



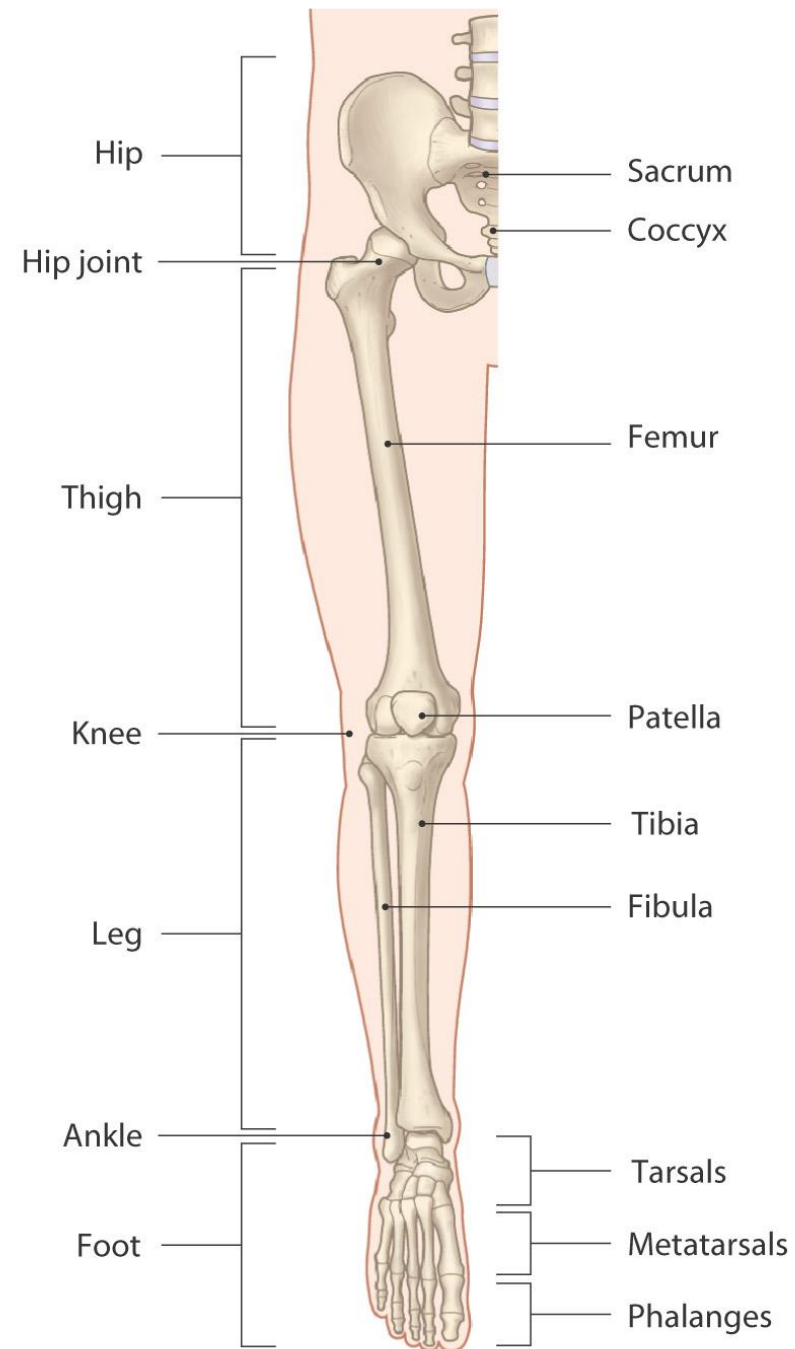
Physiotherapy Department

Biomechanics

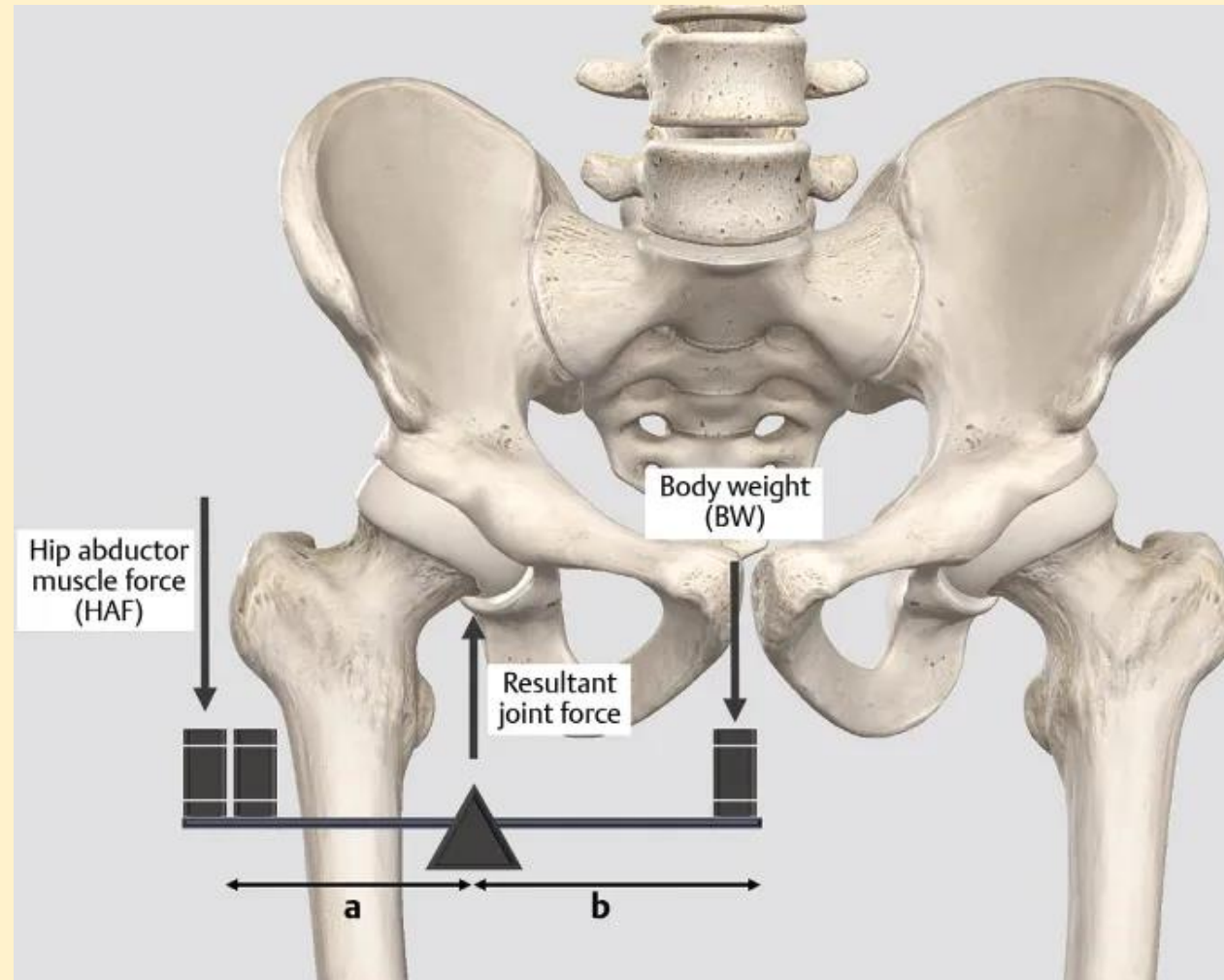
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Biomechanics of the Joints of Lower Limb



Biomechanics of the Hip



Lecture 9

Biomechanics of the Hip

12-12-2023

Synopsis

- Overview
- Articulation
- Osteokinematics
- Arthrokinematics
- Muscles acting on the joint

Objectives

- By the end of this lecture, students should understand and be able to describe the basic biomechanics of the hip as follows:
 - Articulation
 - Osteokinematics
 - Arthrokinematics
 - Muscles acting on the joint

Overview

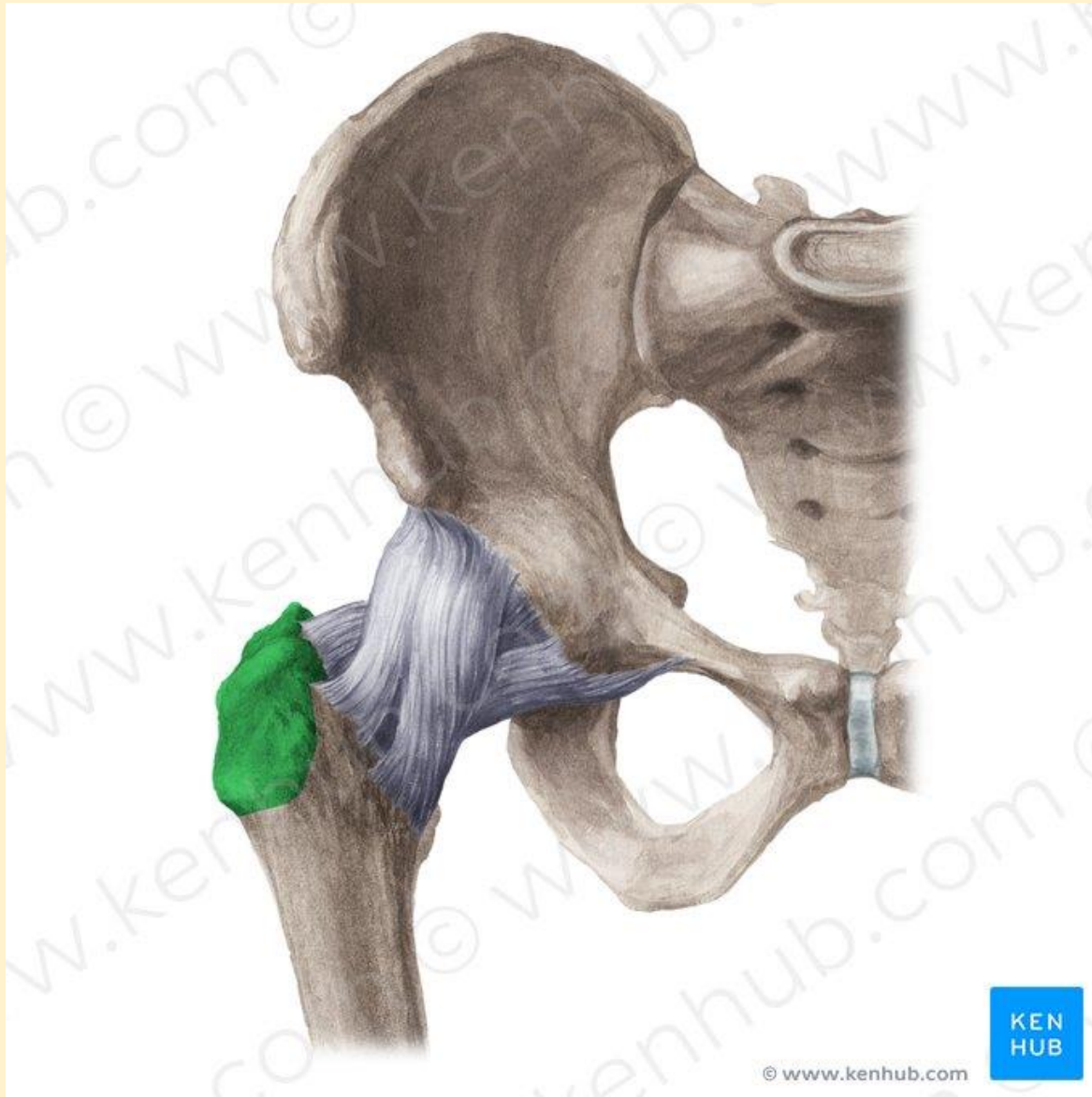
- Lower limb comprises the weight-bearing joints of the body
- Biomechanics of the major joints will be presented based on the following subheadings:
 - Articulations
 - Osteokinematics
 - Arthrokinematics
 - Muscles acting on the joint

Overview

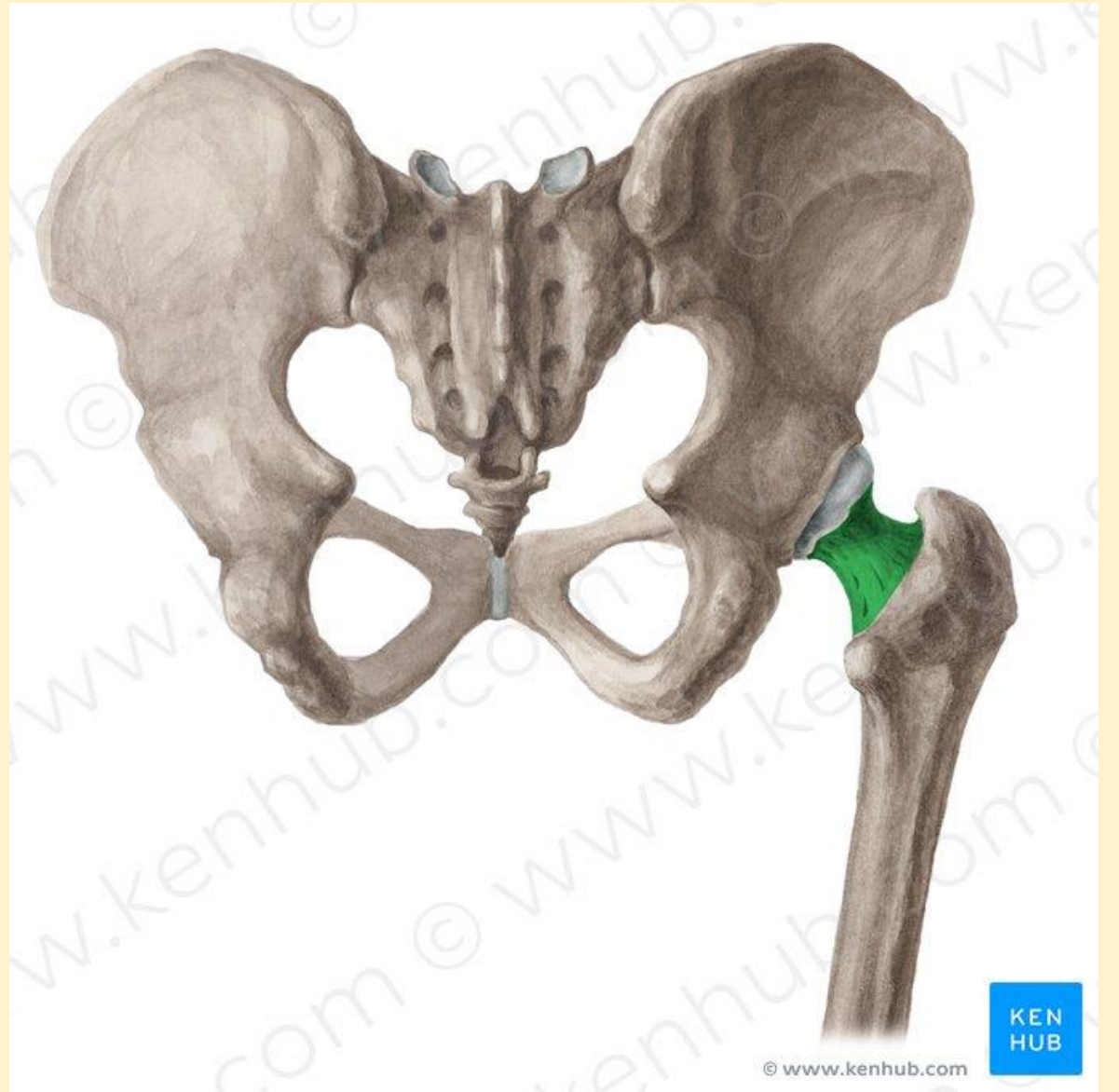
- Hip joint links the lower extremity with the trunk
- Hip joint serve as base joints for the lower extremities, as well as basilar joints for the entire superimposed pelvis and trunk
- Pathology or trauma affecting the hips typically causes a wide range of functional limitations, including difficulty in ADLs
- Hip joint has many anatomical features that are well suited for stability during standing, walking, and running

Biomechanics of the hip joint

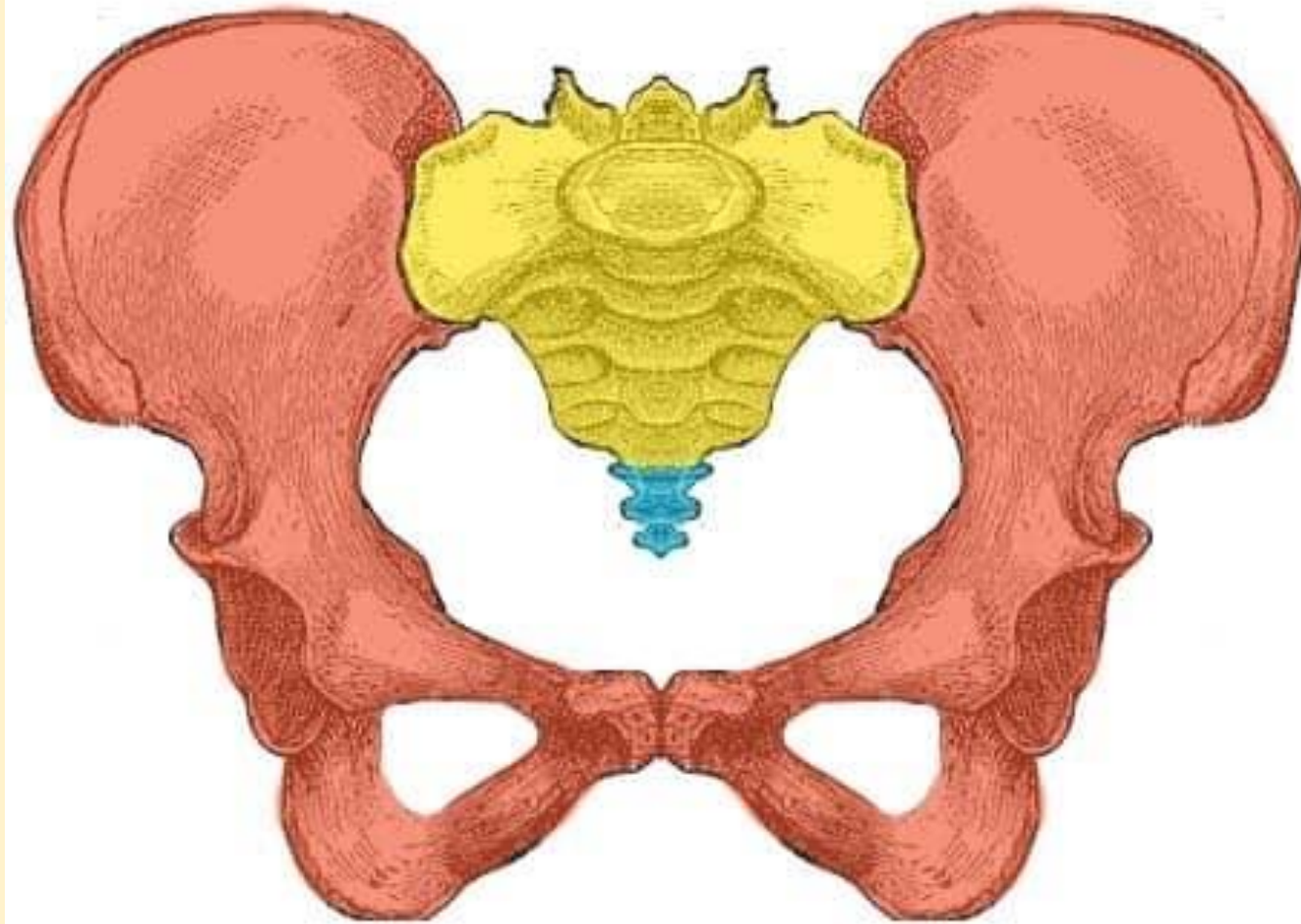
- Hip joint comprises the following bones:
 - Hip or Innominate
 - Femur
- Innominate bone (from the Latin innominatum, meaning nameless) is the union of three bones:
 - Ilium
 - Pubis
 - Ischium
- Acetabulum is the socket of the hip, formed by the three bones of the innominate
- Ilium and ischium contribute about 75%, where as pubis contributes the remaining approximately 25% of the acetabulum



Anterior




Posterior

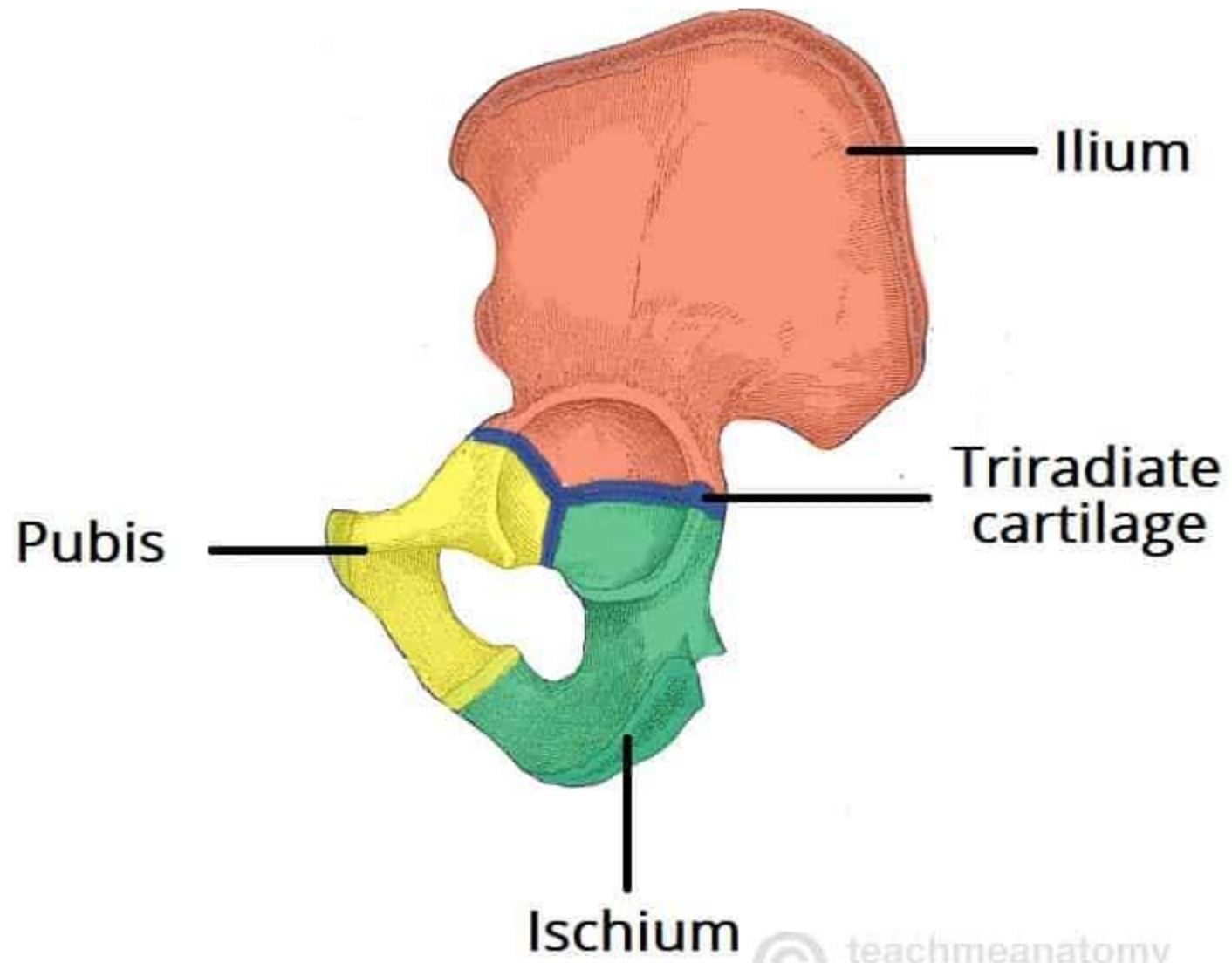


 Hip bones

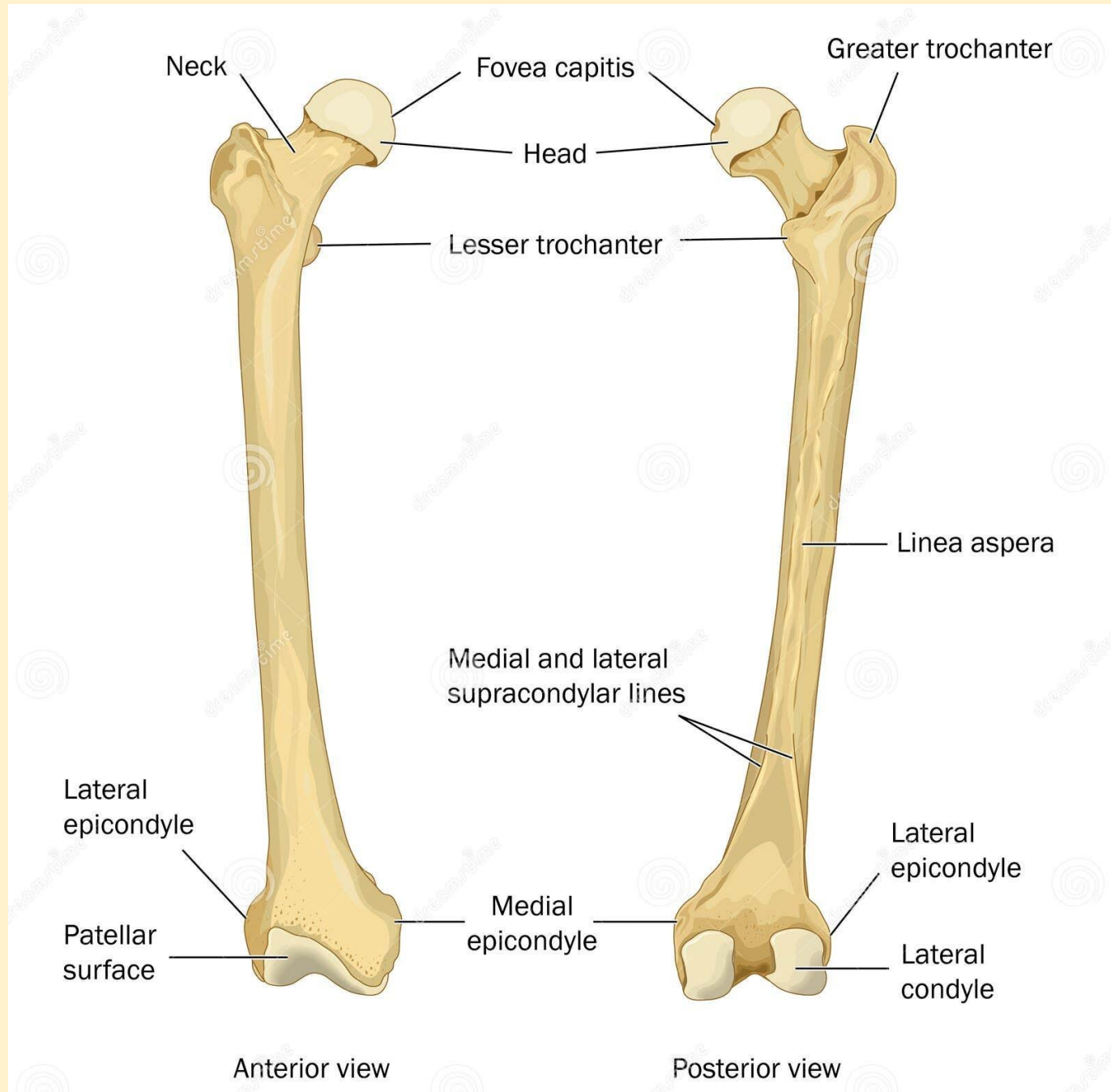
 Sacrum

 Coccyx

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Osteologic Features of the Ilium

EXTERNAL SURFACE

- Posterior, anterior, and inferior gluteal lines
- Anterior-superior iliac spine
- Anterior-inferior iliac spine
- Iliac crest
- Posterior-superior iliac spine
- Posterior-inferior iliac spine
- Greater sciatic notch
- Greater sciatic foramen
- Sacrotuberous and sacrospinous ligaments

INTERNAL SURFACE

- Iliac fossa
- Auricular surface
- Iliac tuberosity

Osteologic Features of the Pubis

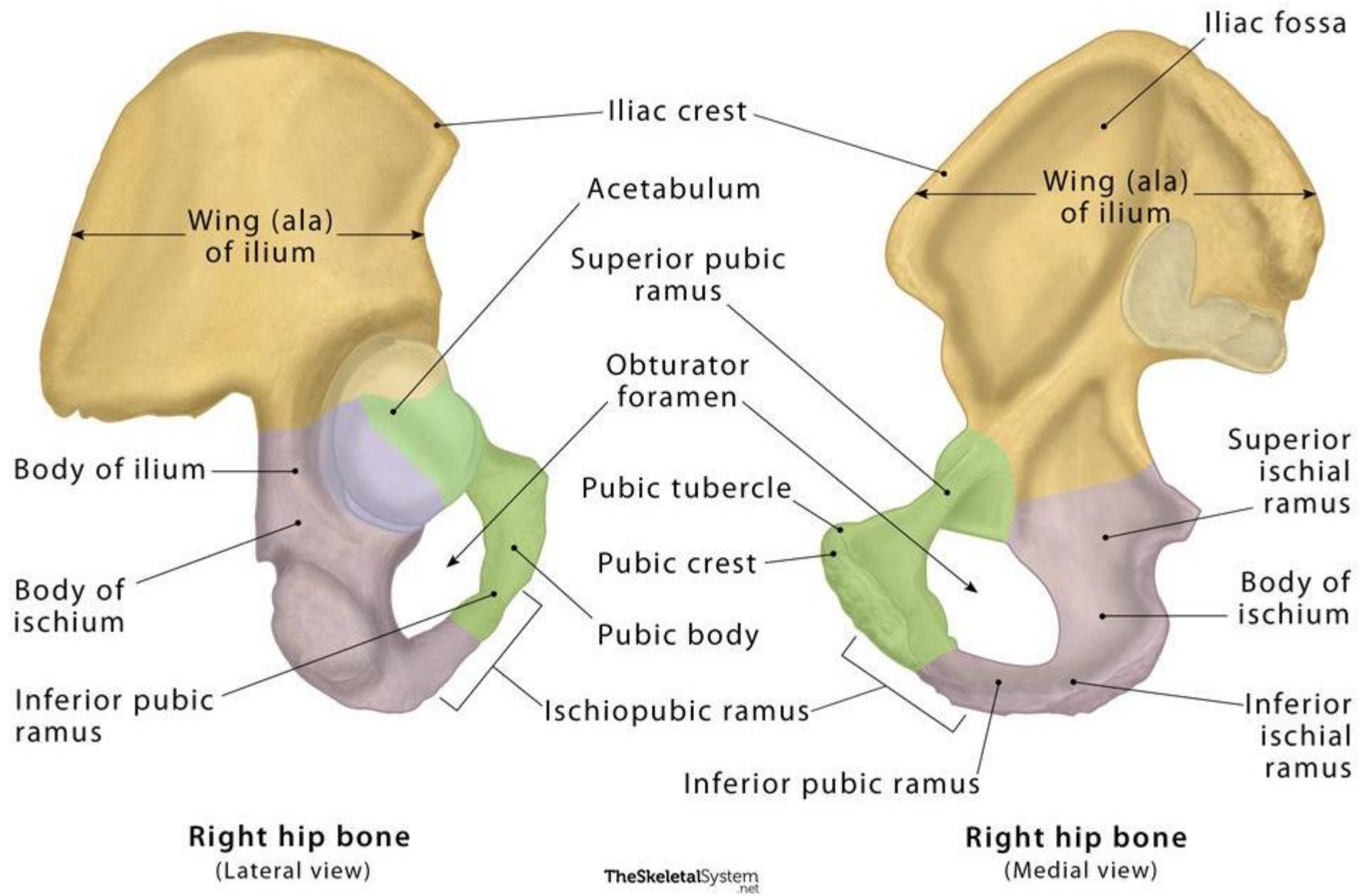
- Superior pubic ramus
- Iliopubic ramus (junction)
- Body
- Crest
- Pectineal line
- Pubic tubercle
- Pubic symphysis joint and disc
- Inferior pubic ramus

Osteologic Features of the Ischium

- Ischial spine
- Lesser sciatic notch
- Lesser sciatic foramen
- Ischial tuberosity
- Ischial ramus

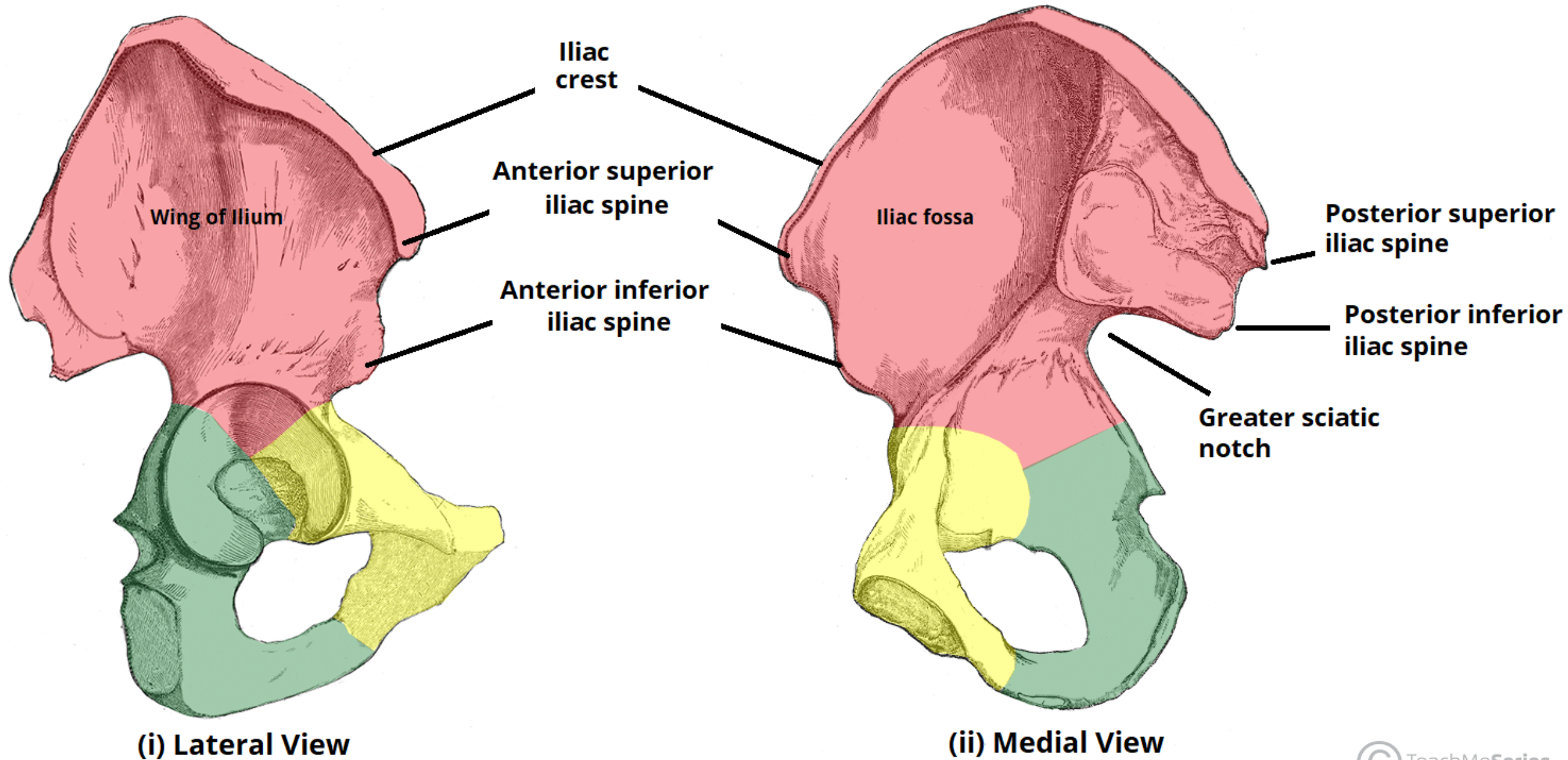
Osteologic Features of the Femur

- Femoral head
- Femoral neck
- Intertrochanteric line
- Greater trochanter
- Trochanteric fossa
- Intertrochanteric crest
- Quadrate tubercle
- Lesser trochanter
- Linea aspera
- Pectineal (spiral) line
- Gluteal tuberosity
- Lateral and medial supracondylar lines
- Adductor tubercle



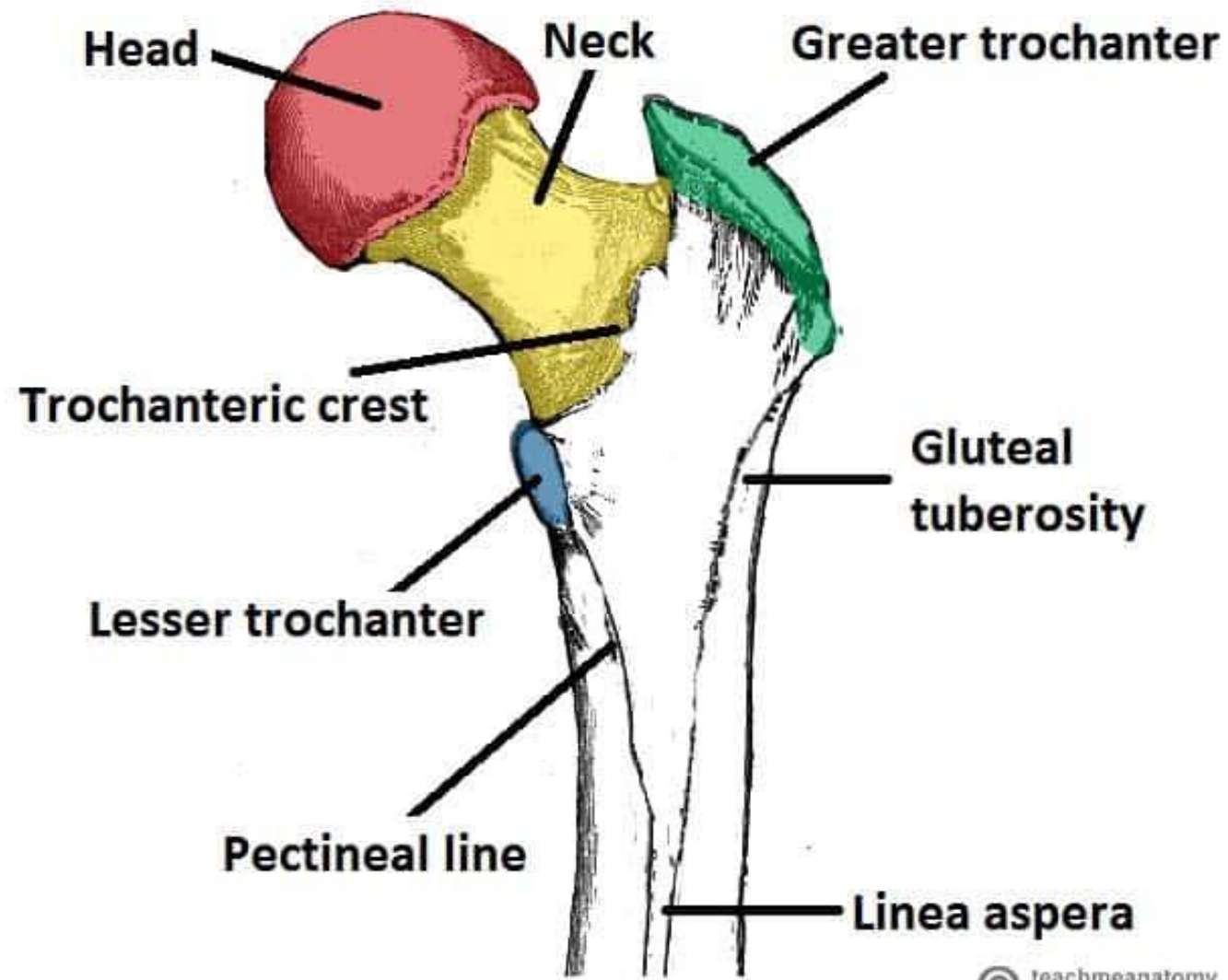
Right hip bone
(Lateral view)

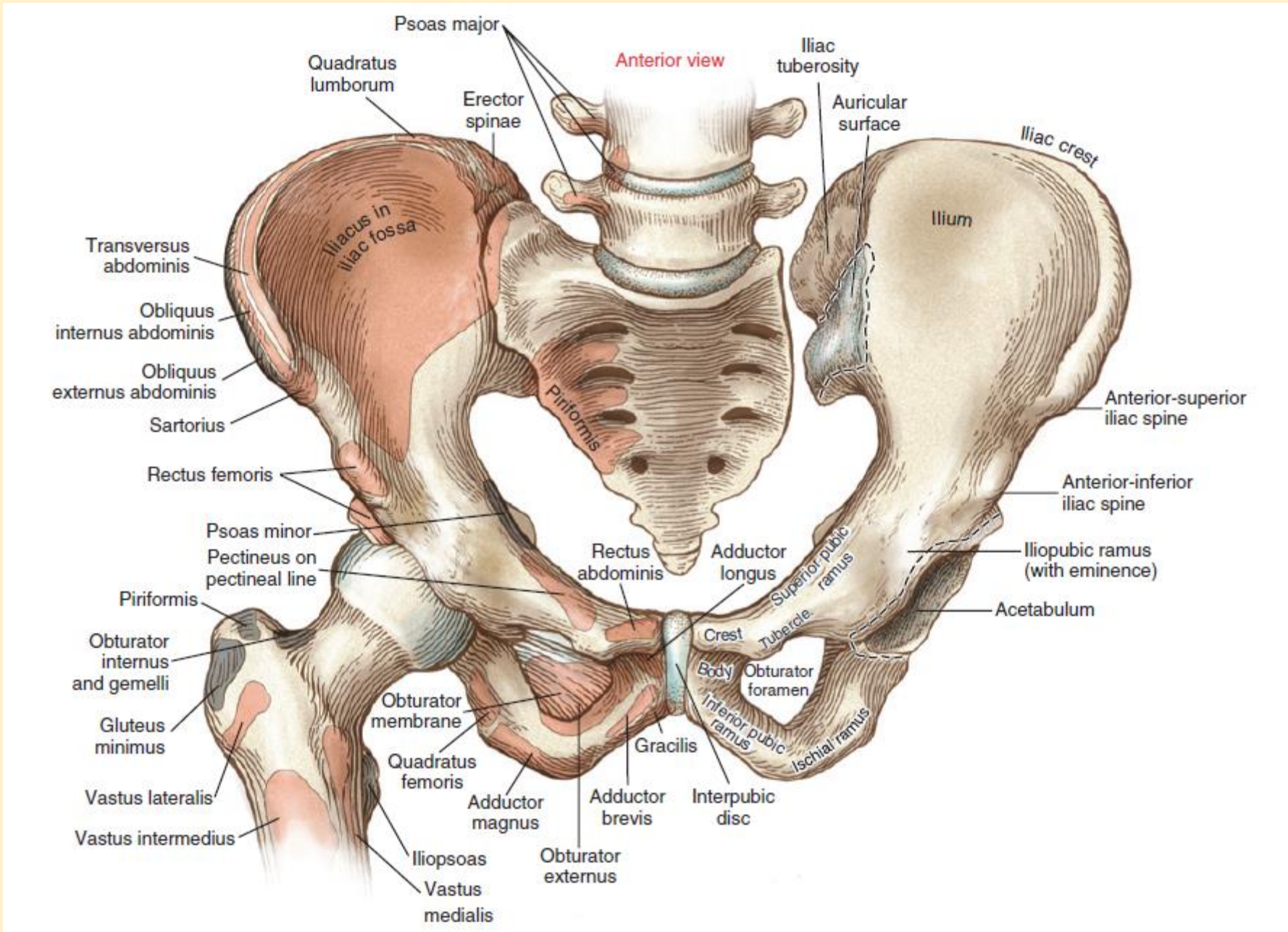
Right hip bone
(Medial view)



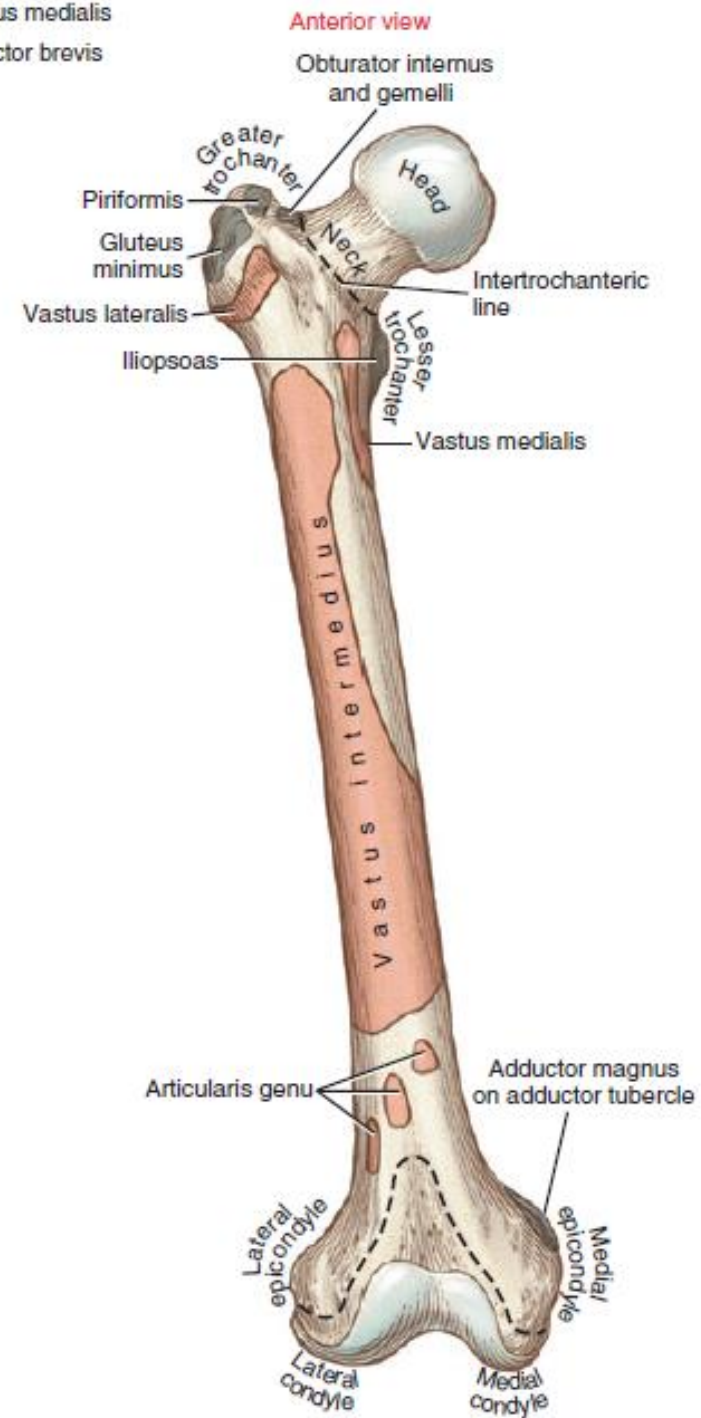
(i) Lateral View

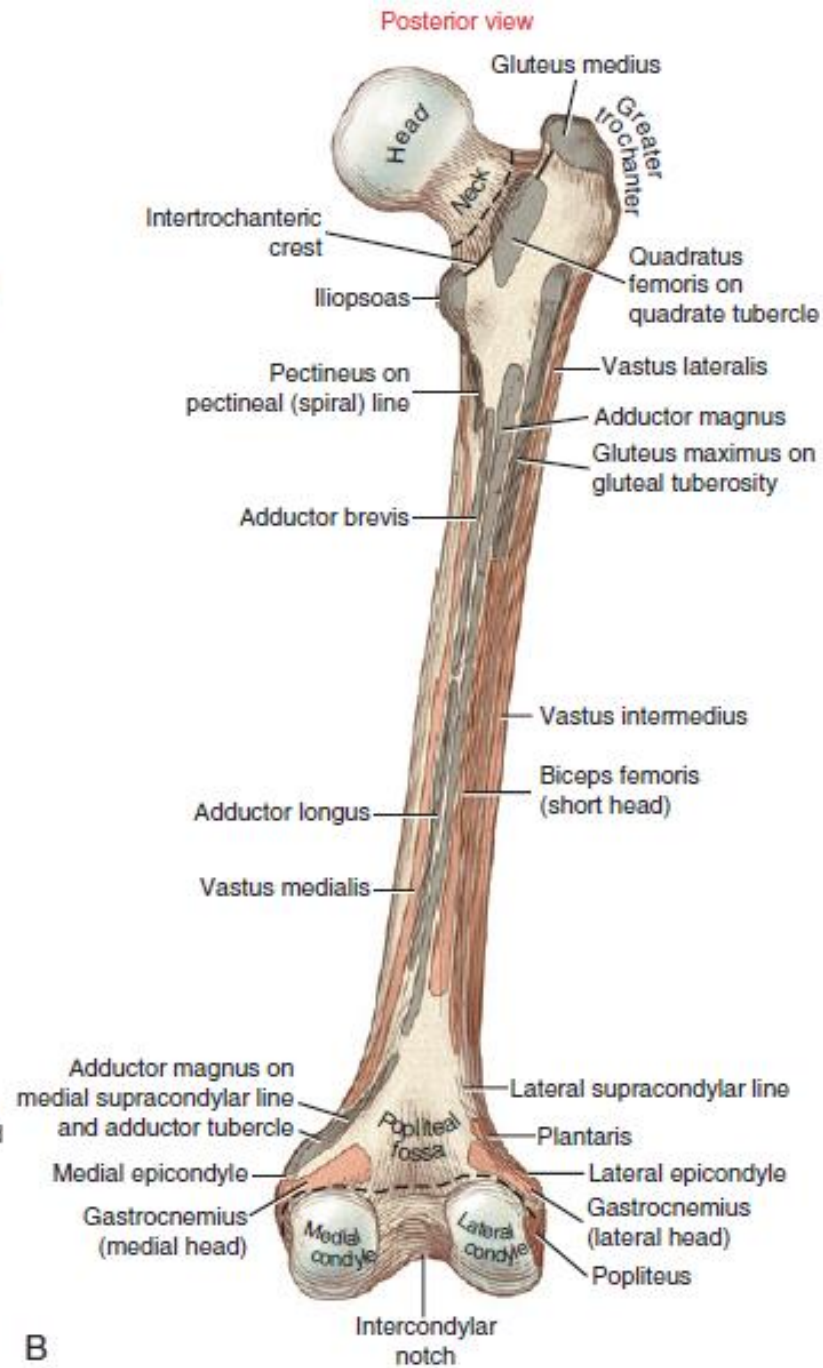
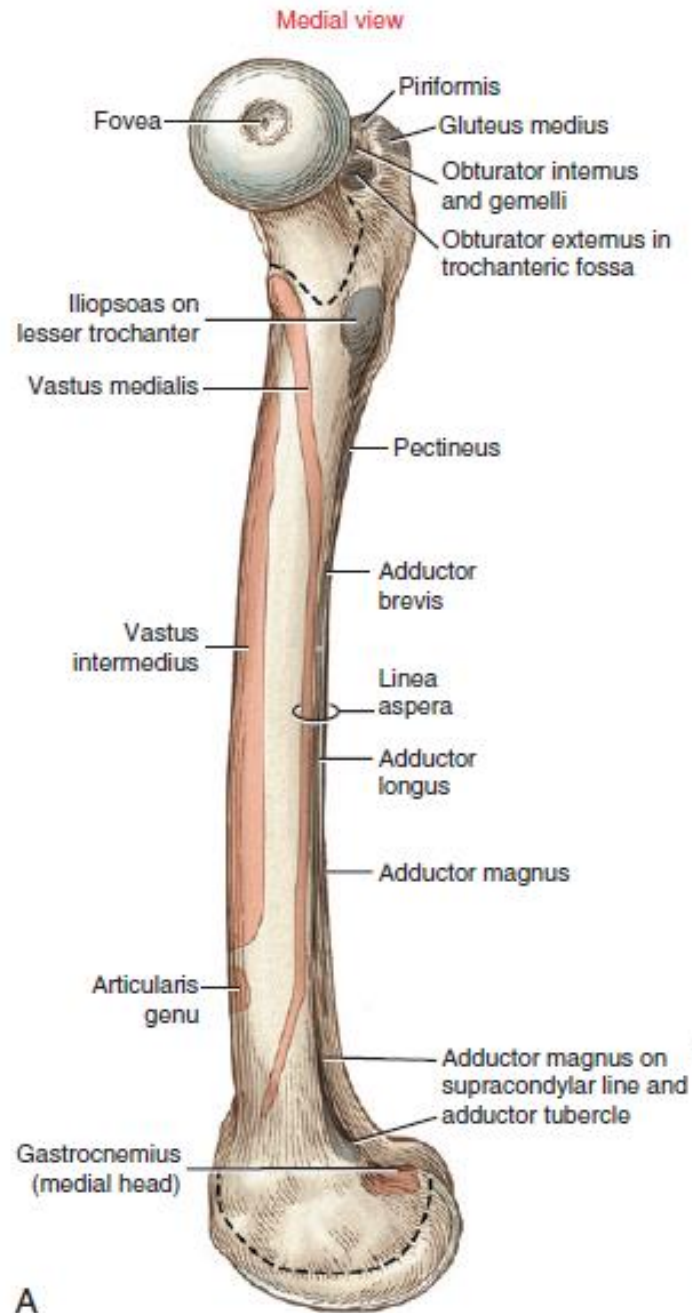
(ii) Medial View





-Vastus medialis
-Adductor brevis

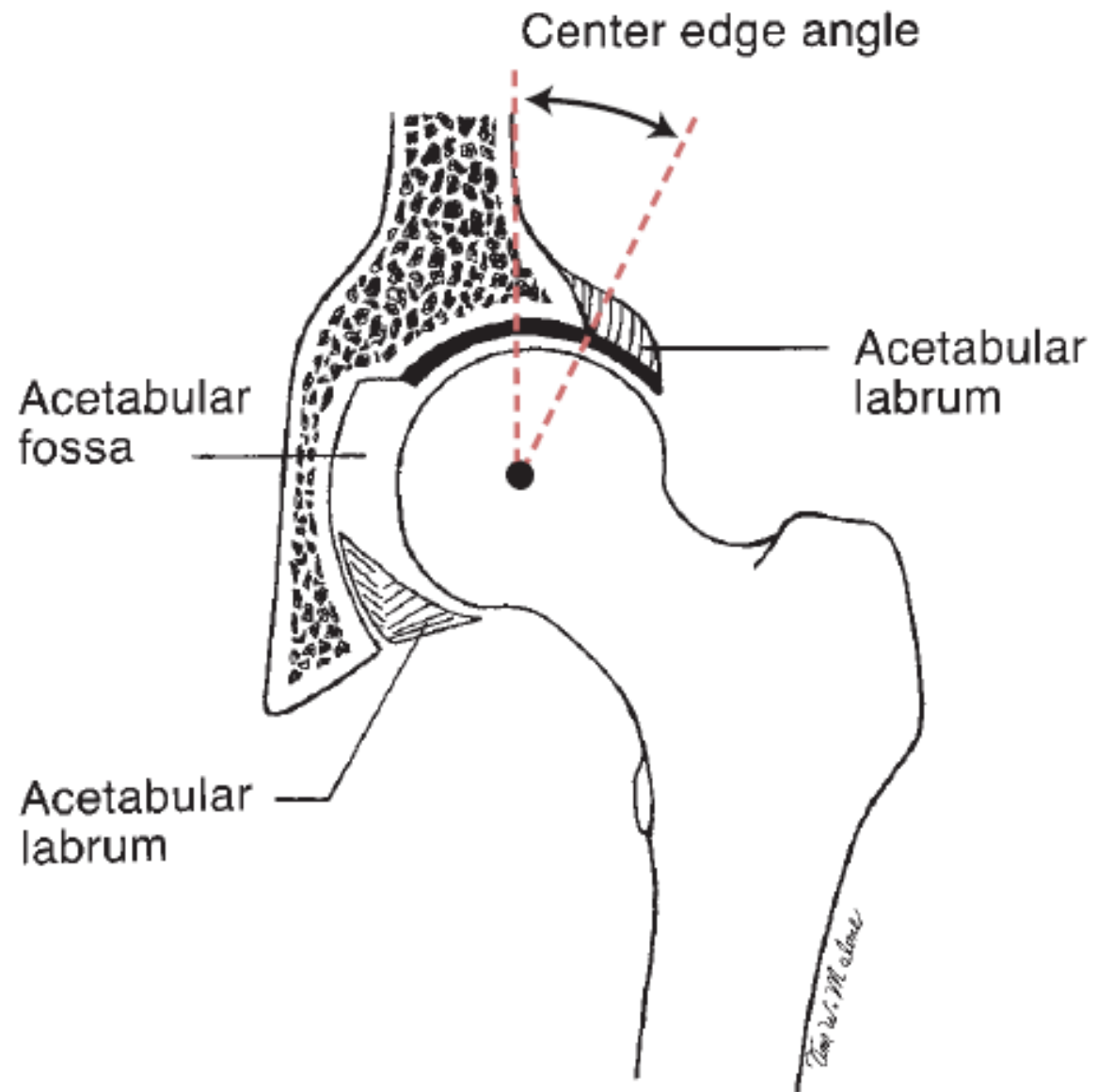




Biomechanics of the hip joint

Articulations

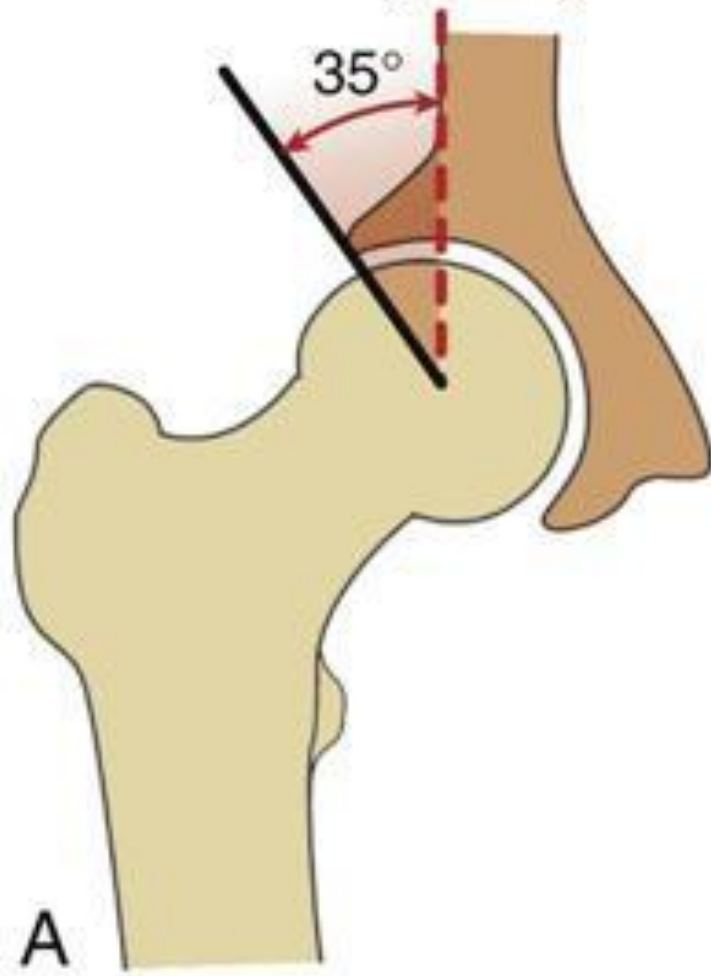
- Hip joint (iliofemoral /coxofemoral joint) articulation is formed by the concave acetabulum of the innominate bone and the convex head of the femoral bone
- The concave acetabulum faces laterally, inferiorly, and anteriorly; and it's deepened by a fibrocartilaginous acetabular labrum
- Center edge (CE) angle of the acetabulum is formed between a vertical line through the center of the femoral head and a line connecting the center of the femoral head and the bony edge of the acetabulum.
- CE angles (angle of Wiberg) in adults average 38 degrees in men and 35 degrees in women



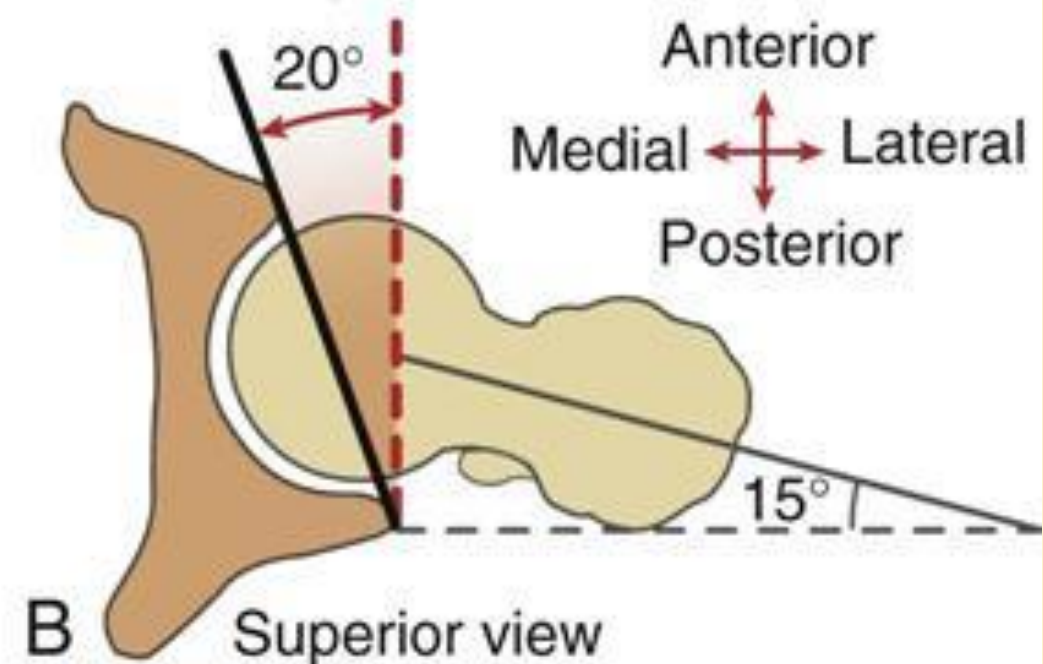
Biomechanics of the hip joint

- Anterior orientation of the acetabulum, referred to as acetabular anteversion, has a reported angle of about 18.5 degrees in men and 21.5 degrees in women
- Head of the femur is a roughly a spherical structure that sits superomedially and projects anteriorly from the femoral neck
- Angle of inclination of the proximal femur is the angle in the frontal plane between the femoral neck and the medial side of the femoral shaft, has an average normal adulthood value of about 125 degrees
- Change in the normal angle of inclination is referred to as either coxa vara (<125) or coxa valga (>125)

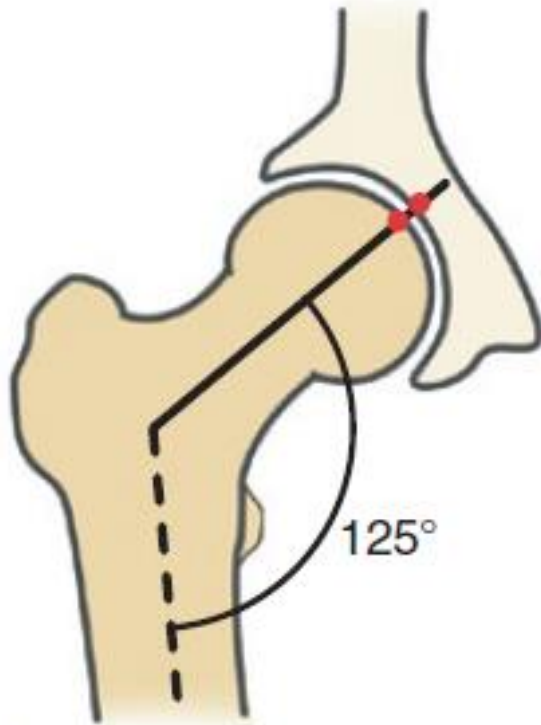
“Center-edge” angle



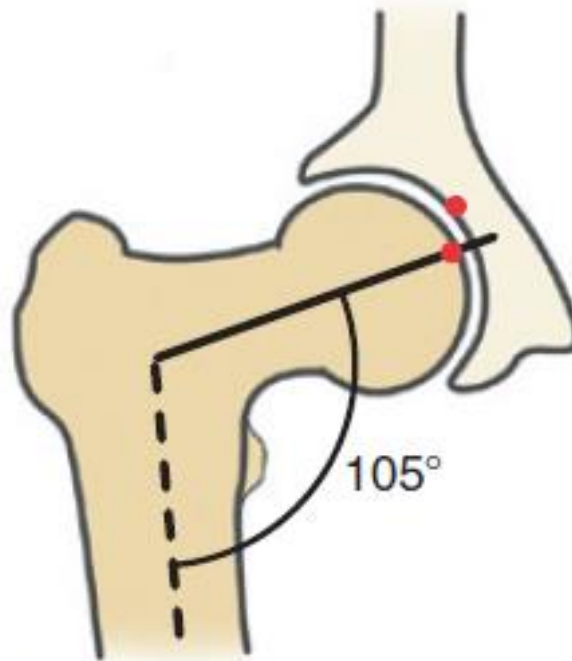
Acetabular anteversion angle



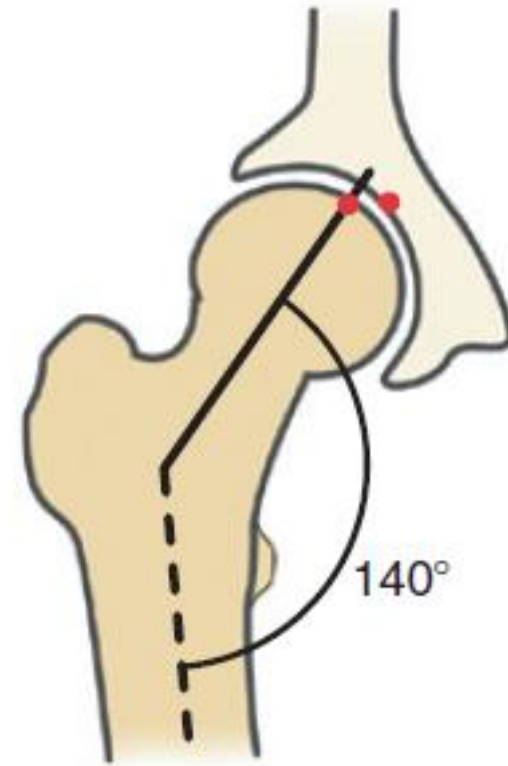
Angle of inclination



A Normal



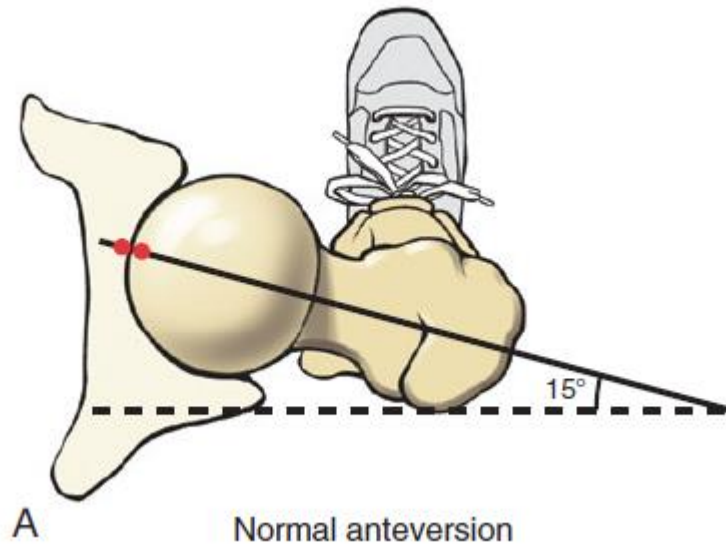
B Coxa vara



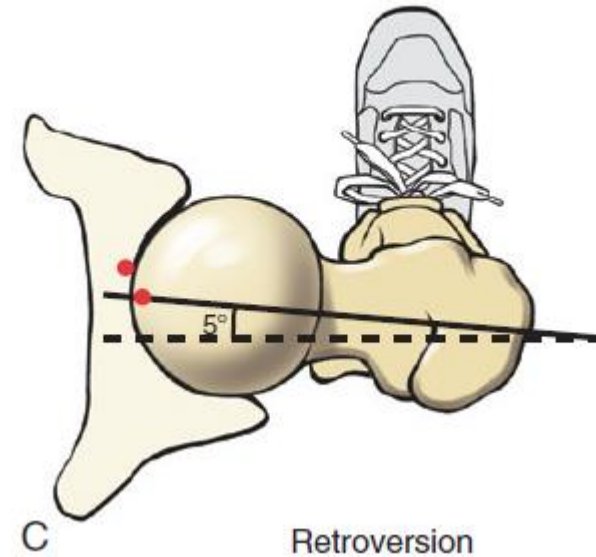
C Coxa valga

Biomechanics of the hip joint

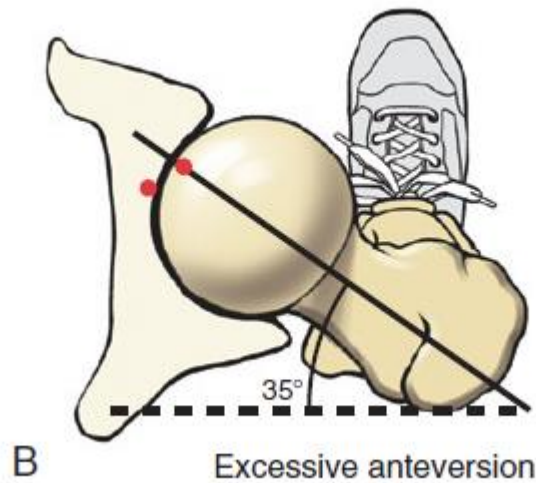
- Femoral torsion describes the relative rotation (twist) between the bone's shaft and neck
- Superiorly, the femoral neck typically projects several degrees anterior to a medial-lateral axis through the femoral condyles
- Normal anteversion angle vary from 8 to 20 degrees
- An approximate 15-degree angle of anteversion affords optimal alignment and joint congruence



A Normal anteversion

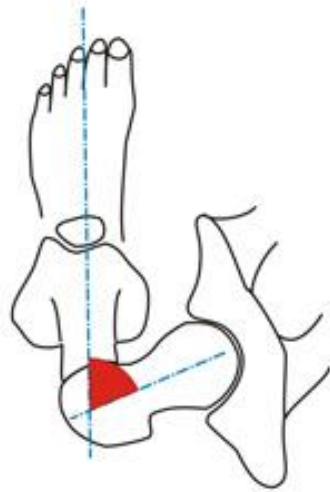


C Retroversion



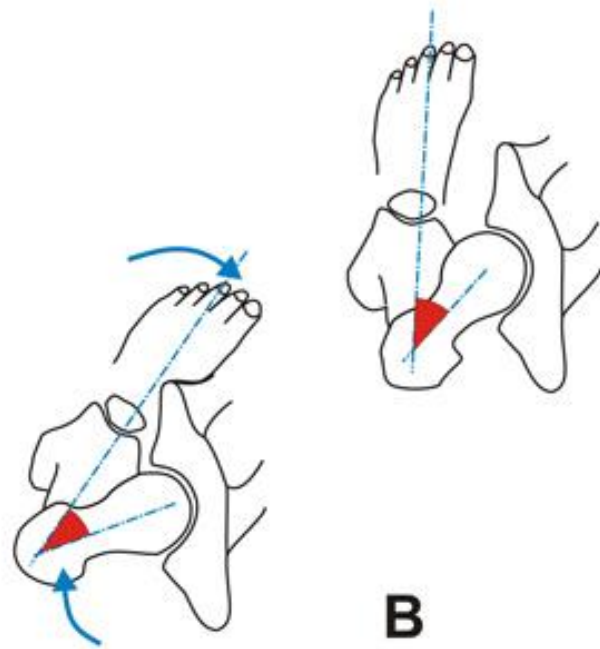
B Excessive anteversion

- Pair of red dots in each figure indicates the different alignments of the hip joint surfaces. Optimal alignment is shown in A



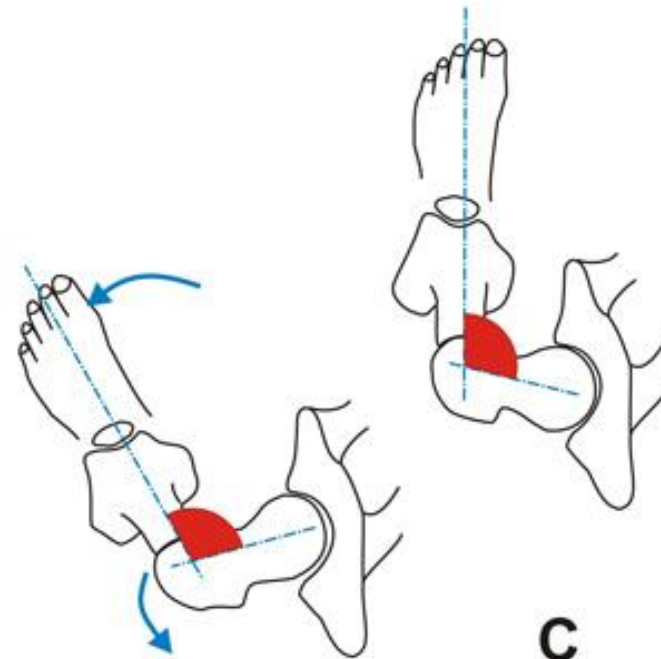
A

NORMAL HIP



B

FEMORAL ANTEVERSION



C

FEMORAL RETROVERSION

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Biomechanics of the hip joint

Osteokinematics

- Hip is a synovial ball-and-socket joint with 3 degrees of freedom
- Motions permitted at the joint are:
 - Flexion–extension in the sagittal plane around a medial–lateral axis
 - Abduction–adduction in the frontal plane around an anterior–posterior axis
 - Medial and lateral rotation in the transverse plane around a vertical or longitudinal axis
- The axis of motion goes through the center of the femoral head

Biomechanics of the hip joint

Arthrokinematics

- In an open kinematic (non-weight-bearing) chain, the convex femoral head rolls in the same direction and slides in the opposite direction to movement of the shaft of the femur.
 - In flexion, the femoral head rolls anteriorly and slides posteriorly and inferiorly on the acetabulum, whereas in extension, the femoral head rolls posteriorly and slides anteriorly superiorly
 - In abduction, the femoral head rolls superiorly and slides inferiorly, whereas in adduction, the femoral head rolls inferiorly and slides superiorly
 - In medial rotation, the femoral head rolls anteriorly and slides posteriorly on the acetabulum, whereas in lateral rotation, the femoral head rolls posteriorly and slides anteriorly

Biomechanics of the hip joint

Muscles acting on the joint

- Include the following:
 - Flexors
 - Extensors
 - Abductors
 - Adductors
 - Internal rotators
 - External rotators

Muscles acting on the hip joint

Flexion	Psoas major, iliacus and rectus femoris; assisted by pectineus, tensor fasciae latae and sartorius
Extension	Gluteus maximus, biceps femoris, semitendinosus, semimembranosus and adductor magnus
Abduction	Glutei medius and minimus; assisted by tensor fasciae latae, piriformis and sartorius
Adduction	Adductors longus, brevis and magnus, gracilis; assisted by pectineus, quadratus femoris and the inferior fibres of gluteus maximus
Internal rotation	Glutei minimus and medius; assisted by tensor fasciae latae and most adductor muscles
External rotation	Gluteus maximus, obturator internus, superior and inferior gemelli, quadratus femoris, piriformis; assisted by obturator externus and sartorius

Contributions and Questions



Tishk
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HAPPY BIRTHDAY DANYA GHASAN



Wishing you many
happy returns!

