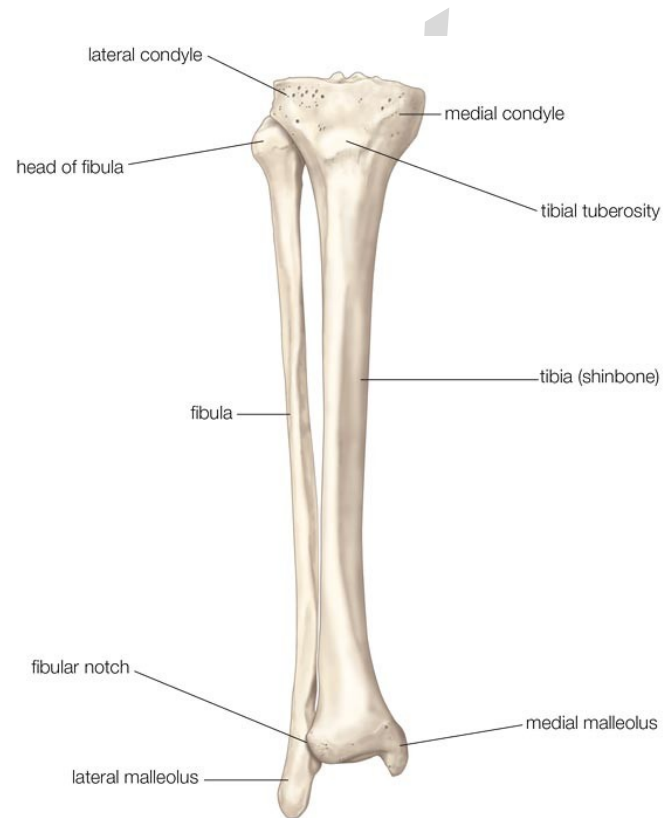
Tibia Surface Features

- Lateral and medial condyles
- Tibial tuberosity
- Medial malleolus
- Distal tibiofibular joint

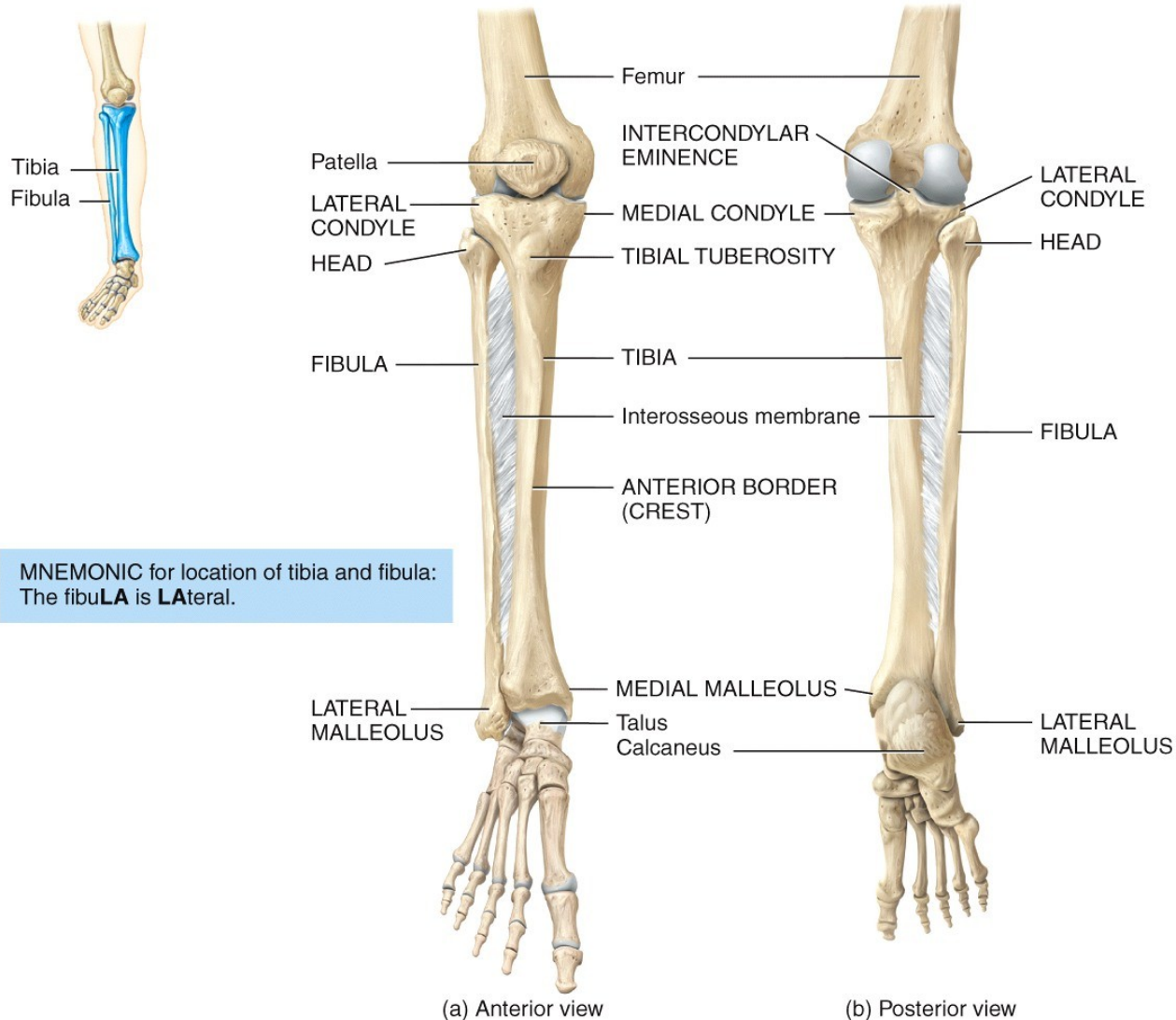


Fibula Surface Features

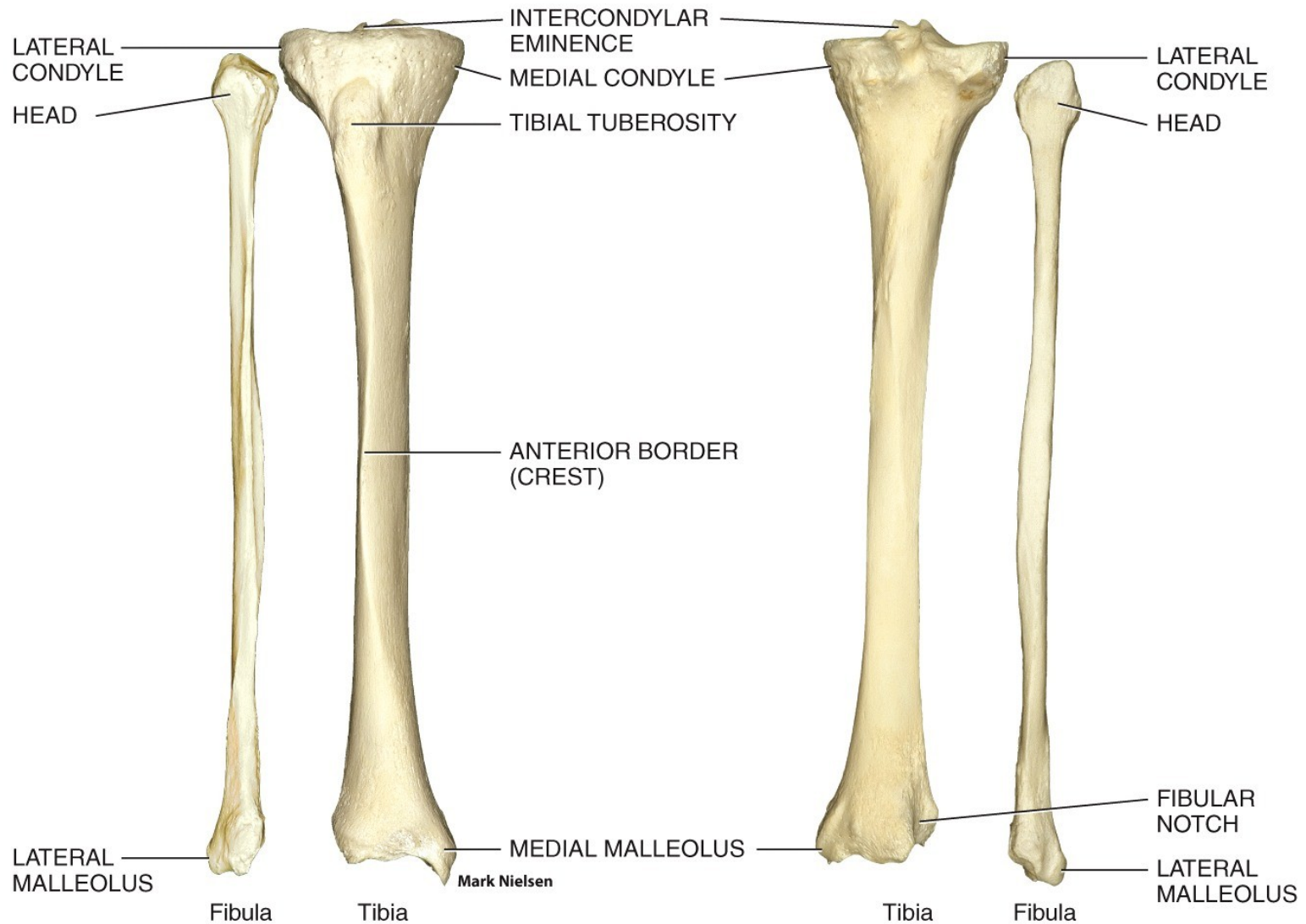
- Proximal tibiofibular joint
- Lateral malleolus



Right Tibia and Fibula



Right Tibia and Fibula

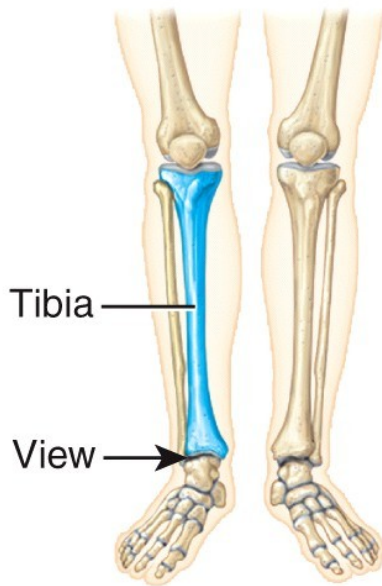


(c) Anterior view

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(d) Posterior view

Right Tibia and Fibula



POSTERIOR

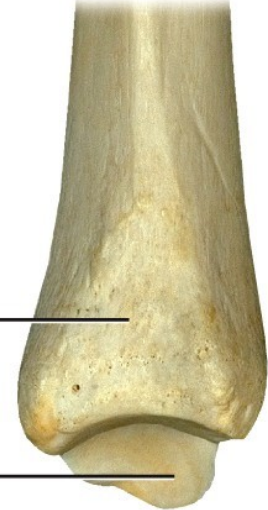
ANTERIOR



(e) Lateral view of distal end of tibia

FIBULAR
NOTCH

MEDIAL
MALLEOLUS



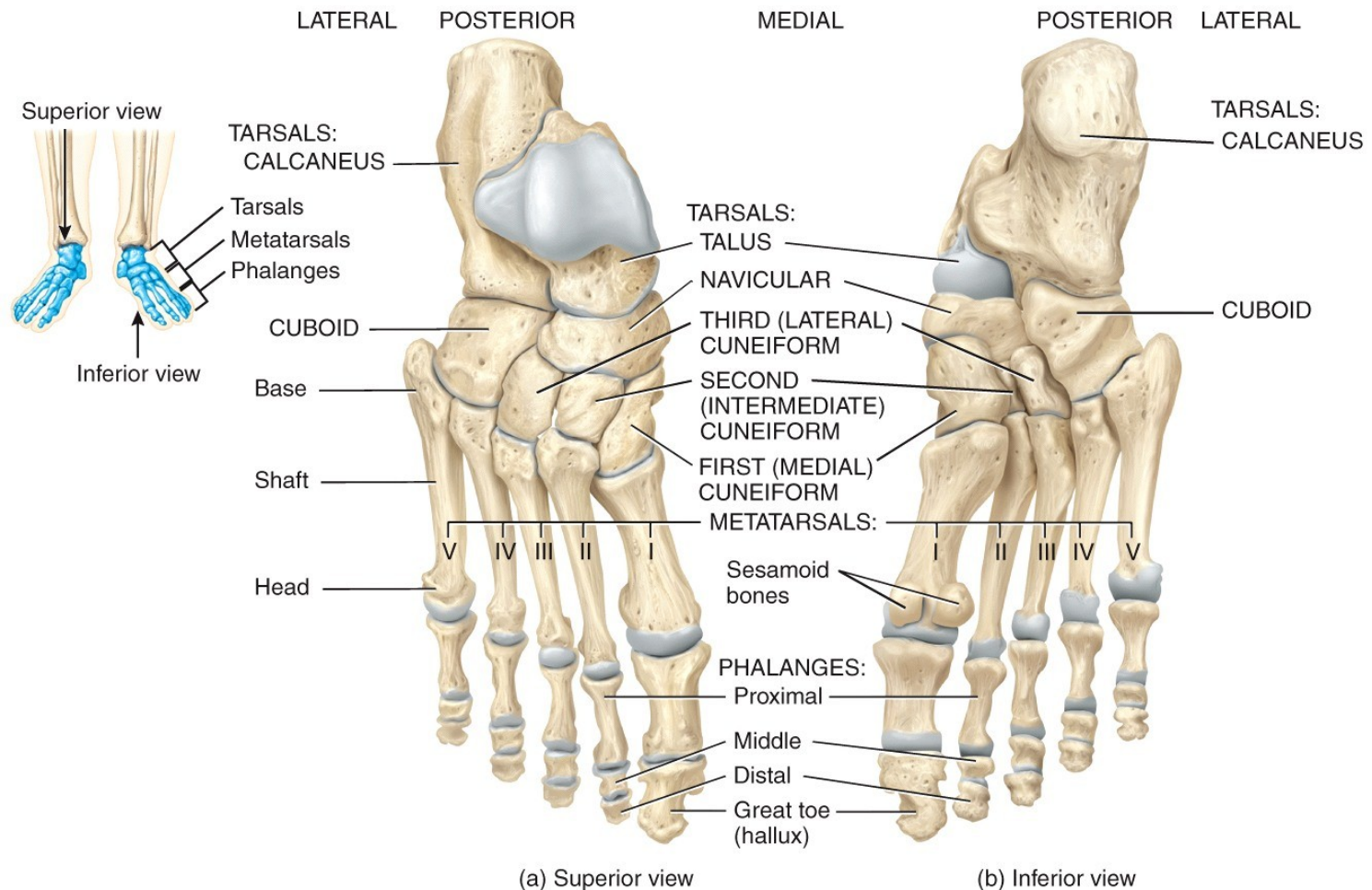
(f) Lateral view

Mark Nielsen

Skeleton of the Foot: Tarsals, Metatarsals, and Phalanges

- Tarsus (ankle) consists of seven tarsal bones.
- Five metatarsals
- Fourteen phalanges

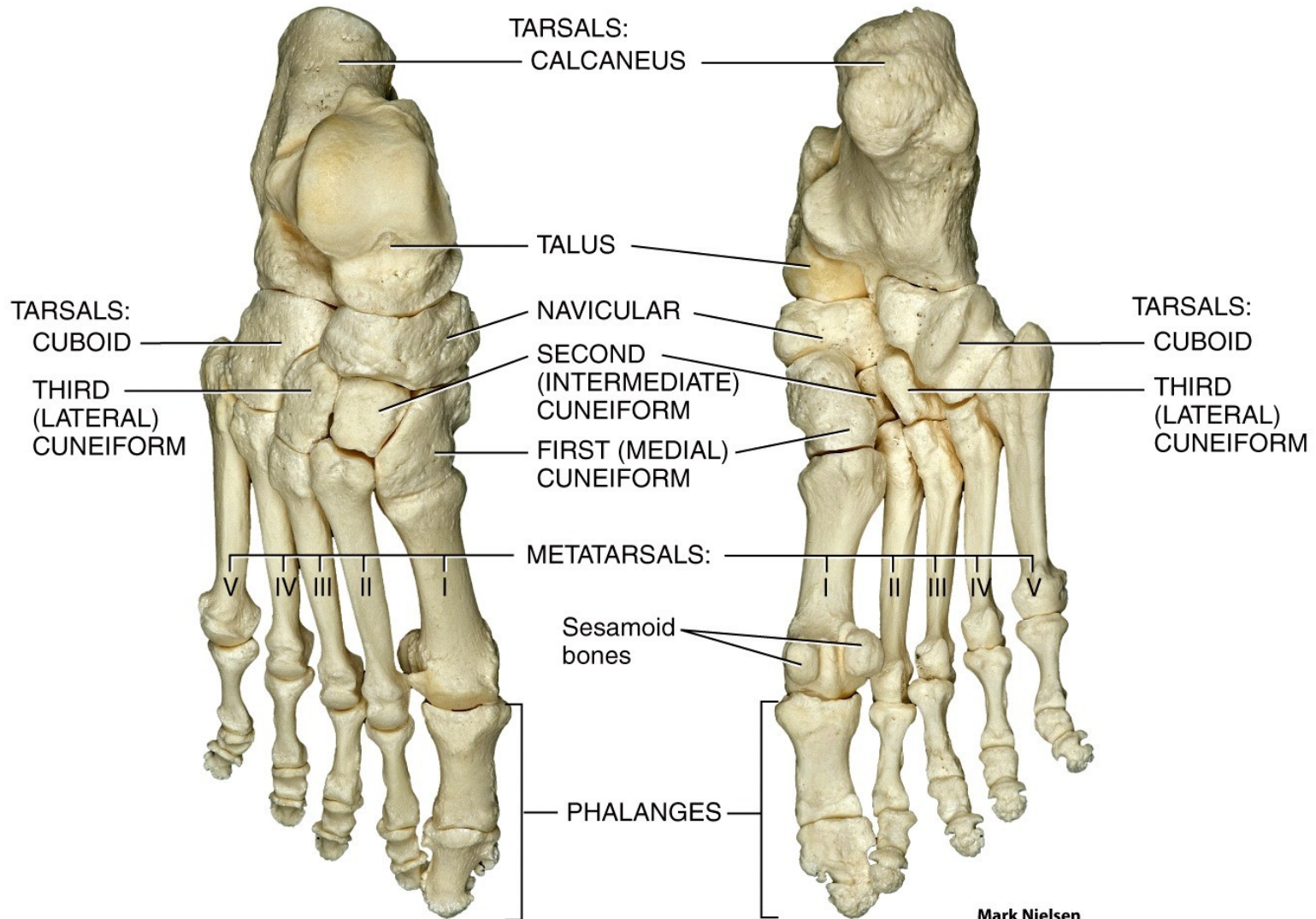
Right Foot and Arches of the Foot



MNEMONIC for tarsals:

Tall	Centers	Never	Take	Shots	From	Corners.
Talus	Calcaneus	Navicular	Third cuneiform	Second cuneiform	First cuneiform	Cuboid

Right Foot and Arches of the Foot



Clinical Connection

- **Fractures of the metatarsals:**

The metatarsal bones are the long bones in your foot that connect your ankle to your toes. They also help you balance when you stand and walk. A sudden blow or severe twist of your foot, or overuse, can cause a break, or acute (sudden) fracture, in one of the bones



Arches of the Foot

- Two arches support the weight of the body.
- The arches provide spring and leverage to the foot when walking.
- The arches flex when body weight is applied.

Clinical Connection

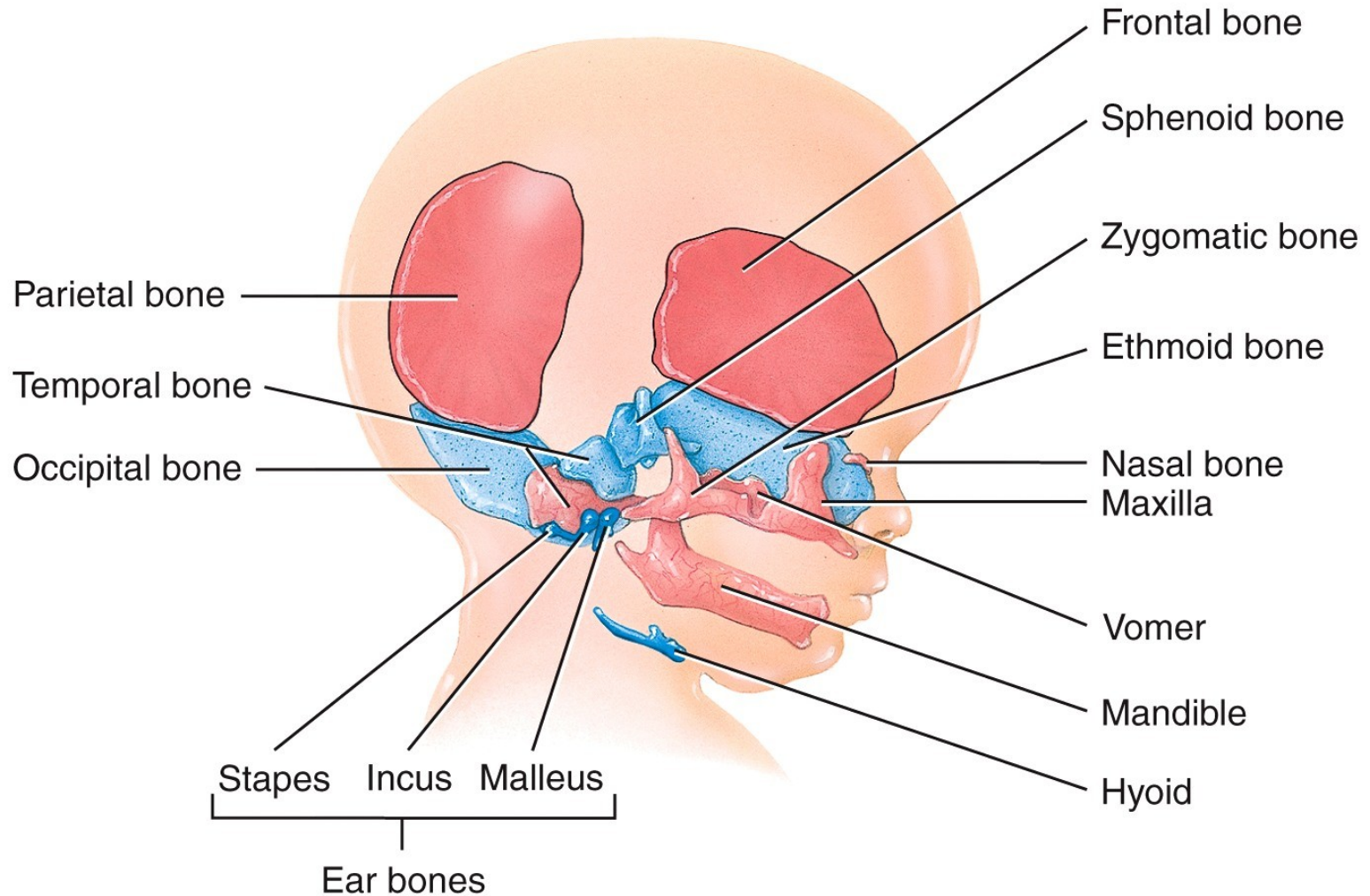
- **Flatfoot:**
a condition in which the foot has an arch that is lower than usual.
- "various surgical techniques are used to correct adult-acquired flatfoot"
- **Clawfoot:**
an excessively arched foot with an unnaturally high instep



Development of the Skeletal System

- Most skeletal tissue arises from mesenchymal cells.
- The skull develops during the fourth week after fertilization.
- Fontanelles are the spaces between the skull bones during fetal life and infancy.
- Upper limb buds form during the fourth week after fertilization, followed by the lower limb buds.
- During the sixth week, hand plates and foot plates form.
- Vertebrae and ribs are formed from sclerotomes of somites.
- Vertebral arch failure to develop results in spina bifida.

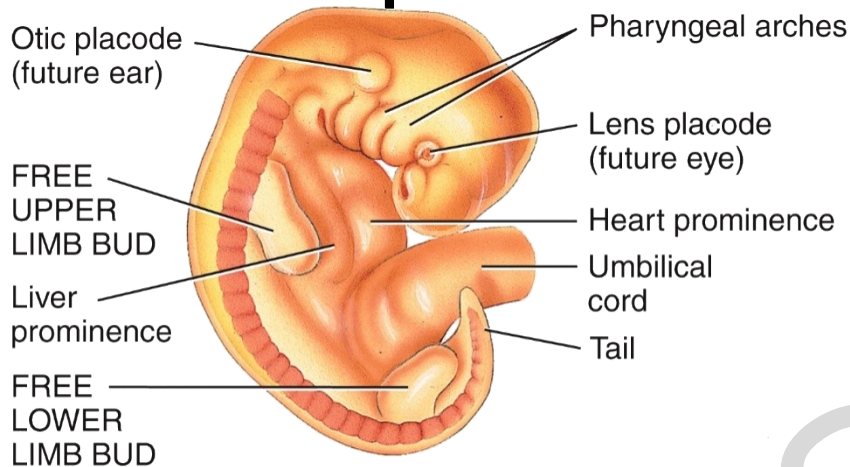
Development of the Skeletal System



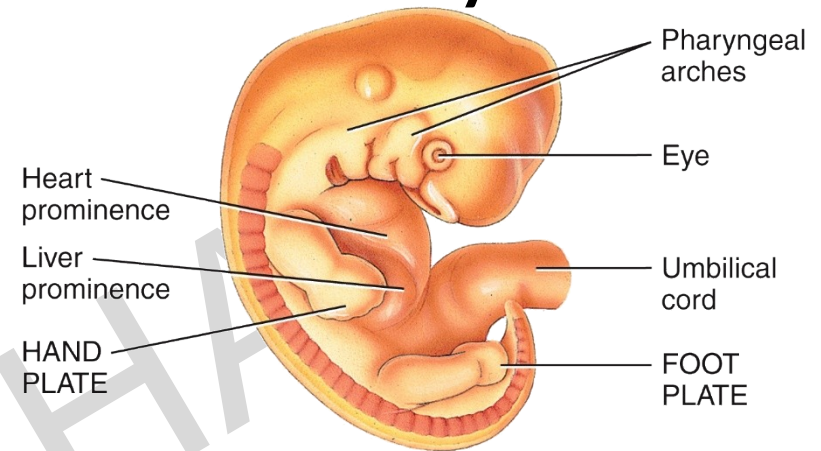
(a) Development of the skull

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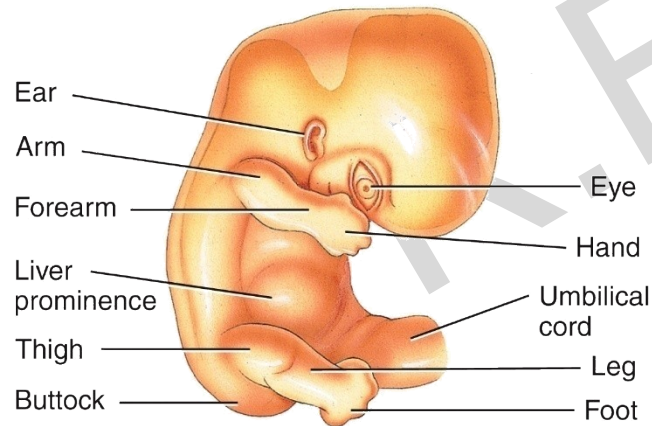
Development of the Skeletal System



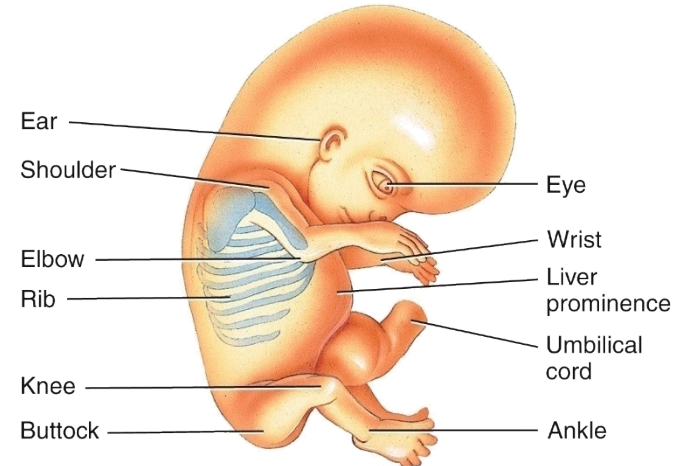
(b) Four-week embryo showing development of free limb buds



(c) Six-week embryo showing development of hand and foot plates



(d) Seven-week embryo showing development of arm, forearm, and hand in free upper limb bud and thigh, leg, and foot in free lower limb bud



(e) Eight-week embryo in which free limb buds have developed into free upper and lower limbs