

## BONES OF THE APPENDICULAR SKELETON

The appendicular skeleton is composed of the 126 bones of the appendages and the pectoral and pelvic girdles, which attach the limbs to the axial skeleton. Although the bones of the upper and lower limbs differ in their functions and mobility, they have the same fundamental plan – each limb is composed of three major segments connected by movable joints.

### LOWER LIMB

Thirty-two (32) separate bones form the bony framework of each lower limb. The lower limbs carry the entire weight of the erect body and are subjected to exceptional forces when we jump or run. Thus, it is not surprising that the bones of the lower limb are thicker and stronger than the comparable bones of the upper limb. Each of the lower limb bones may be described regionally as a bone of the pelvic girdle, thigh, leg, or foot (Figure 7).

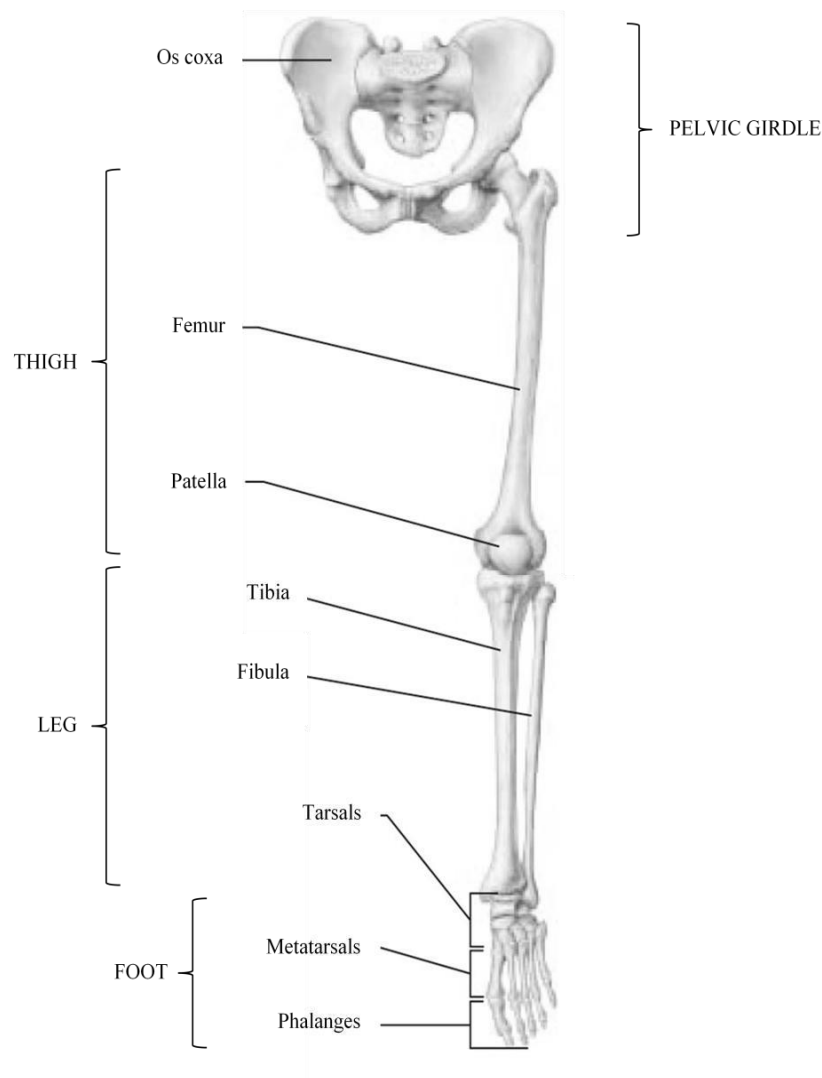


Figure 7: Bones of the lower limb

## Pelvic (Hip) Girdle

The pelvic girdle is formed by the paired **os coxae** (coxal bones). Together with the sacrum and coccyx of the axial skeleton, this group of bones forms the bony pelvis. The ability to bear weight is more important in the pelvic girdle than the pectoral girdle. Thus, the os coxae are heavy and massive with a firm attachment to the axial skeleton. Each os coxa is a result of the fusion of three bones: the ilium, ischium, and pubis. These three bones fuse at the deep hemispherical socket, the **acetabulum**, which receives the femur.

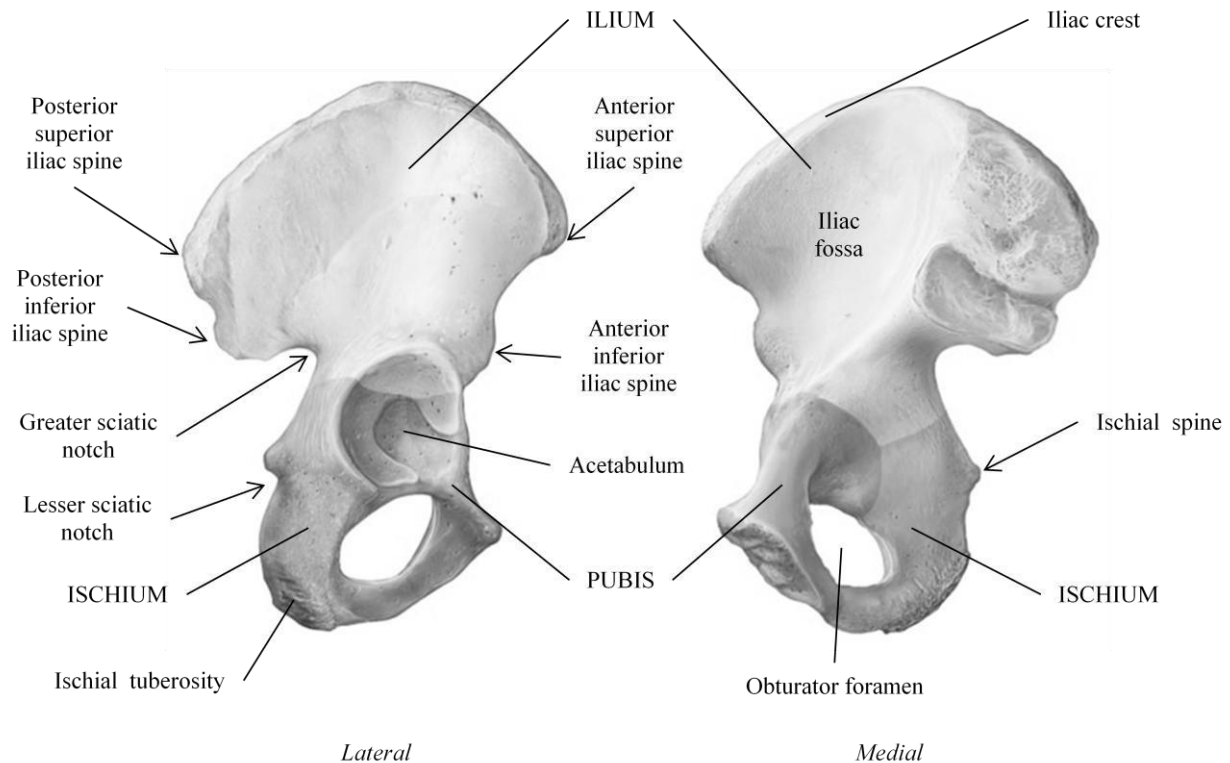


Figure 8: Right os coxa, lateral and medial views

A. **Ilium:** Large, flaring bone; forms superior region of os coxa.

### *Landmarks / Markings:*

- **Iliac crest:** Thickened, superior margin of the ilium; site of muscle attachment.
- **Anterior superior iliac spine:** Blunt anterior ending to the iliac crest; site of muscle attachment.
- **Posterior superior iliac spine:** Sharp posterior ending to the iliac crest; site of muscle attachment.

- **Anterior inferior iliac spine:** Less prominent projection located directly inferior to the anterior superior iliac spine; site of muscle attachment.
- **Posterior inferior iliac spine:** Less prominent projection located directly inferior to the posterior superior iliac spine; site of muscle attachment.
- **Greater sciatic notch:** Large indentation just inferior to the posterior inferior iliac spine; passageway for nerve.
- **Iliac fossa:** Concavity on the medial surface of the ilium; site of muscle attachment.

B. **Ischium:** Roughly arc-shaped bone; forms the most inferior and posterior portion of the os coxa.

*Landmarks / Markings:*

- **Ischial tuberosity:** Roughened and thickened inferior surface of the ischial bone; site of muscle and ligament attachment.
- **Ischial spine:** Projection located superior to the ischial tuberosity; site of ligament attachment.
- **Lesser sciatic notch:** Small indentation inferior to the ischial spine; Passageway for nerves and blood vessels.

C. **Pubis:** V-shaped bone; forms the most anterior portion of the os coxa.

*Landmarks / Markings:*

- **Obturator foramen:** Large opening in the os coxa; closed off by fibrous membrane in life.
- **Pubic crest:** Thickened anterior border of pubis; site of muscle attachment.
- **Pubic tubercle:** Small projection at the lateral end of the pubic crest; site of ligament attachment.

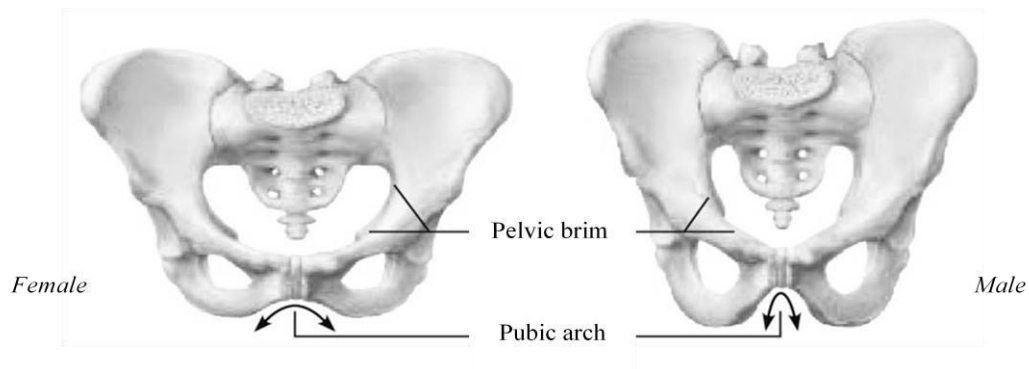
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### *Comparison of the Male and Female Pelvis*

Although bones of males are usually larger and heavier and have more prominent bone markings, the bones of the male and female skeletons are very similar. The outstanding exception is the pelvic structure.

The female pelvis reflects modifications for child-bearing. Generally speaking, the female pelvis is wider, more shallow, lighter, and rounder than that of the male. Not only must the female pelvis support the increasing size of the developing fetus, but it must also be large enough to allow the infant's head to descend through the birth canal. The major differences between the male and female pelvis are summarized below:

- ❖ The female inlet (entrance to lower pelvic cavity surrounded by bone) is larger and more circular.
  - The female sacrum is broader and less curved, and the pubic arch is more rounded.
  - The female acetabula are smaller and farther apart, and the ilia flare more laterally.
  - The female ischial spines are shorter, farther apart, and everted thus enlarging the pelvic outlet.



## Thigh

The thigh consists of a single bone, the femur (Figure 9). The largest, longest, and strongest bone in the human body, it articulates with the os coxa at the hip and with the tibia at the knee. Although technically not part of the thigh, the patella, or kneecap, is included in this region as well.

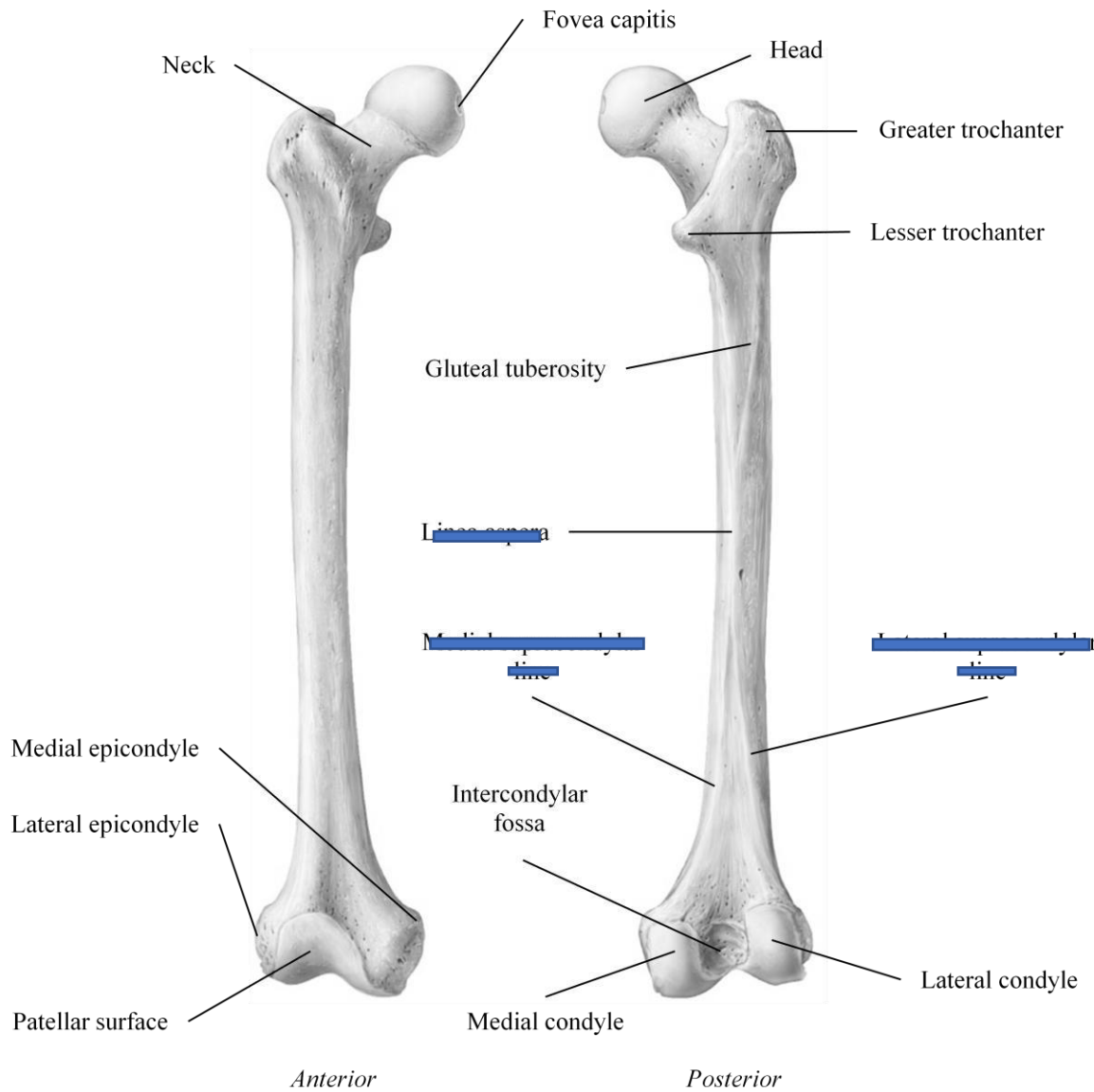


Figure 9: Right femur, anterior and posterior views

## A. Femur

### *Landmarks / Markings:*

- **Head:** Rounded region at the proximal end of the femur; articulates with the acetabulum of the os coxa.
- **Fovea capitis:** Small indentation located centrally in the head of the femur; site of ligament attachment.
- **Neck:** Constriction just inferior to the head of the femur; weakest part of femur.
- **Greater trochanter:** Large prominence on the lateral surface of the femur just below the neck; site of muscle attachment.
- **Lesser trochanter:** Small prominence on the posteromedial surface of the femur just below the neck; site of muscle attachment.
- **Gluteal tuberosity:** Small projection at the superior edge of the linea aspera; site of muscle attachment.
- **Medial condyle:** Wheel-like structure located medially on the distal end of the femur; articulates with the tibia of the lower leg.
- **Lateral condyle:** Wheel-like structure located laterally on the distal end of the femur; articulates with the tibia of the lower leg.
- **Indercondylar notch:** Deep, U-shaped depression on the posterior of the femur between the lateral and medial condyle.
- **Patellar surface:** Smooth surface between the condyles on the anterior femoral surface; articulates with the patella.
- **Medial epicondyle:** Small projection on the medial surface of the femur just above the medial condyle; site of muscle attachment.
- **Lateral epicondyle:** Small projection on the lateral surface of the femur just above the lateral condyle; site of muscle attachment.

B. **Patella:** Triangular sesamoid bone enclosed in the quadriceps tendon; protects knee anteriorly and improves leverage of thigh muscles (Figure 10).



*Anterior*



*Posterior*

Figure 10: Right patella, anterior and posterior views

## Legs

Two parallel bones, the tibia and the fibula, form the leg (Figure 11). Lacking the movements associated with the forearm, the bones of the leg form a stronger and more stable limb structure.

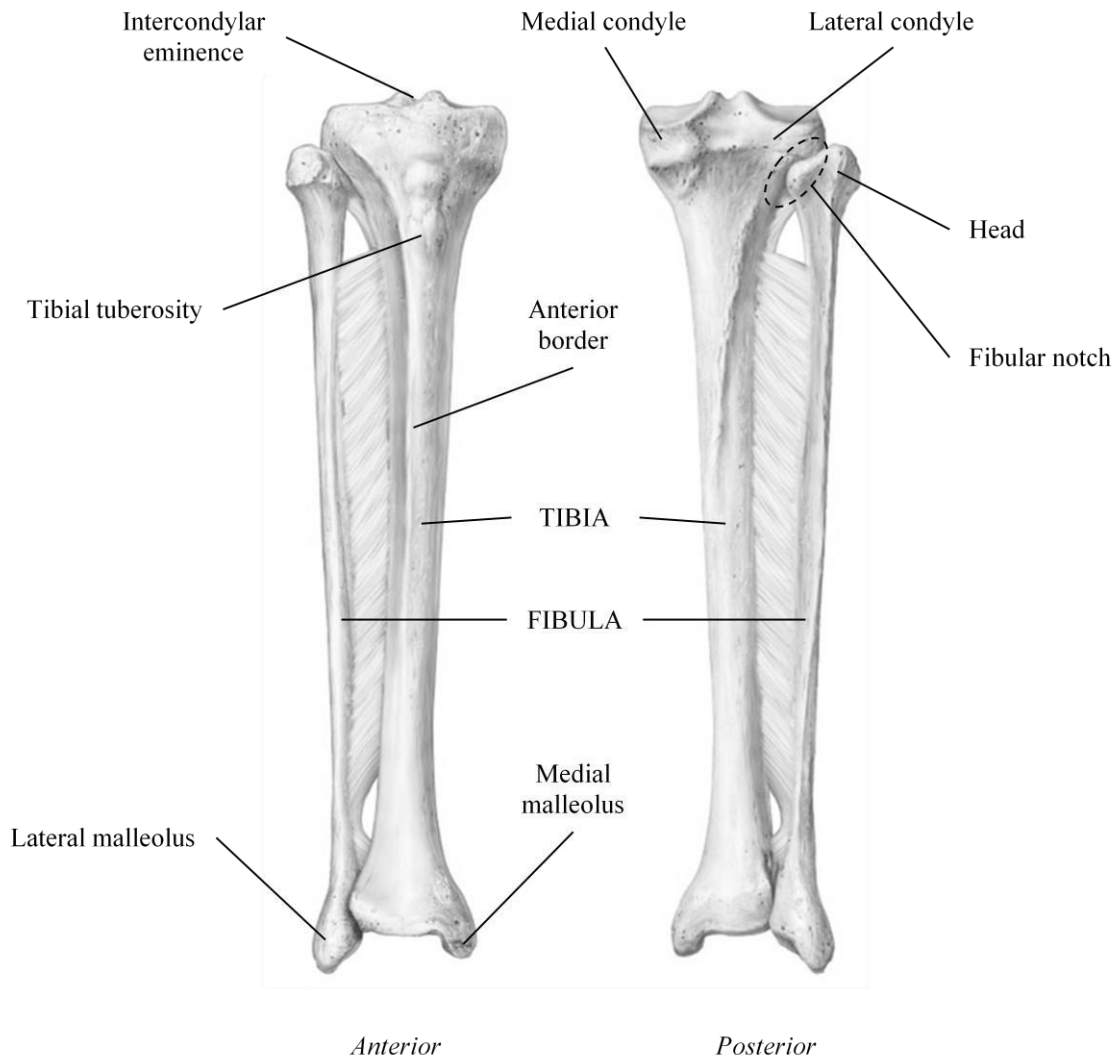


Figure 11: Right tibia and fibula, anterior and posterior views

A. **Tibia:** Typical long bone; articulates with the femur at the knee and with the talus at the ankle.

*Landmarks / Markings:*

- **Medial condyle:** Broad concave structure located medially at the proximal end of the tibia; articulates with the medial condyle of femur.



- **Lateral condyle:** Broad concave structure located laterally at the proximal end of the tibia; articulates with the lateral condyle of femur.
  - **Intercondylar eminence:** Irregular projection located between the lateral and medial condyles.
  - **Tibial tuberosity:** Rough projection on the anterior surface of the tibia just inferior to the condyles; site of ligament attachment.
  - **Anterior border:** Sharpened ridge running down the anterior shaft of the tibia.
  - **Medial malleolus:** Medial downward projection on the distal end of the tibia; forms the medial bulge of the ankle.
  - **Fibular notch:** Slight depression located laterally on the distal end of the tibia; articulates with the fibula.
- B. **Fibula:** Slender bone with slightly expanded ends; runs parallel to the tibia along the lower leg, articulating with the talus of the ankle at its distal end.

*Landmarks / Markings:*

- **Head:** Expanded proximal end of the fibula; articulates with fibular notch of the tibia.
- **Lateral malleolus:** Spade-shaped distal end of the fibula; forms the lateral bulge of the ankle.

## Foot

The skeleton of the foot includes the bones of the tarsus (ankle); the bones of the metatarsus (sole), and the bones of the phalanges (toes) (Figure 12).

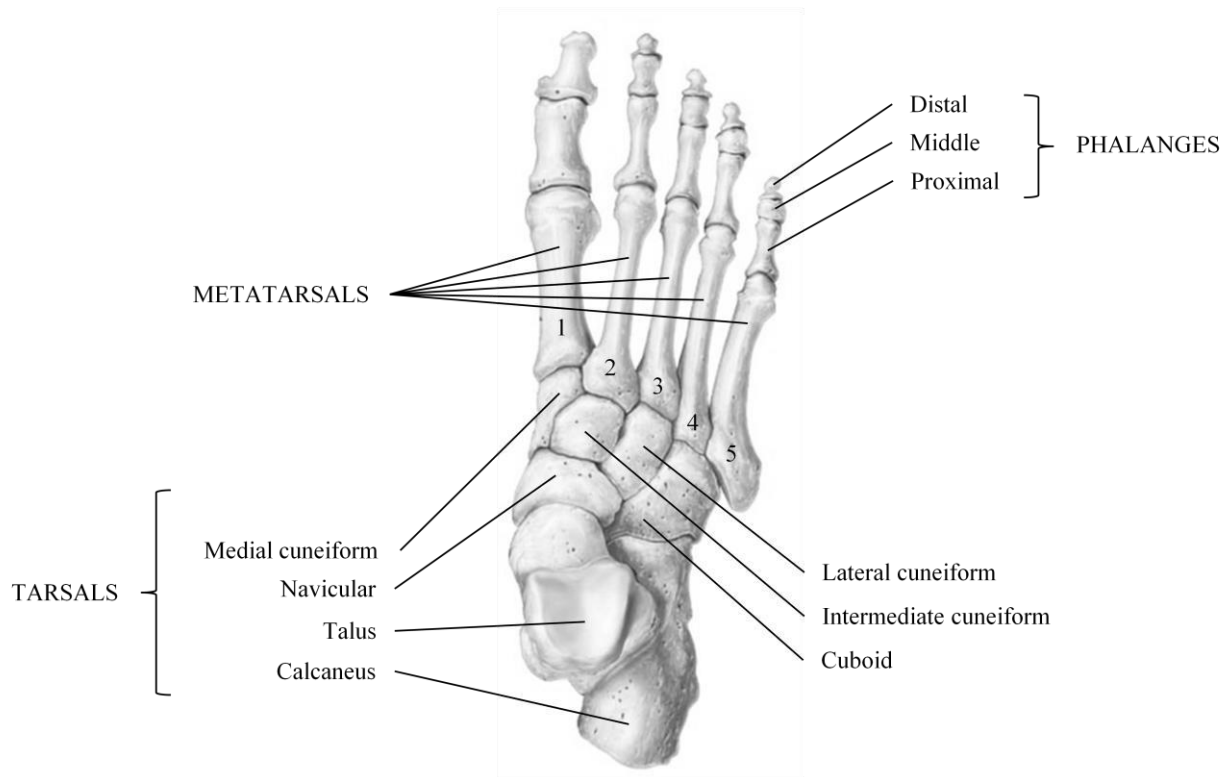


Figure 6: Right foot, superior view

A. **Tarsals** (ankle): Seven (7) short / irregular bones closely united by ligaments; supports the weight of the body.

- 1) **Talus** (articulates with tibia / fibula)
- 2) **Calcaneus**
- 3) **Cuboid**
- 4) **Navicular**

- 5) **Medial cuneiform**
- 6) **Intermediate cuneiform**
- 7) **Lateral cuneiform**

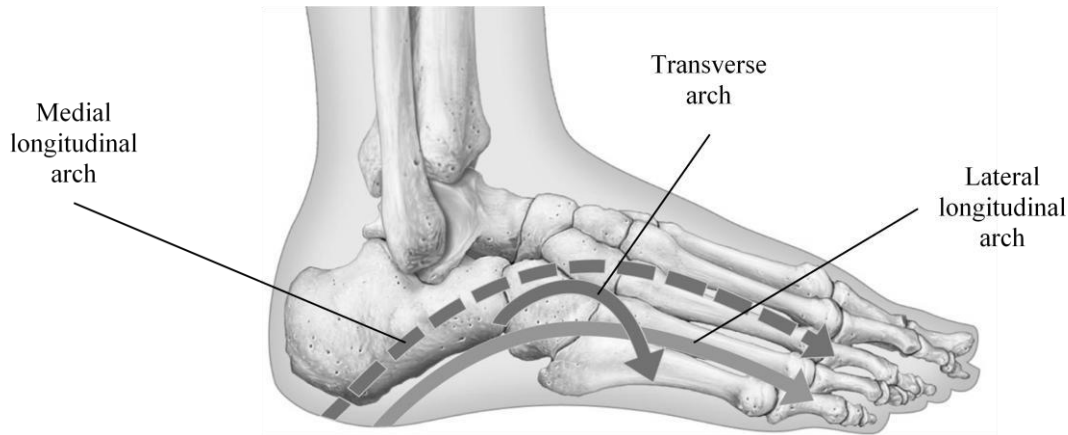
B. **Metatarsals**: Five (5) small long bones radiating from the ankle relatively parallel to one-another; numbered 1 – 5 from the great toe to the little toe (medial to lateral).

C. **Phalanges**: Fourteen (14) miniature long bones that form the toes; numbered 1 – 5 from the great toe (**hallux**) to the little toe.

- 1) **Proximal phalange (1 – 5)**
- 2) **Middle phalange (2 – 5)**
- 3) **Distal phalange (1 – 5)**

## *Arches of the Foot*

A segmented structure can hold up weight only if it is arched. The foot has three arches that allow for it to support the weight of the body. These arches are maintained by the interlocking shapes of the foot bones, by strong ligaments, and by the pull of some tendons during muscle activity. Together, the arches form a half-dome that distributes about half of a person's standing and walking weight to the heel bones and half to the heads of the metatarsals.



- 1) **Medial longitudinal arch:** Curves the foot well above the ground; the talus is the keystone of this arch which originates at the calcaneus, rises toward the talus, and then descend to the three medial metatarsals.
- 2) **Lateral longitudinal arch:** Low arch found on lateral portion of foot; redistributes some of the weight to the calcaneus and the head of the fifth metatarsal with the cuboid acting as the keystone bone.
- 3) **Transverse arch:** Arch running obliquely from one side of the foot to the other; follows line of the joints between the tarsals and metatarsals.

**CHECKLIST: BONES / MARKINGS OF THE PELVIC GIRDLE / LOWER LIMB**

**BONES OF THE PELVIC GIRDLE:**

**Ilium**

- Iliac crest
- Anterior / posterior superior iliac spine
- Anterior / posterior inferior iliac spine
- Greater sciatic notch
- Iliac fossa

**Ischium**

- Ischial tuberosity
- Ischial spine
- Lesser sciatic notch

**Pubis**

- Obturator foramen
- Pubic crest
- Pubic tubercle

**Os Coxa\***

**BONE OF THE (LOWER) LEG:**

**Tibia\***

- Medial / lateral condyle ➤  
Intercondylar eminence
- Tibial tuberosity
- Anterior border
- Medial malleolus
- Fibular notch

**Fibula\***

- Head
- Lateral malleolus
- Acetabulum

**BONE OF THE THIGH:**

**Femur\***

- Head
- Fovea capitis
- Neck
- Greater / lesser trochanter
- Gluteal tuberosity
- Medial / lateral condyle
- Intercondylar notch
- Patellar surface
- Medial / lateral epicondyle

**Patella**

**BONES OF THE ANKLE / FOOT:**

**Calcaneus**

**Talus**

**Navicular**

**Cuboid**

**Medial cuneiform**

**Intermediate cuneiform**

**Lateral cuneiform**

**Metatarsals (1 – 5)**

**Phalanges**

- Proximal, middle, distal
- Hallux

\* Need to be able to identify bone from right vs. left side of body

