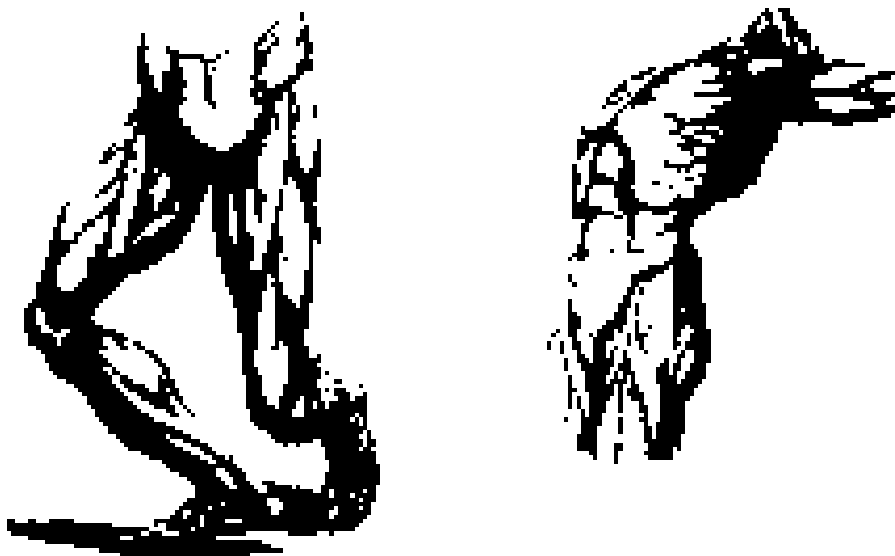


UPPER & LOWER LIMBS

Week 7. Bi8612c Comparative Osteology Practical Training



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Aims:

- Identify the divisions of the upper & lower limbs & describe the bones in each region
- List the bones & bony landmarks that articulate at each joint of the lower & upper limbs

1. Part II. Bones of the Upper Limb

The upper limb is divided into three regions. These consist of the arm, located between the shoulder and elbow joints; the forearm, which is between the elbow and wrist joints; and the hand, which is located distal to the wrist. There are 30 bones in each upper limb. The humerus is the single bone of the upper arm, and the ulna (medially) and the radius (laterally) are the paired bones of the forearm. The base of the hand contains eight bones, each called a carpal bone, and the palm of the hand is formed by five bones, each called a metacarpal bone. The fingers and thumb contain a total of 14 bones, each of which is a phalanx bone of the hand.

Humerus

The humerus is the single bone of the upper arm region. At its proximal end is the head of the humerus. This is the large, round, smooth region that faces medially. The head articulates with the glenoid cavity of the scapula to form the glenohumeral (shoulder) joint. The margin of the smooth area of the head is the anatomical neck of the humerus. Located on the lateral side of the proximal humerus is an expanded bony area called the greater tubercle. The smaller lesser tubercle of the humerus is found on the anterior aspect of the humerus. Both the greater and lesser tubercles serve as attachment sites for muscles that act across the shoulder joint. Passing between the greater and lesser tubercles is the narrow intertubercular groove (sulcus), which is also known as the bicipital groove because it provides passage for a tendon of the biceps brachii muscle. The surgical neck is located at the base of the expanded, proximal end of the humerus, where it joins the narrow shaft of the humerus. The surgical neck is a common site of arm fractures. The deltoid tuberosity is a roughened, V-shaped region located on the lateral side in the middle of the humerus shaft. As its name indicates, it is the site of attachment for the deltoid muscle.

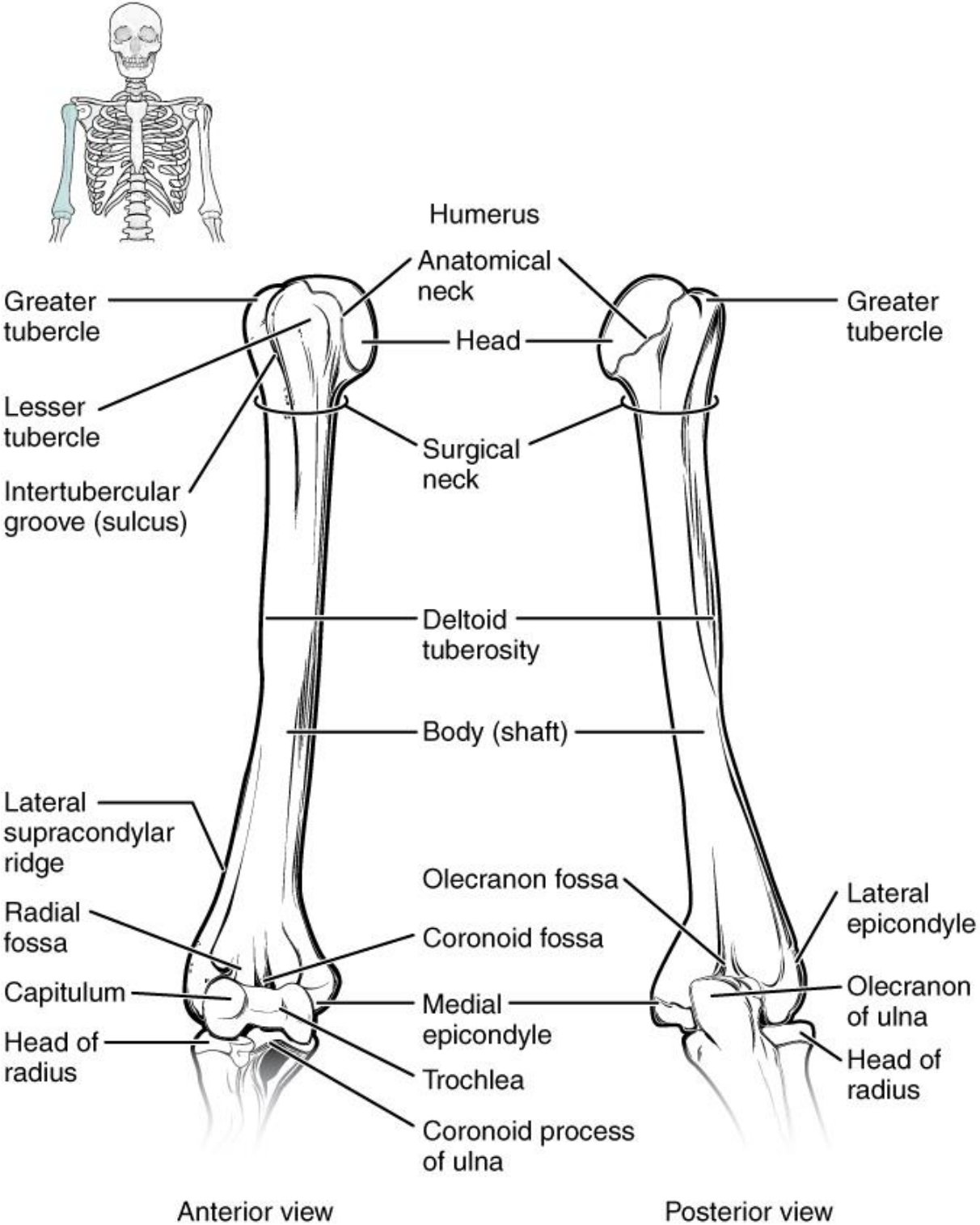
Humerus and Elbow Joint

The humerus is the single bone of the upper arm region. It articulates with the radius and ulna bones of the forearm to form the elbow joint.

Distally, the humerus becomes flattened. The prominent bony projection on the medial side is the medial epicondyle of the humerus. The much smaller lateral epicondyle of the humerus is found on the lateral side of the distal humerus. The roughened ridge of bone above the lateral epicondyle is the lateral supracondylar ridge. All of these areas are attachment points for muscles that act on the forearm, wrist, and hand. The powerful grasping muscles of the anterior forearm arise from the medial epicondyle, which is thus larger and more robust than the lateral epicondyle that gives rise to the weaker posterior forearm muscles.

The distal end of the humerus has two articulation areas, which join the ulna and radius bones of the forearm to form the elbow joint. The more medial of these areas is the trochlea, a spindle- or pulley-shaped region (trochlea = "pulley"), which articulates with the ulna bone. Immediately lateral to the trochlea is the capitulum ("small head"), a knob-like structure located on the anterior surface of the distal humerus. The capitulum articulates with the radius bone of the forearm. Just above these bony areas are two small depressions. These spaces accommodate the forearm bones when the elbow is fully bent (flexed). Superior to the trochlea is the coronoid fossa, which receives the coronoid process of the ulna, and above the capitulum is the radial fossa, which receives the head of the radius when

the elbow is flexed. Similarly, the posterior humerus has the olecranon fossa, a larger depression that receives the olecranon process of the ulna when the forearm is fully extended.



Ulna

The ulna is the medial bone of the forearm. It runs parallel to the radius, which is the lateral bone of the forearm. The proximal end of the ulna resembles a crescent wrench with its large, C-shaped trochlear notch. This region articulates with the trochlea of the humerus as part of the elbow joint. The inferior margin of the trochlear notch is formed by a prominent lip of bone called the coronoid process of the ulna. Just below this on the anterior ulna is a roughened area called the ulnar tuberosity. To the lateral side and slightly inferior to the trochlear notch is a small, smooth area called the radial notch of the ulna. This area is the site of articulation between the proximal radius and the ulna, forming the proximal radioulnar joint. The posterior and superior portions of the proximal ulna make up the olecranon process, which forms the bony tip of the elbow.

Ulna and Radius

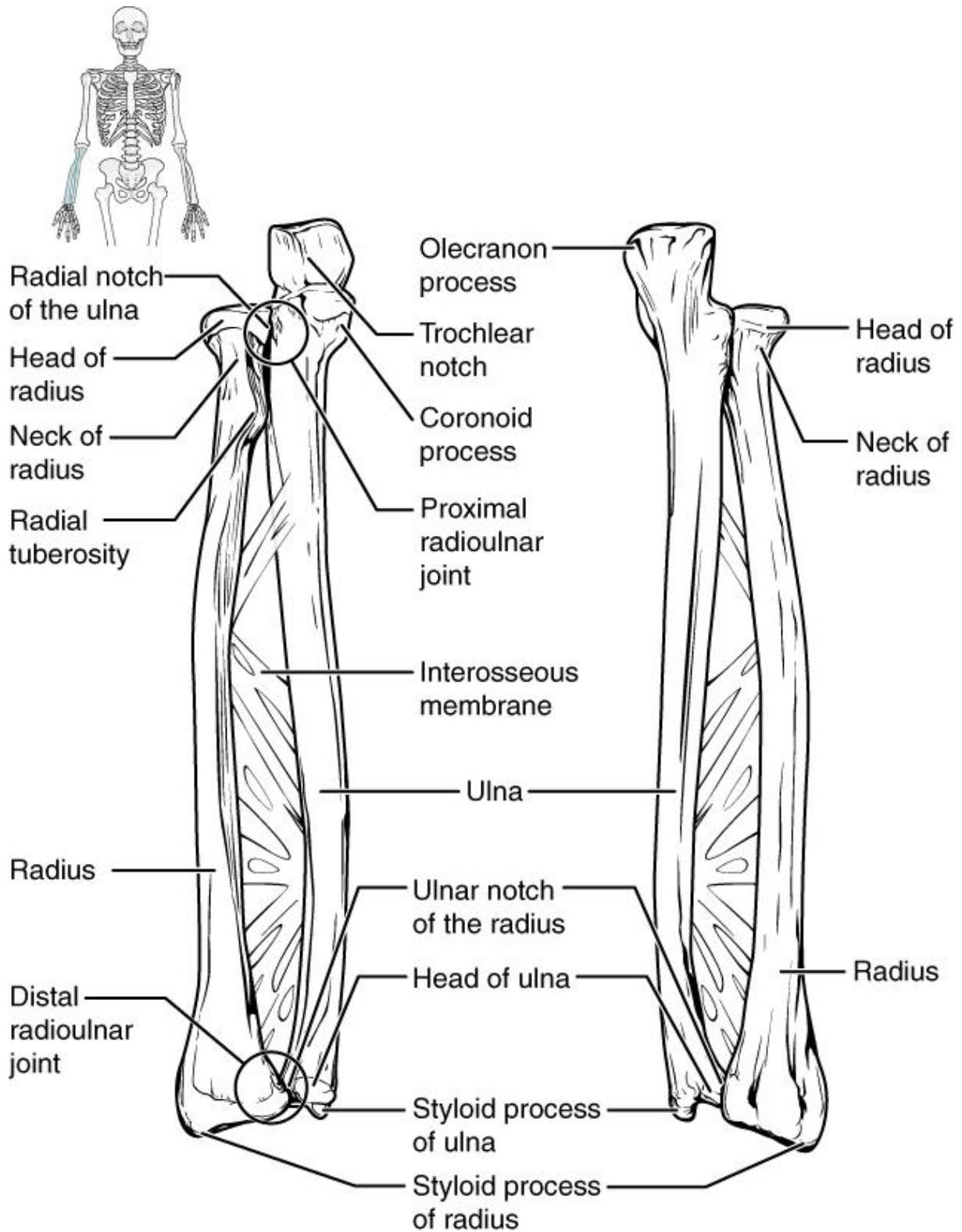
The ulna is located on the medial side of the forearm, and the radius is on the lateral side. These bones are attached to each other by an interosseous membrane.

More distal is the shaft of the ulna. The lateral side of the shaft forms a ridge called the interosseous border of the ulna. This is the line of attachment for the interosseous membrane of the forearm, a sheet of dense connective tissue that unites the ulna and radius bones. The small, rounded area that forms the distal end is the head of the ulna. Projecting from the posterior side of the ulnar head is the styloid process of the ulna, a short bony projection. This serves as an attachment point for a connective tissue structure that unites the distal ends of the ulna and radius.

In the anatomical position, with the elbow fully extended and the palms facing forward, the arm and forearm do not form a straight line. Instead, the forearm deviates laterally by 5–15 degrees from the line of the arm. This deviation is called the carrying angle. It allows the forearm and hand to swing freely or to carry an object without hitting the hip. The carrying angle is larger in females to accommodate their wider pelvis.

Radius

The radius runs parallel to the ulna, on the lateral (thumb) side of the forearm. The head of the radius is a disc-shaped structure that forms the proximal end. The small depression on the surface of the head articulates with the capitulum of the humerus as part of the elbow joint, whereas the smooth, outer margin of the head articulates with the radial notch of the ulna at the proximal radioulnar joint. The neck of the radius is the narrowed region immediately below the expanded head. Inferior to this point on the medial side is the radial tuberosity, an oval-shaped, bony protuberance that serves as a muscle attachment point. The shaft of the radius is slightly curved and has a small ridge along its medial side. This ridge forms the interosseous border of the radius, which, like the similar border of the ulna, is the line of attachment for the interosseous membrane that unites the two forearm bones. The distal end of the radius has a smooth surface for articulation with two carpal bones to form the radiocarpal joint or wrist joint. On the medial side of the distal radius is the ulnar notch of the radius. This shallow depression articulates with the head of the ulna, which together form the distal radioulnar joint. The lateral end of the radius has a pointed projection called the styloid process of the radius. This provides attachment for ligaments that support the lateral side of the wrist joint. Compared to the styloid process of the ulna, the styloid process of the radius projects more distally, thereby limiting the range of movement for lateral deviations of the hand at the wrist joint.



2. Part II. Bones of the Lower Limb

Like the upper limb, the lower limb is divided into three regions. The thigh is that portion of the lower limb located between the hip joint and knee joint. The leg is specifically the region between the knee joint and the ankle joint. Distal to the ankle is the foot. The lower limb contains 30 bones. These are the femur, patella, tibia, fibula, tarsal bones, metatarsal bones, and phalanges. The femur is the single bone of the thigh. The patella is the kneecap and articulates with the distal femur. The tibia is the larger, weight-bearing bone located on the medial side of the leg, and the fibula is the thin bone of the lateral leg. The bones of the foot are divided into three groups. The posterior portion of the foot is formed by a group of seven bones, each of which is known as a tarsal bone, whereas the mid-foot contains five elongated bones, each of which is a metatarsal bone. The toes contain 14 small bones, each of which is a phalanx bone of the foot.

Femur

The femur, or thigh bone, is the single bone of the thigh region. It is the longest and strongest bone of the body, and accounts for approximately one-quarter of a person's total height. The rounded, proximal end is the head of the femur, which articulates with the acetabulum of the hip bone to form the hip joint. The fovea capitis is a minor indentation on the medial side of the femoral head that serves as the site of attachment for the ligament of the head of the femur. This ligament spans the femur and acetabulum, but is weak and provides little support for the hip joint. It does, however, carry an important artery that supplies the head of the femur.

Femur and Patella

The femur is the single bone of the thigh region. It articulates superiorly with the hip bone at the hip joint, and inferiorly with the tibia at the knee joint. The patella only articulates with the distal end of the femur.

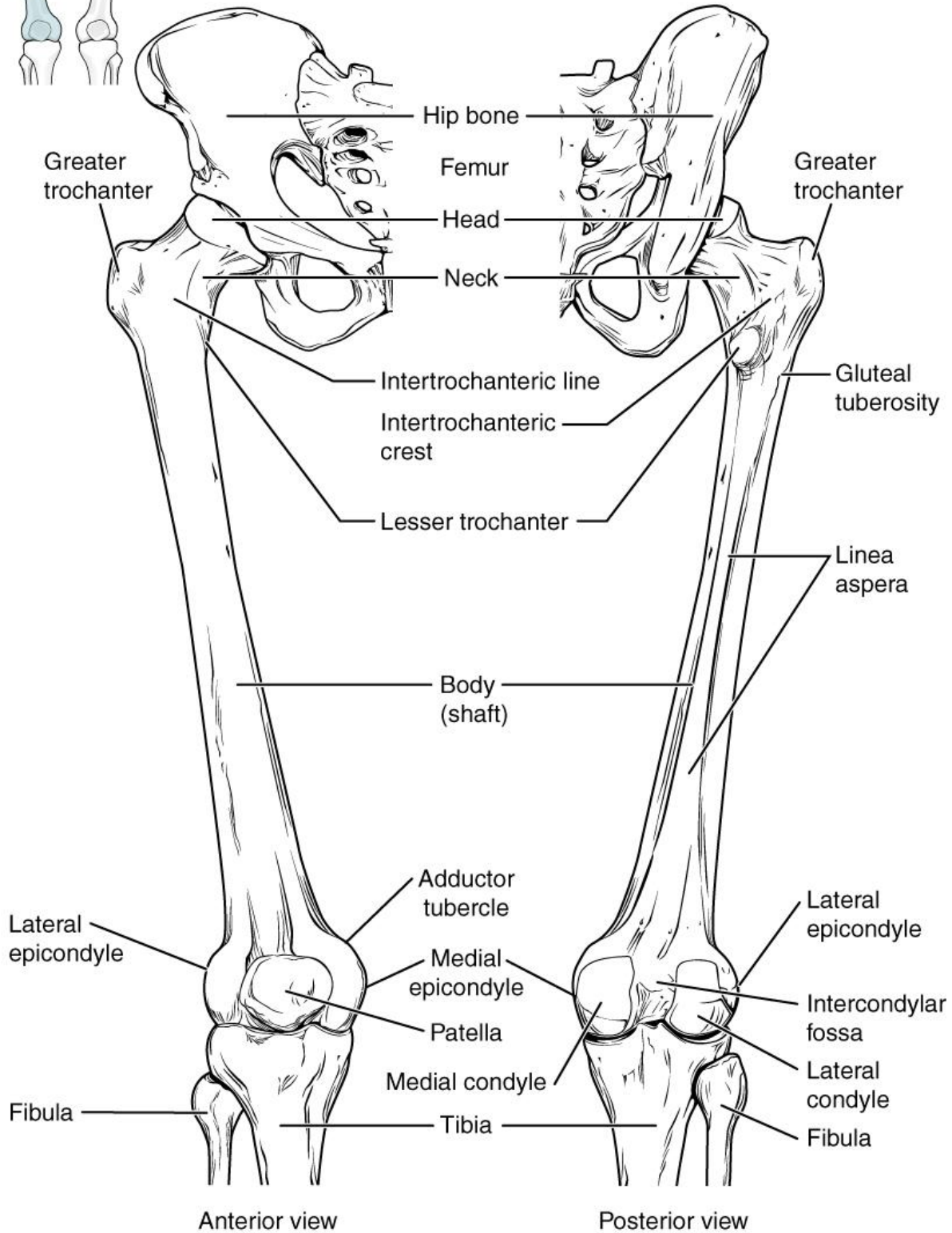
The narrowed region below the head is the neck of the femur. This is a common area for fractures of the femur. The greater trochanter is the large, upward, bony projection located above the base of the neck. Multiple muscles that act across the hip joint attach to the greater trochanter, which, because of its projection from the femur, gives additional leverage to these muscles. The greater trochanter can be felt just under the skin on the lateral side of your upper thigh. The lesser trochanter is a small, bony prominence that lies on the medial aspect of the femur, just below the neck. A single, powerful muscle attaches to the lesser trochanter. Running between the greater and lesser trochanters on the anterior side of the femur is the roughened intertrochanteric line. The trochanters are also connected on the posterior side of the femur by the larger intertrochanteric crest.

The elongated shaft of the femur has a slight anterior bowing or curvature. At its proximal end, the posterior shaft has the gluteal tuberosity, a roughened area extending inferiorly from the greater trochanter. More inferiorly, the gluteal tuberosity becomes continuous with the linea aspera ("rough line"). This is the roughened ridge that passes distally along the posterior side of the mid-femur. Multiple muscles of the hip and thigh regions make long, thin attachments to the femur along the linea aspera.

The distal end of the femur has medial and lateral bony expansions. On the lateral side, the smooth portion that covers the distal and posterior aspects of the lateral expansion is the lateral condyle of the femur. The roughened area on the outer, lateral side of the condyle is the lateral epicondyle of the femur. Similarly, the smooth region of the distal and posterior medial femur is the medial condyle of the femur, and the irregular outer, medial side of this is the medial epicondyle of the femur. The lateral and medial condyles articulate with the tibia to form the knee joint. The epicondyles provide attachment for muscles and supporting ligaments of the knee. The adductor tubercle is a small bump located at the superior margin of the medial epicondyle. Posteriorly, the medial and lateral condyles are separated by a deep depression called the intercondylar fossa. Anteriorly, the smooth surfaces of the condyles join together to form a wide groove called the patellar surface, which provides for articulation with the patella bone. The combination of the medial and lateral condyles with the patellar surface gives the distal end of the femur a horseshoe (U) shape.

Patella

The patella (kneecap) is largest sesamoid bone of the body. A sesamoid bone is a bone that is incorporated into the tendon of a muscle where that tendon crosses a joint. The sesamoid bone articulates with the underlying bones to prevent damage to the muscle tendon due to rubbing against the bones during movements of the joint. The patella is found in the tendon of the quadriceps femoris muscle, the large muscle of the anterior thigh that passes across the anterior knee to attach to the tibia. The patella articulates with the patellar surface of the femur and thus prevents rubbing of the muscle tendon against the distal femur. The patella also lifts the tendon away from the knee joint, which increases the leverage power of the quadriceps femoris muscle as it acts across the knee. The patella does not articulate with the tibia.



Anterior view

Posterior view

Tibia

The tibia (shin bone) is the medial bone of the leg and is larger than the fibula, with which it is paired. The tibia is the main weight-bearing bone of the lower leg and the second longest bone of the body, after the femur. The medial side of the tibia is located immediately under the skin, allowing it to be easily palpated down the entire length of the medial leg.

Tibia and Fibula

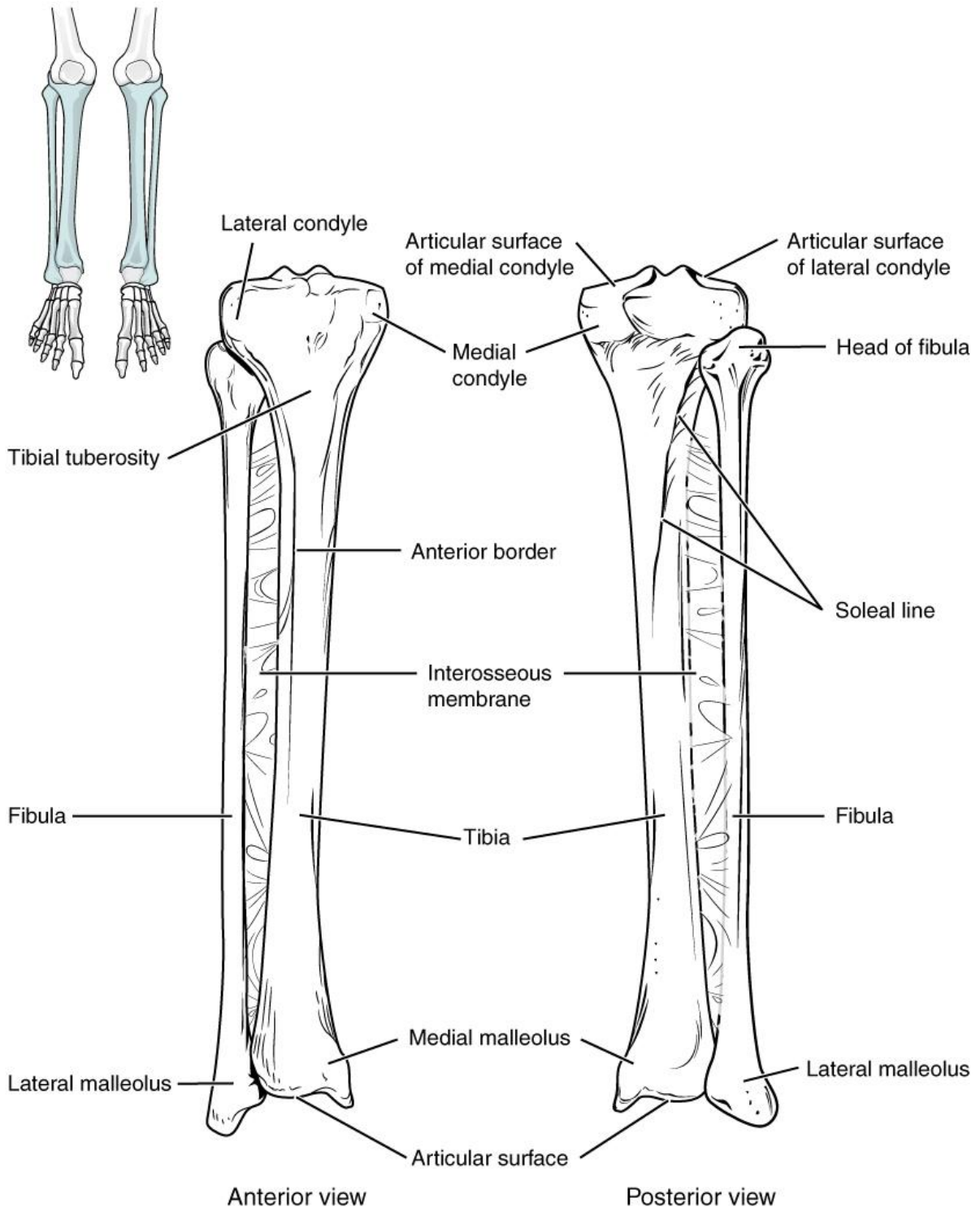
The tibia is the larger, weight-bearing bone located on the medial side of the leg. The fibula is the slender bone of the lateral side of the leg and does not bear weight.

The proximal end of the tibia is greatly expanded. The two sides of this expansion form the medial condyle of the tibia and the lateral condyle of the tibia. The tibia does not have epicondyles. The top surface of each condyle is smooth and flattened. These areas articulate with the medial and lateral condyles of the femur to form the knee joint. Between the articulating surfaces of the tibial condyles is the intercondylar eminence, an irregular, elevated area that serves as the inferior attachment point for two supporting ligaments of the knee.

The tibial tuberosity is an elevated area on the anterior side of the tibia, near its proximal end. It is the final site of attachment for the muscle tendon associated with the patella. More inferiorly, the shaft of the tibia becomes triangular in shape. The anterior apex of

MH this triangle forms the anterior border of the tibia, which begins at the tibial tuberosity and runs inferiorly along the length of the tibia. Both the anterior border and the medial side of the triangular shaft are located immediately under the skin and can be easily palpated along the entire length of the tibia. A small ridge running down the lateral side of the tibial shaft is the interosseous border of the tibia. This is for the attachment of the interosseous membrane of the leg, the sheet of dense connective tissue that unites the tibia and fibula bones. Located on the posterior side of the tibia is the soleal line, a diagonally running, roughened ridge that begins below the base of the lateral condyle, and runs down and medially across the proximal third of the posterior tibia. Muscles of the posterior leg attach to this line.

The large expansion found on the medial side of the distal tibia is the medial malleolus ("little hammer"). This forms the large bony bump found on the medial side of the ankle region. Both the smooth surface on the inside of the medial malleolus and the smooth area at the distal end of the tibia articulate with the talus bone of the foot as part of the ankle joint. On the lateral side of the distal tibia is a wide groove called the fibular notch. This area articulates with the distal end of the fibula, forming the distal tibiofibular joint.



Fibula

The fibula is the slender bone located on the lateral side of the leg. The fibula does not bear weight. It serves primarily for muscle attachments and thus is largely surrounded by muscles. Only the proximal and distal ends of the fibula can be palpated.

The head of the fibula is the small, knob-like, proximal end of the fibula. It articulates with the inferior aspect of the lateral tibial condyle, forming the proximal tibiofibular joint. The thin shaft of the fibula has the interosseous border of the fibula, a narrow ridge running down its medial side for the attachment of the interosseous membrane that spans the fibula and tibia. The distal end of the fibula forms the lateral malleolus, which forms the easily palpated bony bump on the lateral side of the ankle. The deep (medial) side of the lateral malleolus articulates with the talus bone of the foot as part of the ankle joint. The distal fibula also articulates with the fibular notch of the tibia.