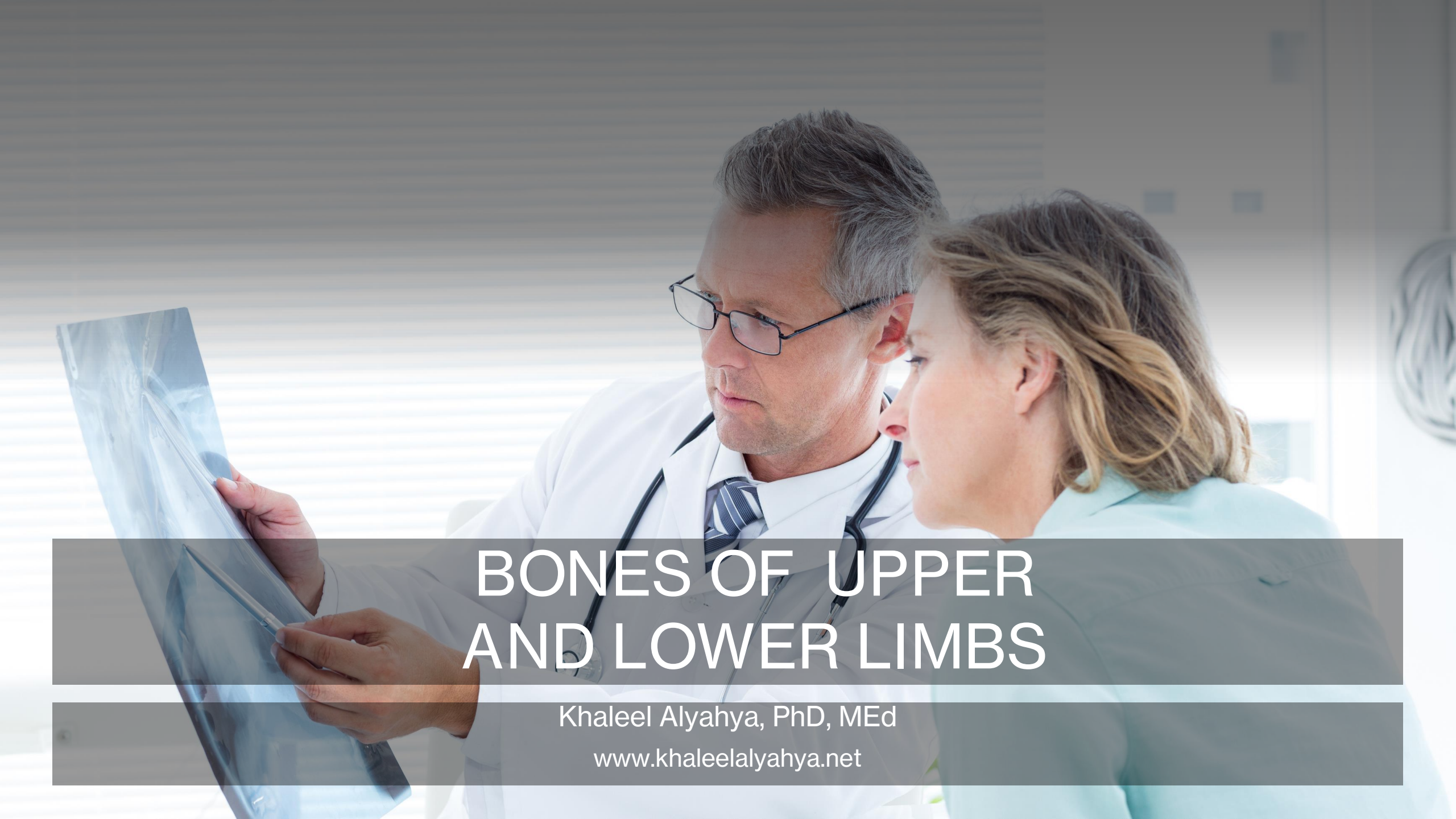

BONES OF UPPER AND LOWER LIMBS

Khaleel Alyahya, PhD, MEd

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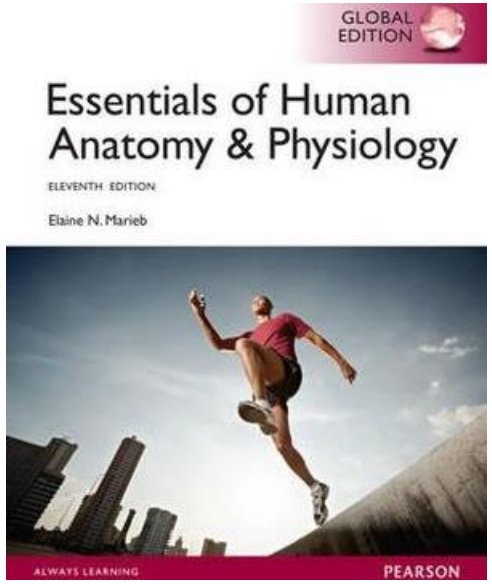
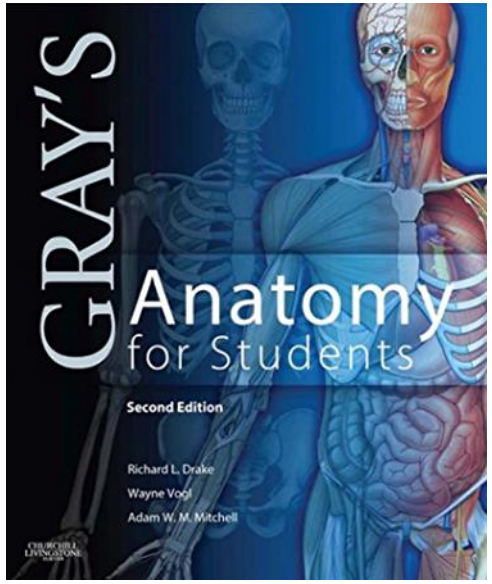
Resources



By Elaine Marieb



By Drake, Vogl & Mitchell

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Objectives

UPPER LIMBS

List the different bones of the upper limbs.

List characteristic features of each bone in upper limbs.

Differentiate between bones of right and left sides.

List articulation surfaces between the different bones.

Clinical notes associated with upper limbs.

LOWER LIMBS

List the different bones of the lower limbs.

List characteristic features of each bone in lower limbs.

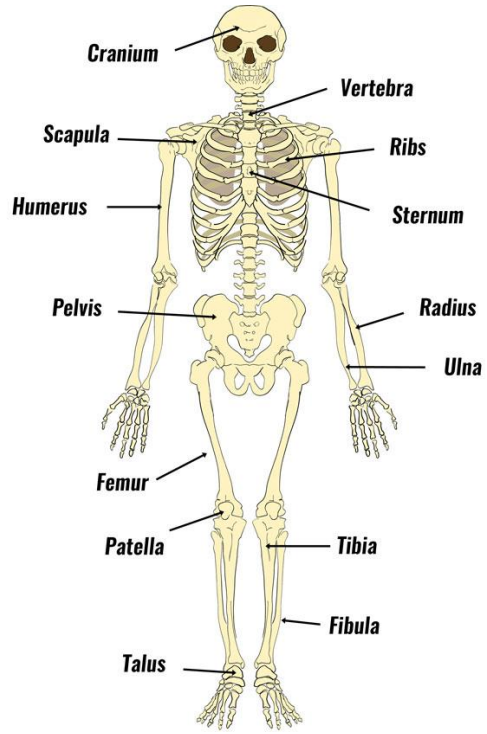
Differentiate between bones of right and left sides.

List articulation surfaces between the different bones.

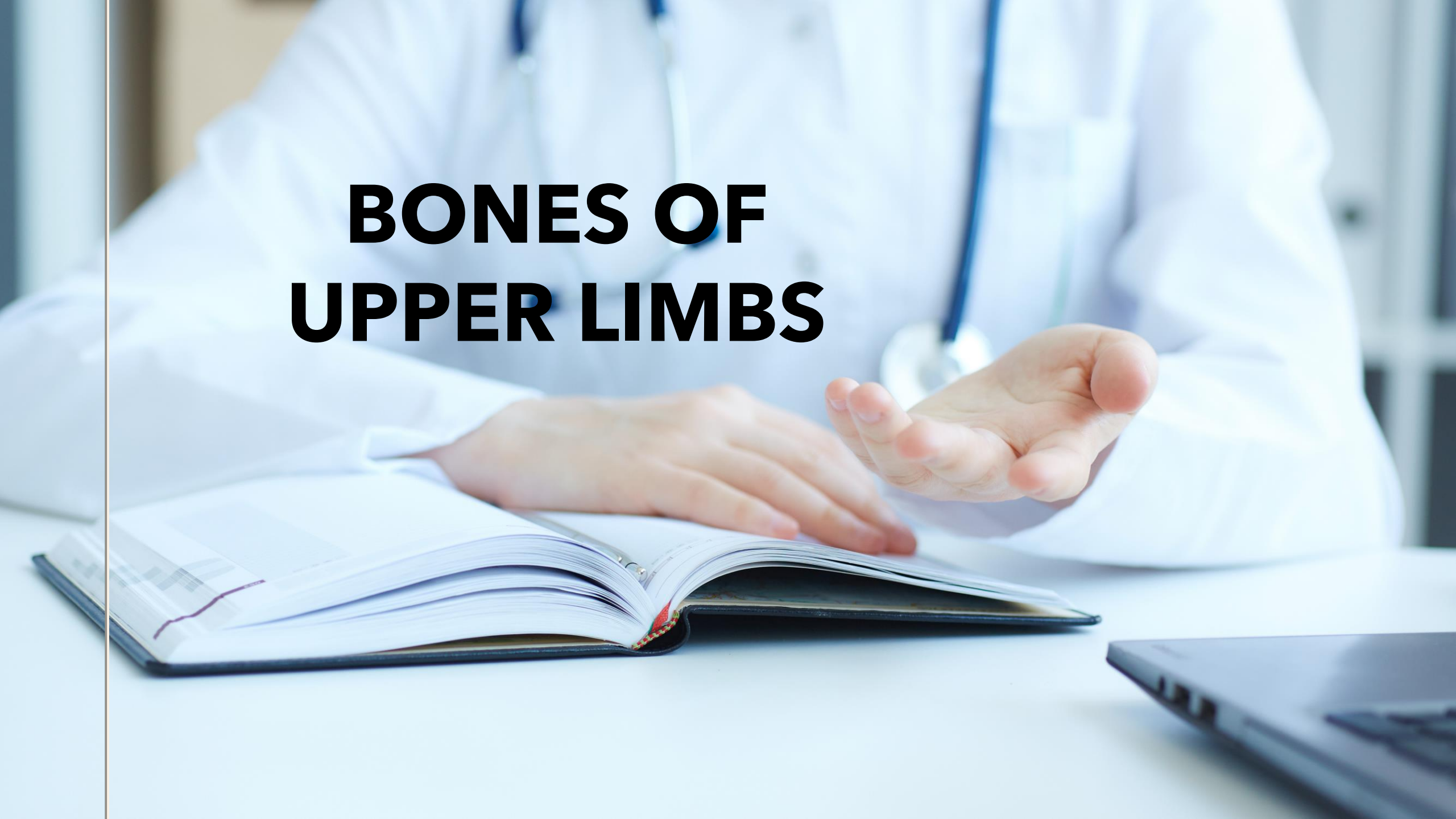
Clinical notes associated with lower limbs.

Introduction

- The human skeleton serves as a framework for the body with many bones, cartilages, ligaments and tendons.
- The human skeleton consists of two principal subdivisions, each with origins distinct from the others and each presenting certain individual features.
- **The axial skeleton**
  - Composed of vertebral column, rib cage and skull.
- **The appendicular skeleton**
  - Composed of limbs (upper and lower) and girdles (pectoral and pelvic).

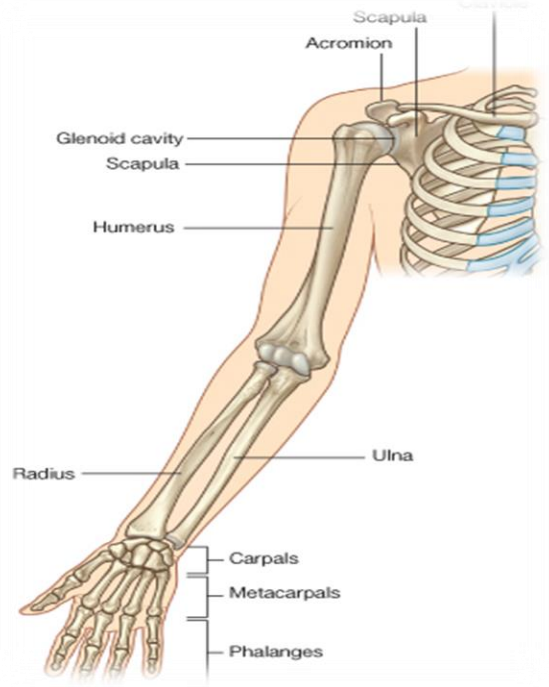


BONES OF UPPER LIMBS



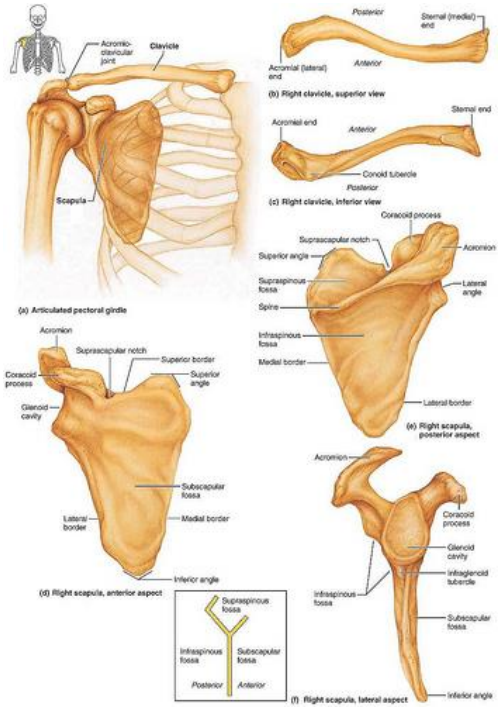
Classification

- **Pectoral Girdle**
  - Clavicle
  - Scapula
- **Arm**
  - Humerus
- **Forearm**
  - Radius & Ulna
- **Wrist**
  - Carpal bones
- **Hand**
  - Metacarpals & Phalanges



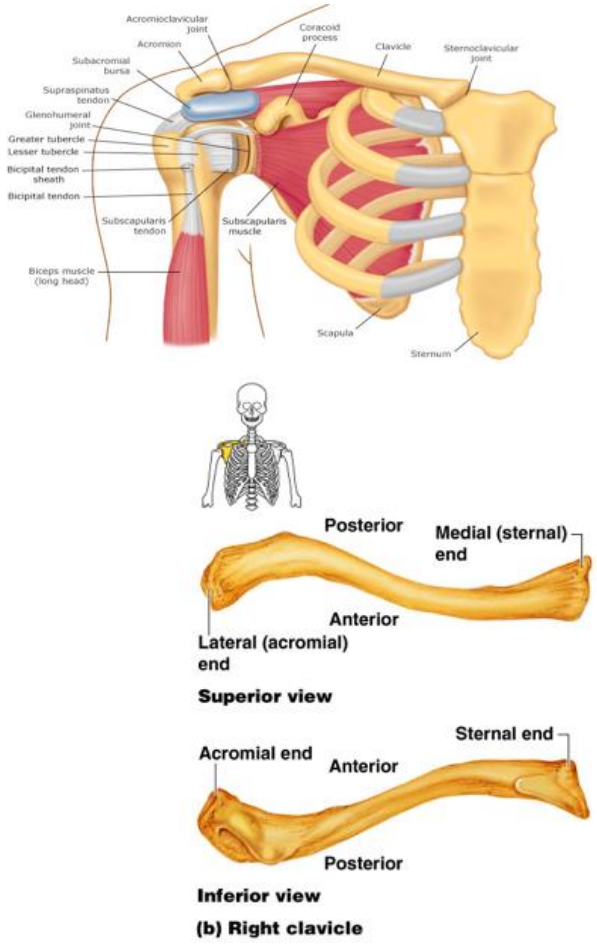
Pectoral Girdle

- It composed of Two bones: Clavicle and scapula
- It is very light, and it allows the upper limb to have exceptionally free movement.



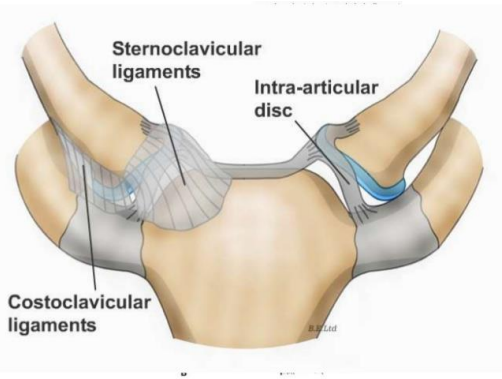
Clavicle

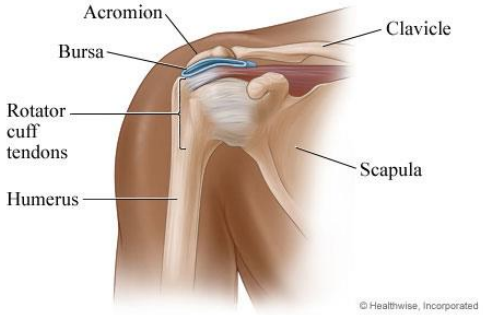
- It is considered a long bone, but it has no medullary (bone marrow) cavity.
- The medial (sternal) end is enlarged & triangular, while the lateral (acromial) end is flattened.
- The medial 2/3 of the body (shaft) is convex forward and the lateral 1/3 is concave forward. Thus, these curves give the clavicle its appearance as the capital (S).
- It has two surfaces:
  - Superior: smooth as it lies just deep to the skin.
  - Inferior: rough because strong ligaments bind it to the 1st rib.
- Functions:
  - It serves as a rigid support to keep upper limb suspended away from the trunk.
  - Transmits forces from the upper limb to the axial skeleton.
  - Provides attachment for muscles.
  - Forms a boundary of the cervicoaxillary canal for protection of the neurovascular bundle of the UL.



Articulations of Clavicle

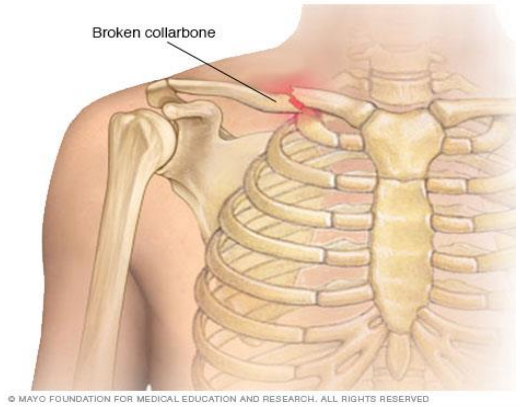
- Medially, sternoclavicular joint with the manubrium
- Inferiorly, costoclavicular Joint with the 1st rib
- Laterally, acromioclavicular joint with the acromial end of the scapula

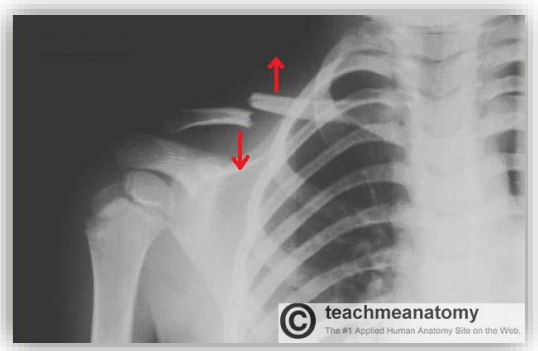




Fracture of Clavicle

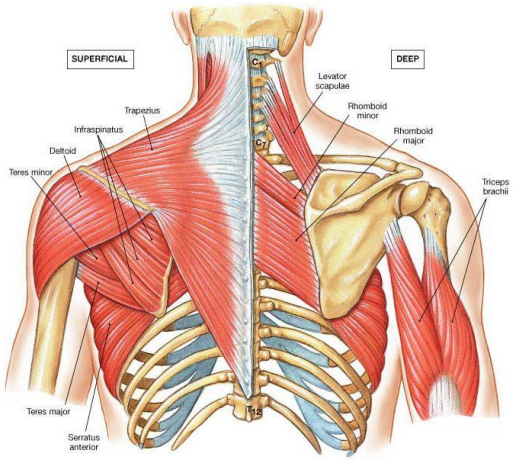
- A function of the clavicle is to transmit forces from the upper limb to the axial skeleton. Thus, the clavicle is the most commonly fractured bone in the body.
- Fractures commonly result from a fall onto the shoulder, or onto an outstretched hand.
- The clavicle is commonly fractured especially in children as forces are impacted to the outstretched hand during falling.
- The weakest part of the clavicle is the junction of the middle and lateral thirds.
- After fracture, the medial fragment is elevated (by the sternomastoid muscle), the lateral fragment drops because of the weight of the UL.
- It may be pulled medially by the adductors of the arm.





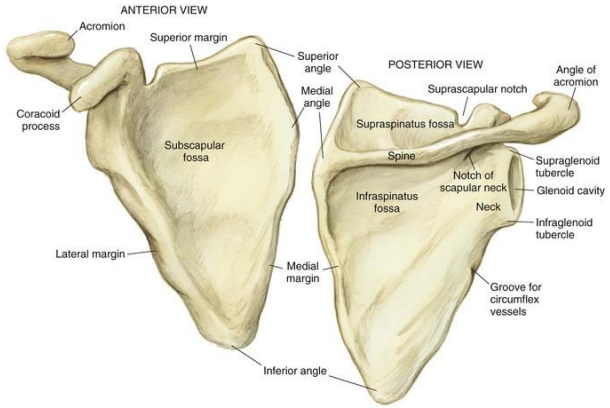
Scapula

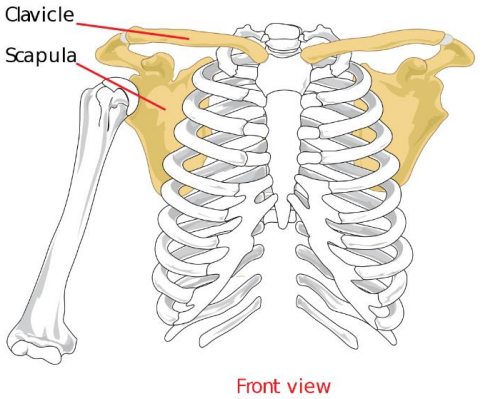
- It is a triangular flat bone.
- It extends between the 2nd and 7th ribs.
- It articulates with:
  - humerus at the glenohumeral joint
  - clavicle at the acromioclavicular joint.
- It connects the upper limb to the trunk.



Structures

- **Three Processes:**
  - Spine: a thick projecting ridge of bone that continues laterally as the flat expanded
  - Acromion: forms the subcutaneous point of the shoulder.
  - Coracoid: a beaklike process. It resembles in size, shape and direction a bent finger pointing to the shoulder.
- **Three Borders:**
  - Superior
  - Medial (Vertebral)
  - Lateral (axillary)
- **Three Angles :**
  - Superior
  - Inferior
  - Lateral
- **Two Surfaces**
  - Convex and Concave

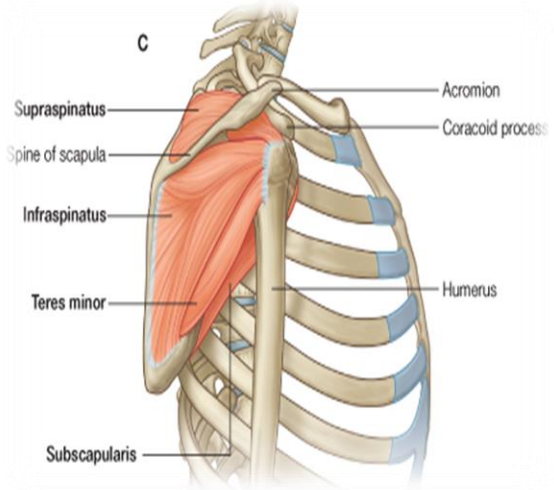




Front view

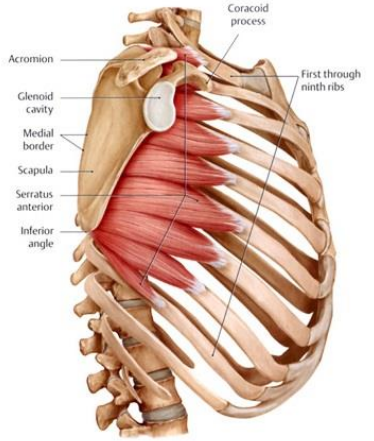
Functions of Scapula

- Gives attachment to muscles.
- Has a considerable degree of movement on the thoracic wall to enable the arm to move freely.
- The glenoid cavity forms the socket of the shoulder joint.
- Because most of the scapula is well protected by muscles and by its association with the thoracic wall , most of its fractures involve the protruding subcutaneous acromion.



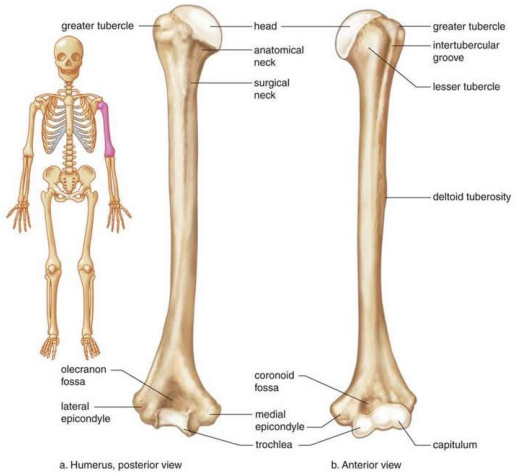
Winging of Scapula

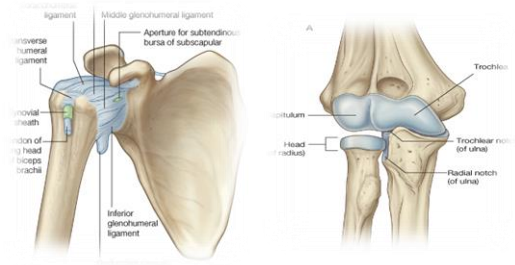
- The serratus anterior muscle originates from ribs 2-8, and attaches the costal face of the scapula, pulling it against the ribcage.
- The long thoracic nerve innervates the serratus anterior.
- If this nerve becomes damaged, the scapula protrudes out of the back when pushing with the arm.
- The long thoracic nerve can become damaged by trauma to the shoulder, repetitive movements involving the shoulder or by structures becoming inflamed and pressing on the nerve.



Arm (humerus)

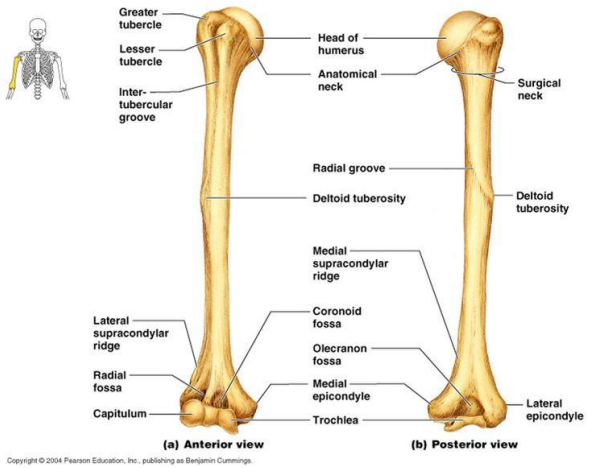
- The arm is a long bone of the upper limb that extends from the shoulder to the elbow.
- It is the largest bone in the upper limbs
- The proximal region of the humerus articulates with the glenoid fossa of the scapula, forming the glenohumeral joint.
- At the distal end, the humerus articulates with the head of the radius and trochlear notch of the ulna forming elbow joint.
- The proximal end has the following features:
  - Head, anatomical neck, greater tubercle, lesser tubercle, intertubercular groove and surgical neck.
- The distal end is widening as the sharp medial and lateral supracondylar ridges form and end in the medial and lateral epicondyles providing muscular attachment.
  - Trochlea, capitulum, coronoid fossa, radial fossa and olecranon fossa
- The shaft (body) has two prominent features:
  - Deltoid tuberosity and spiral groove.

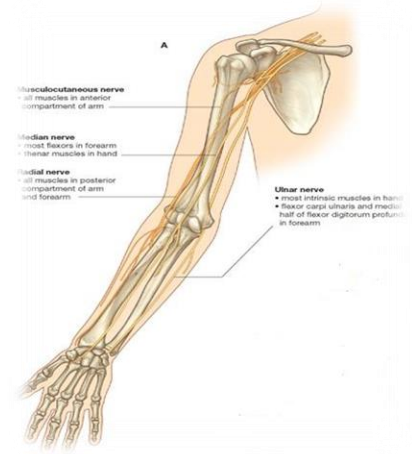




Fracture of Humerus

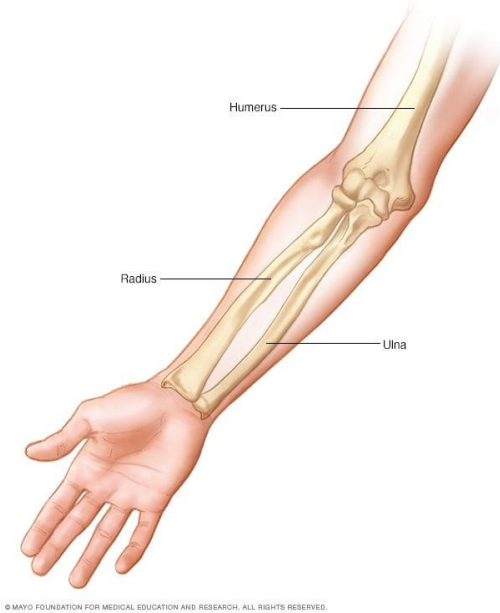
- Most common fractures of the surgical neck especially in elder people with osteoporosis.
- The fracture results from falling on the hand (transmitting of force through the bones of forearm of the extended limb).
- In younger people, fractures of the greater tubercle results from falling on the hand when the arm is abducted .
- The body of the humerus can be fractured by a direct blow to the arm or by indirect injury as falling on the outstretched hand.
- The following nerves are affected in the fractures of humerus:
  - Surgical neck: axillary nerve
  - Radial groove: radial nerve
  - Distal end of humerus: median nerve
  - Medial epicondyle: ulnar nerve





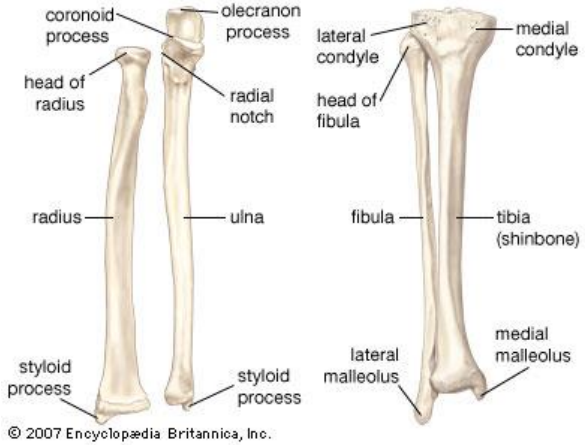
Forearm

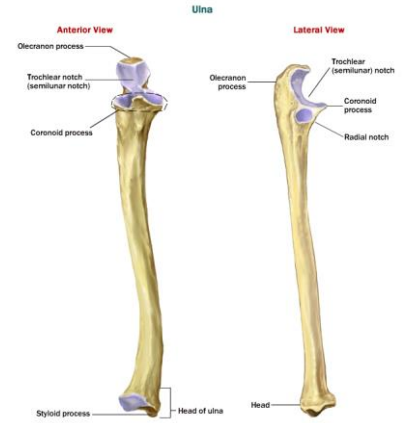
- Formed of two bones:
  - The Radius is the lateral bone.
  - The Ulna is the medial bone.



Ulna

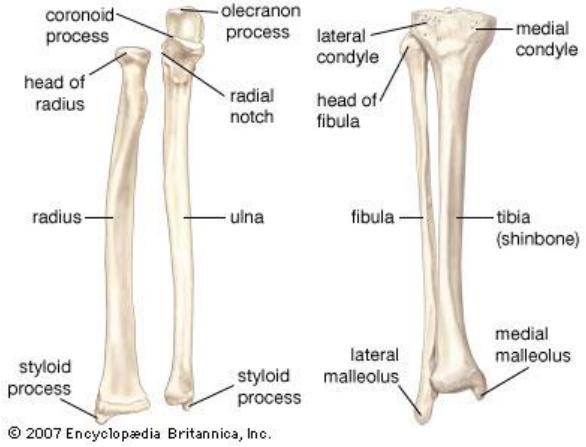
- It is the stabilizing bone of the forearm.
- It is the medial & longer of the two bones of the forearm.
- Proximal end has two prominent projections:
  - Olecranon process: projects proximally from the posterior aspect (Forms the prominence of the elbow).
  - Coronoid process: projects anteriorly.
- Trochlear notch: articulates with trochlea of humerus.
- Radial notch: a smooth rounded concavity lateral to coronoid process.
- Tuberosity of ulna: inferior to coronoid process.
- The shaft is thick and cylindrical superiorly but diminishes in diameter inferiorly.
- It has three surfaces (Anterior, Medial & Posterior) with sharp lateral interosseous border.
- Distal end is small rounded Head: Styloid process
- The head lies distally at the wrist.
- The articulations between the ulna and humerus at the elbow joint allows primarily only flexion & extension (small amount of abduction & adduction occurs).

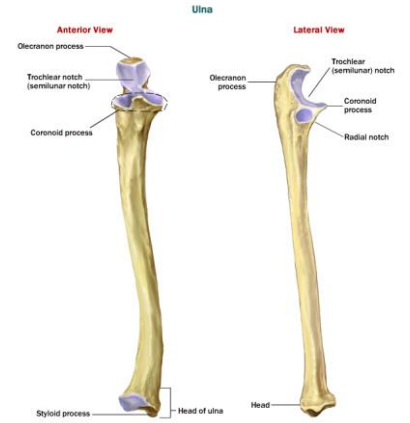




Radius

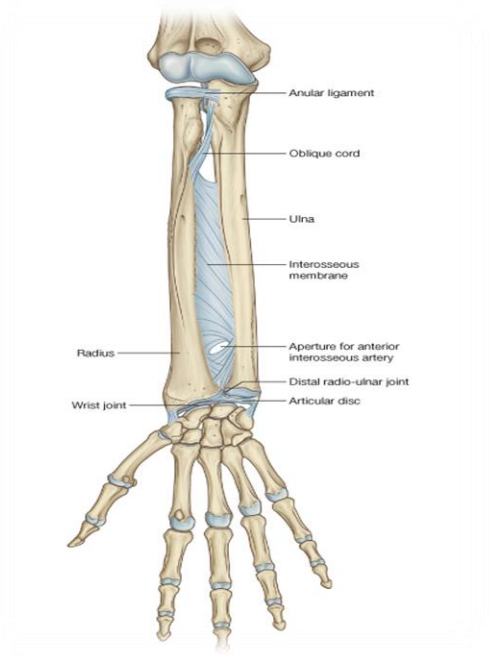
- It is the shorter and lateral of the two forearm bones.
- The proximal end consists of:
  - Head: small, circular and its upper surface is concave for articulation with the capitulum.
  - Neck
  - Radial (Bicipital) Tuberosity: medially directed and separates the proximal end from the body.
- The shaft has a lateral convexity, and it gradually enlarges as it passes distally.
- The distal end is rectangular.
- Its medial aspect forms a concavity: Ulnar notch to accommodate the head of the ulna.
- Radial Styloid process: extends from the lateral aspect.
- Dorsal tubercle: projects dorsally.





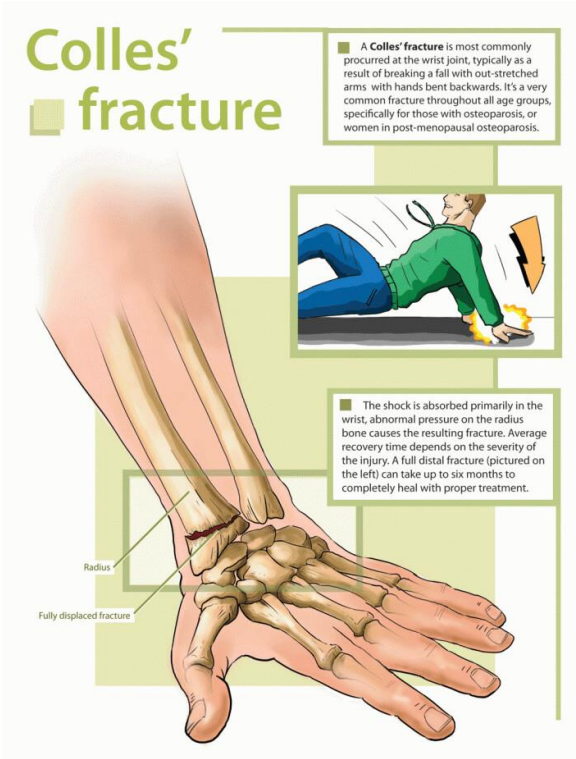
The Articulations of Forearm

- **Elbow joint**
  - Distal end of Humerus with the proximal ends of Radius & Ulna
- Proximal **Radioulnar joint**
- Distal **Radioulnar joint**
  - The two bones are connected by the flexible **interosseous membrane**



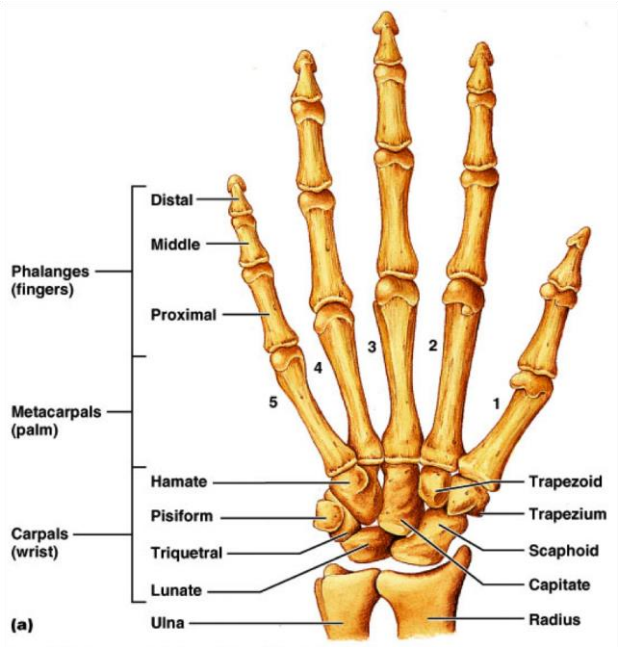
Colle’s Fracture

- The fracture of the distal end of radius is the most common fracture of the forearm.
- It is more common in women after middle age because of osteoporosis.
- It results from forced dorsiflexion of the hand as a result to ease a fall by outstretching the upper limb.



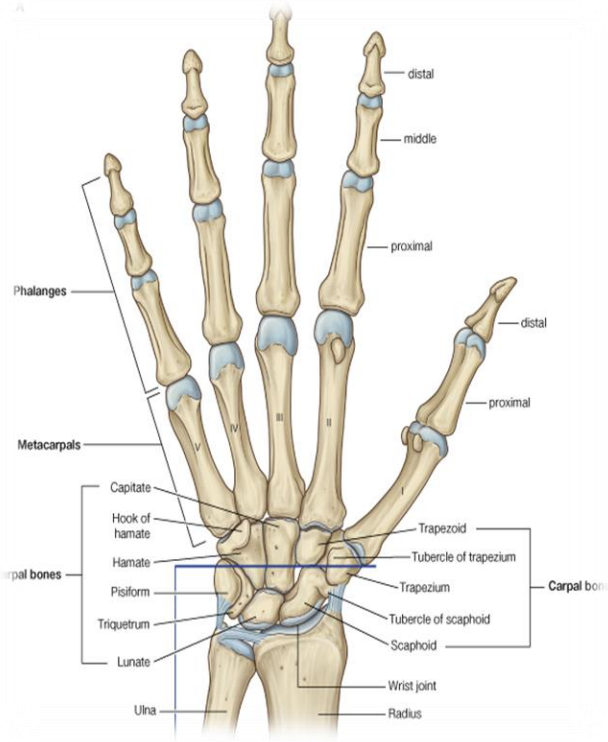
The Hand

- The skeleton of the hand consists of the:
  - **Carpals** for the carpus (wrist joint)
  - **Metacarpals** for the palm
  - **Phalanges** for the fingers



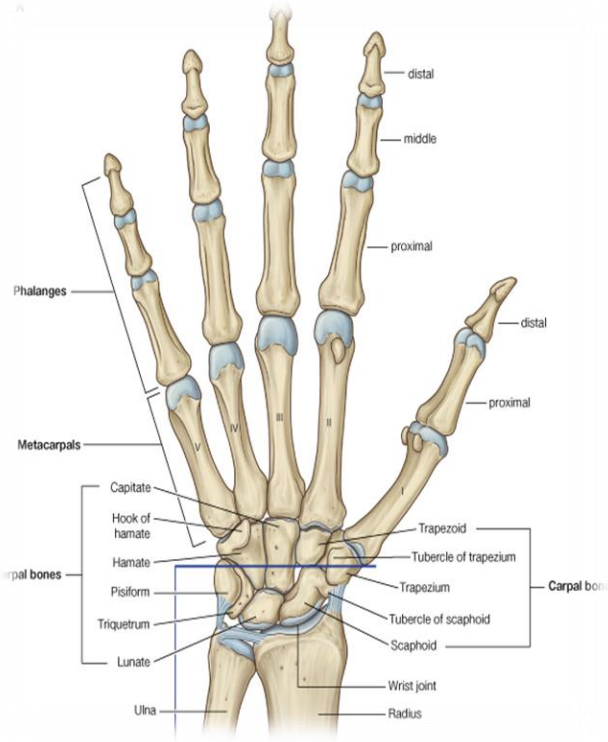
Wrist (Carpus)

- Compose of **eight** carpal bones arranged in two irregular rows, each of four.
- These small bones give flexibility to the wrist.
- The Carpus presents concavity on their anterior surface & convex from side to side posteriorly.
- Proximal row (from lateral to medial):
  - Scaphoid
  - Lunate
  - Triquetrum
  - Pisiform
- Distal row (from lateral to medial):
  - Trapezium
  - Trapezoid
  - Capitate
  - Hamate



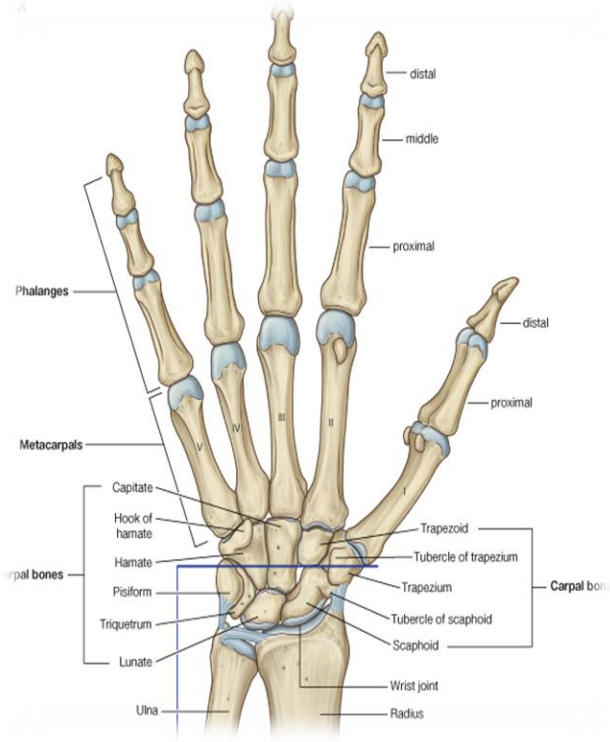
Metacarpals

- It is the skeleton of the hand between the carpus and phalanges.
- It is composed of Five Metacarpal bones, each has a Base, Shaft, and a Head.
- They are numbered 1-5 from the thumb.
- The distal ends (Heads) articulate with the proximal phalanges to form the knuckles of the fist.
- The Bases of the metacarpals articulate with the carpal bones. The 1st metacarpal is the shortest and most mobile. 3rd metacarpal has a styloid process on the lateral side of the base.



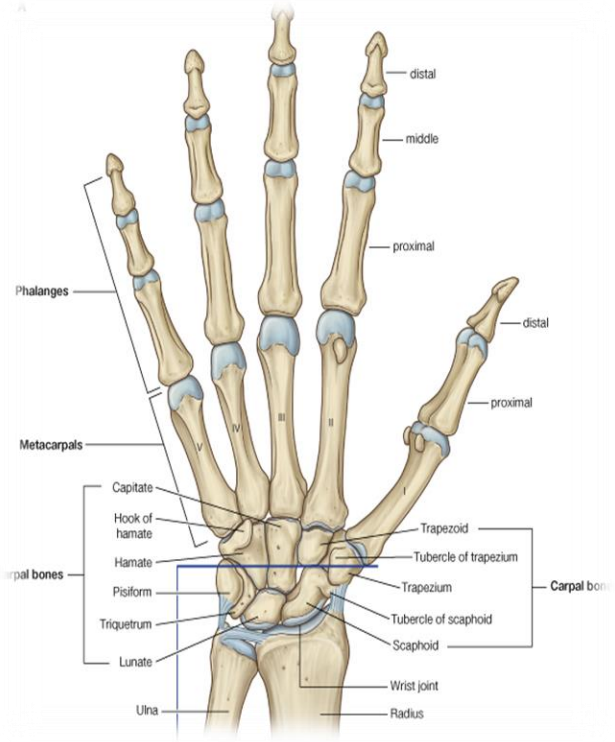
Digits (Phalanges)

- Each digit has Three Phalanges
- Except the Thumb which has only two
- Each phalanx has a base proximally, a head distally and a body between the base and the head.
- The proximal phalanx is the largest.
- The middle ones are intermediate in size.
- The distal ones are the smallest, its distal ends are flattened and expanded distally to form the nail beds.

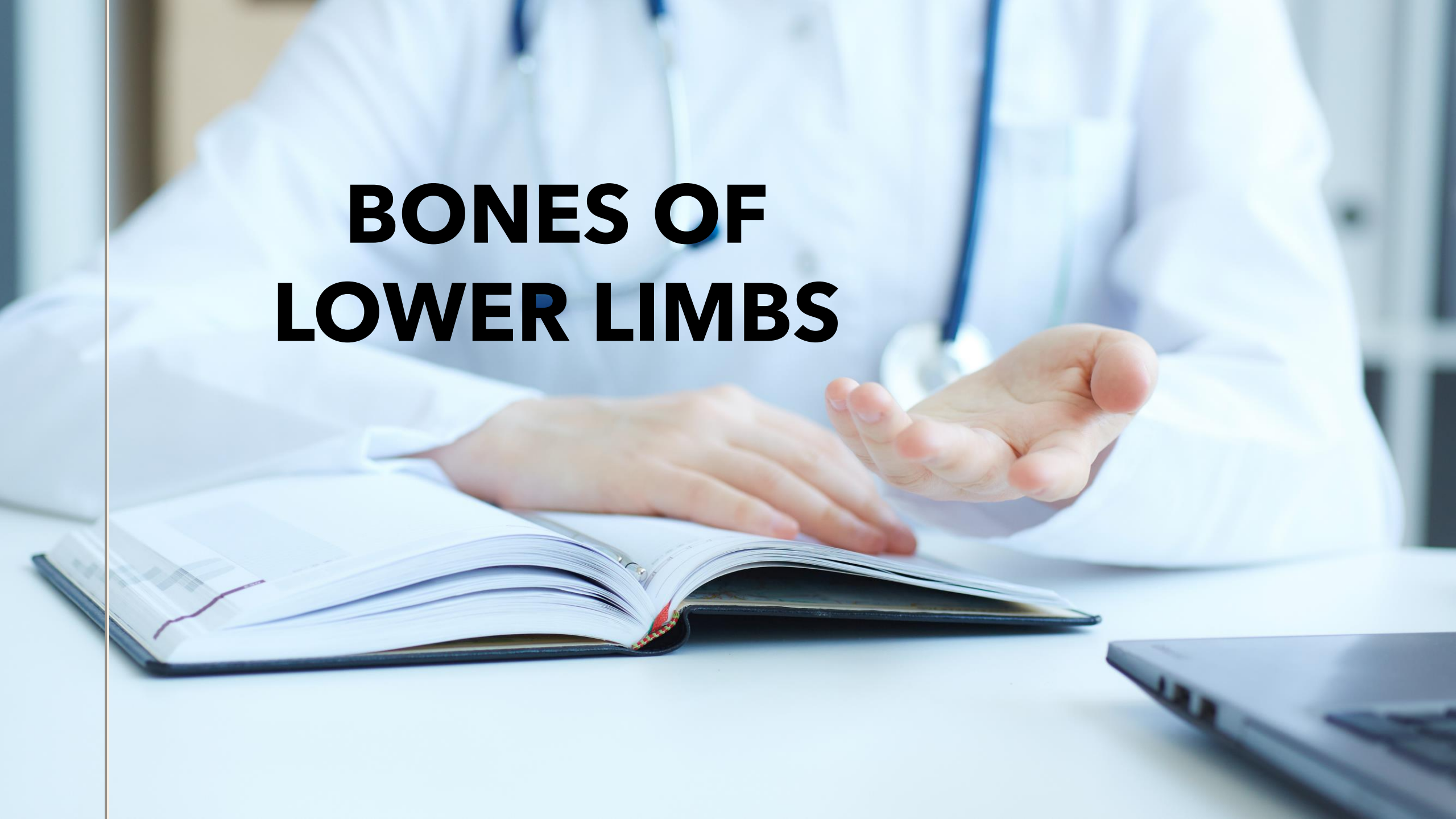


Articulations of the Hand

- Bases of the Metacarpal bones articulate with the distal row of the carpal bones
  - **Carpometacarpal joints**
- Heads (knuckles) articulate with the Proximal Phalanges
  - **Metacarpophalangeal joints**
- The phalanges articulate with each other
  - **Interphalangeal joints**
- Distal end of Radius with the Proximal Raw of Carpal bones
  - **Wrist joint**

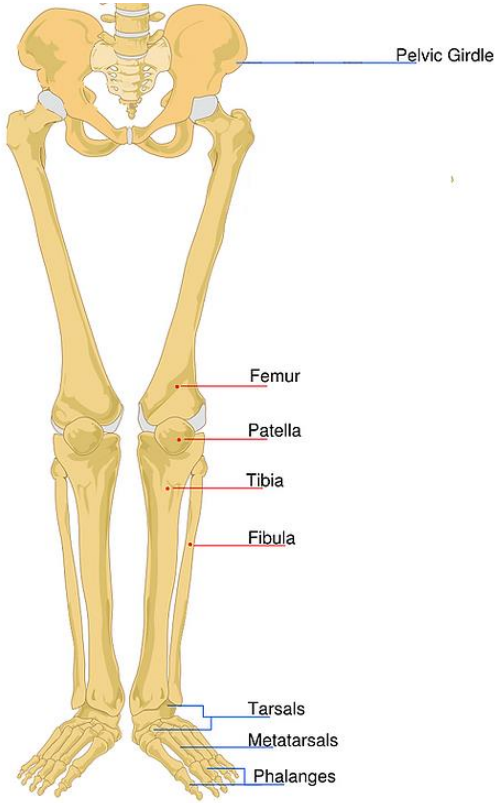


BONES OF LOWER LIMBS



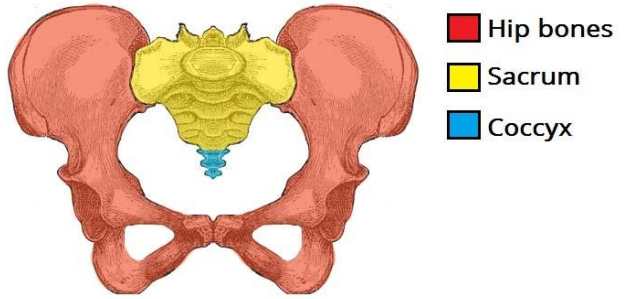
Classification

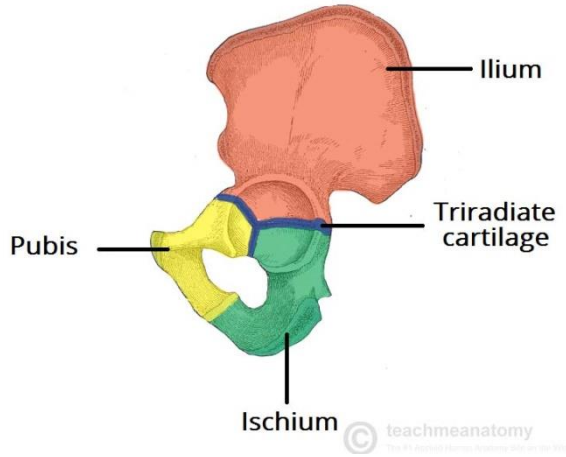
- **Pelvic Girdle**
  - Hip Bone
  - Sacrum
  - Coccyx
- **Thigh**
  - Femur and Patella
- **Leg**
  - Tibia and Fibula
- **Ankle**
  - Tarsal bones
- **Foot**
  - Metatarsals & Phalanges



Pelvic Girdle

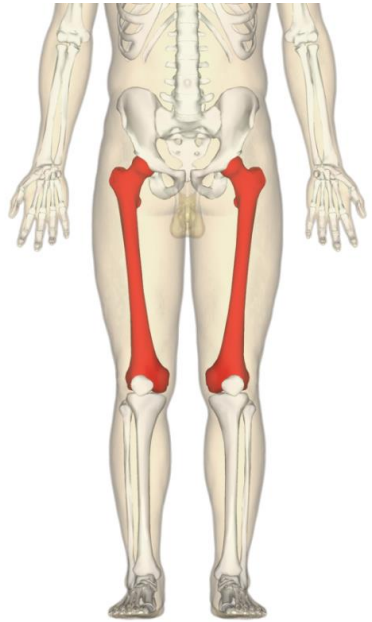
- The pelvic girdle is a ring-like bony structure, located in the lower part of the trunk.
- It connects the axial skeleton to the lower limbs.
- The bony pelvis consists of the following:
  - Two hip (pelvic) bones
  - Sacrum
  - Coccyx
- The hip bone is comprised of the three parts; the ilium, pubis and ischium.
- The left and right hip bones are two irregularly shaped bones that form part of the pelvic girdle.
- The hip bones have three main articulations:
  - **Sacroiliac joint:** articulation with the sacrum.
  - **Pubic symphysis:** articulation between the left and right hip bones.
  - **Hip joint:** articulation with the head of femur.





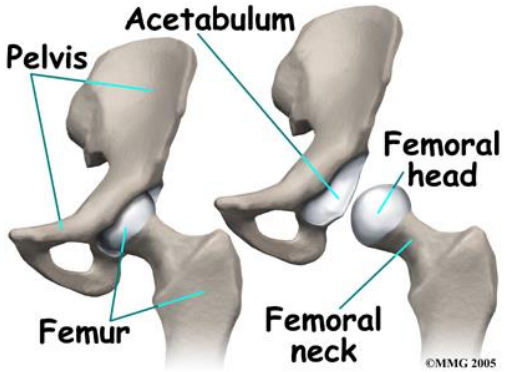
Femur

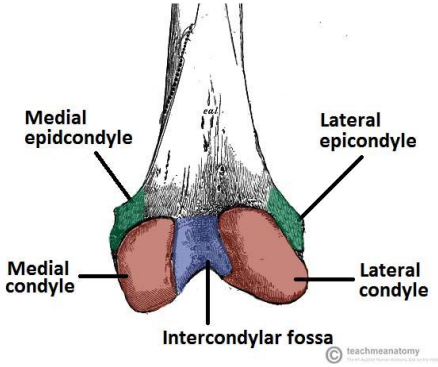
- It is considered a long bone and is the longest bone in the body.
- The main function of the femur is to transmit forces from the tibia to the hip joint.
- It acts as the site of origin and attachment of many muscles and ligaments,
- It can be divided into three areas; proximal, shaft and distal.

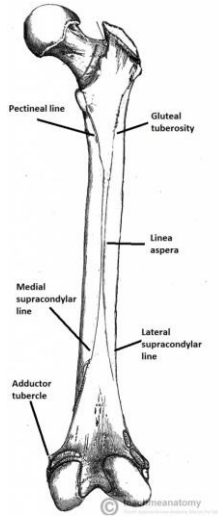


Structures

- The proximal area of the femur articulate with the hip joint with the pelvis.
  - **Head:** Articulates with the acetabulum of the pelvis to form the hip joint.
  - **Neck:** Connects the head of the femur with the shaft.
  - **Greater trochanter and lesser trochanter:** project from the anterior aspect and from the posteromedial side of the femur, respectively.
  - **Intertrochanteric line and crest:** connect the two trochanters together.
- The shaft descends in a slight medial direction.
  - On the posterior surface of the femoral shaft, there are roughened ridges of bone, these are called the linea aspera (Latin for rough line)
  - Distally, the linea aspera widens and forms the floor of the popliteal fossa, the medial and lateral borders form the medial and lateral supracondylar lines.
- The distal end is characterized by the presence of the medial and lateral condyles, which articulate with the tibia and patella, forming the knee joint.
  - **Medial and lateral condyles:** Rounded areas at the end of the femur.
  - **Medial and lateral epicondyles:** The area of attachment of some muscles and the collateral ligaments of the knee joint.
  - **Intercondylar fossa:** A depression found on the posterior surface of the femur.
  - **Facets:** For attachment of the anterior and posterior cruciate ligament.







Fracture of Femur

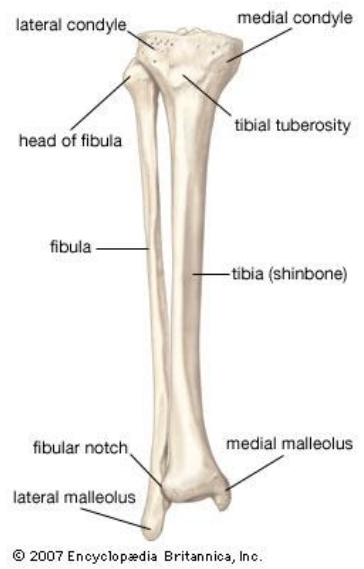
- It is a bone fracture that involves the femur.
- They are typically sustained in high-impact trauma, such as car crashes, due to the large amount of force needed to break the bone.
- Fractures of the diaphysis, or middle of the femur, are managed differently from those at the head, neck, and trochanter.
- The fracture may be classed as open, which occurs when the bone fragments protrude through the skin, or there is an overlying wound which penetrates to the bone.
- These types of fracture cause more damage to the surrounding tissue, are less likely to heal properly, and are at much greater risk of infection.

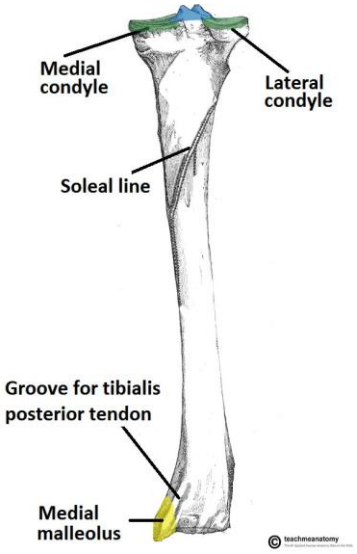
The Legs

- Formed of two bones:
  - The **Tibia** is the medial bone.
    - The tibia is the main bone of the leg, forming what is more commonly known as the shin.
    - It expands at the proximal and distal ends, articulating at the knee and ankle joints respectively.
    - It is the second largest bone in the body, this is due to its function as a weight bearing structure.
  - The **Fibula** is the lateral bone.
    - The fibula is found laterally to the tibia and is much thinner.
    - Since it does not articulate with the femur at the knee joint, its main function is to act as an attachment for muscles, and not as a weight bearer.

The Tibia

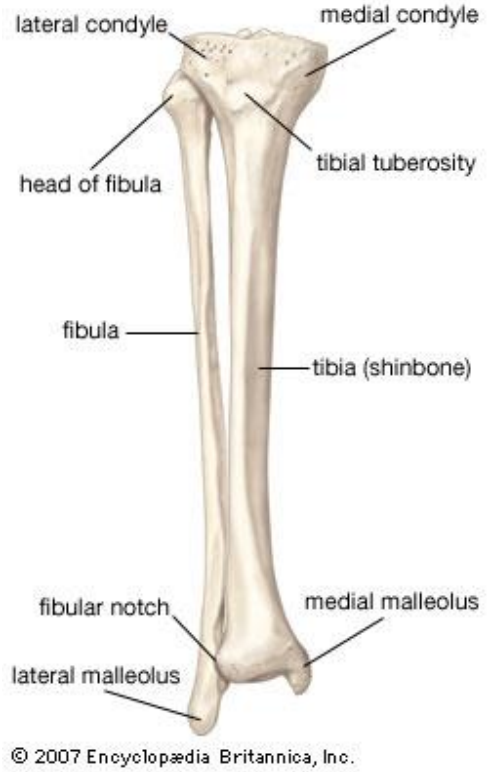
- At the **proximal end**, the tibia is widened by the medial and lateral condyles, aiding in weight bearing.
  - The condyles form a flat surface, known as the tibial plateau to articulates with the femoral condyles to form the major articulation of the knee joint.
  - The intercondylar eminence is located between the condyles which is the main site of attachment for the ligaments and the menisci of the knee joint.
  - The tibial intercondylar tubercles fit into the intercondylar fossa of the femur.
- The **shaft** has three borders and three surfaces; anterior, posterior and lateral.
  - Anterior border is marked by the tibial tuberosity, and it is palpable down the anterior surface of the leg as the shin.
  - Posterior surface is marked by a ridge of bone called the soleal line.
  - Lateral border is known as the interosseous border, and it gives attachment to the interosseous membrane that binds the tibia and the fibula together.
- The **distal end** of the tibia is widening to help with weight bearing.
  - There is a bony projection continuing inferiorly on the medial side called the medial malleolus to articulate with the tarsal bones to form part of the ankle joint.
  - On the posterior surface of the tibia, there is a groove where the tibialis posterior muscle attaches.





The Fibula

- The **proximal end** of fibula has an enlarged head, which contains a facet for articulation with the lateral condyle of the tibia.
  - On the posterior and lateral surface of the fibular neck, the common fibular nerve can be found.
- The **shaft** has three surfaces; anterior, lateral and posterior.
  - The leg is split into three compartments, and each surface faces its respective compartment.
- The **distal end** has a lateral surface continues inferiorly and is called the lateral malleolus.
  - The lateral malleolus is more prominent than the medial malleolus, and can be palpated at the ankle on the lateral side of the leg

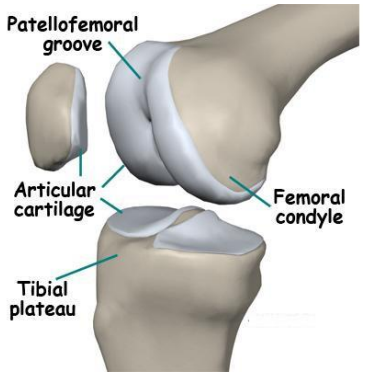


Fracture of Tibia and Fibula

- Tibia fractures are normally caused by trauma.
- Whether a sporting injury, a fall at home or a fall at work, the tibia can have a variety of complex injuries that often involve the knee and ankle as well.
- Fractures include a break to the tibia (the load bearing bone) and often the fibula (the thinner lateral bone of the lower leg).
- Fractures can be proximal (upper), mid or distal (lower).
- Full recovery takes at least a year and sometimes two.

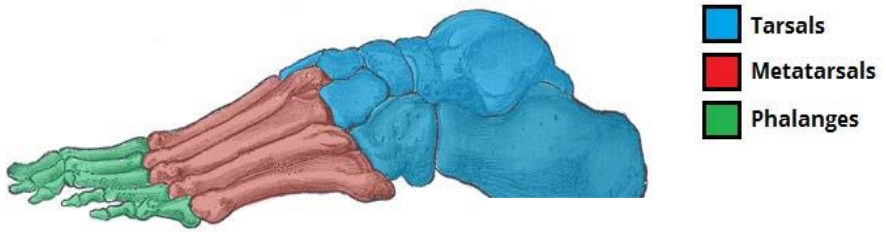
The Patella

- The patella (Kneecap) is located at the front of the knee joint, within the patellofemoral groove of the femur.
- Its superior aspect is attached to the quadriceps tendon, and inferior aspect to the patellar ligament.
- It is classified as a **sesamoid** type bone due to its position within the quadriceps tendon and is the largest sesamoid bone in the body.
- The apex of the patella is situated inferiorly and is connected to the tibial tuberosity by the patella ligament.
- The base forms the superior aspect of the bone and provides the attachment area for the quadriceps tendon.
- It has two main functions:
  - **Leg extension** to enhances the leverage that the quadriceps tendon can exert on the femur, increasing the efficiency of the muscle.
  - **Protection** to protect the anterior aspect of the knee joint from physical trauma.



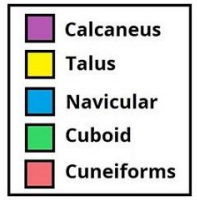
The Foot

- The skeleton of the foot consists of the:
  - **Tarsals**: there are **seven** irregularly shaped bones situated proximally in the foot, in the ankle area.
  - **Metatarsals**: There are **five** in number, and they connect the phalanges to the tarsals.
  - **Phalanges**: The bones of the toes, and each toe has three phalanges; a proximal, intermediate and distal.
    - Except the big toe, which only has two phalanges.



Tarsals

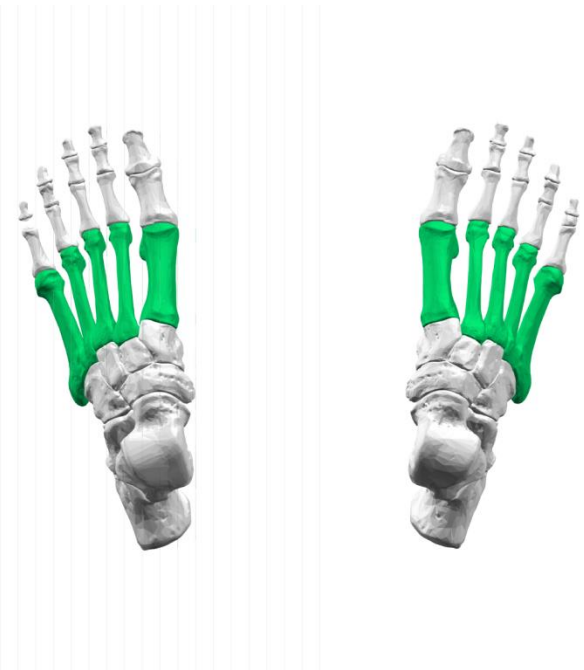
- **Proximal Group**
  - The proximal tarsal bones are the talus and the calcaneus.
  - They form the bony framework around the proximal ankle and heel area.
  - The talus is the most superior of the tarsal bones, and it has three articulations:
    - Superiorly: Ankle joint between the talus and the bones of the leg.
    - Inferiorly: Subtalar joint between the talus and calcaneus.
    - Anteriorly: Talonavicular joint between the talus and the navicular.
  - The calcaneus lies underneath the talus, and has two articulations:
    - Superiorly: Subtalar joint between the calcaneus and the talus.
    - Anteriorly: Calcaneocuboid joint between the calcaneus and the cuboid.
  - The posterior aspect of the calcaneus is marked by calcaneal tuberosity, to which the Achilles tendon attaches.



- **Intermediate Group**
  - The intermediate row of tarsal bones contains only one bone, the navicular (given the name because it is shaped like a boat) articulates with the talus posteriorly, the cuneiform bones anteriorly, and the cuboid bone laterally.
- **Distal Group**
  - There are four tarsal bones; the cuboid and the three cuneiforms, and they articulate with the metatarsals of the foot.
  - The cuboid is the most lateral bone in the distal row, and it articulate with the calcaneus posteriorly, and two metatarsals anteriorly.
  - The three cuneiforms (lateral, intermediate and medial) are wedge shaped bones, and they articulate with the navicular posteriorly, and the metatarsals anteriorly.

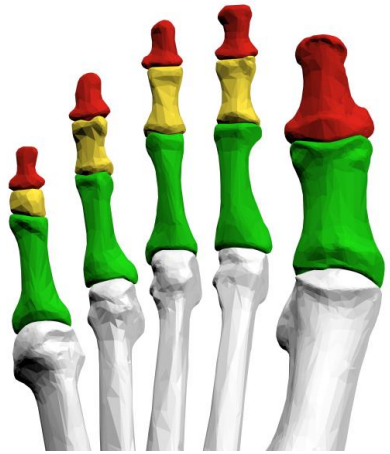
Metatarsals

- The metatarsals are located in the midfoot, between the tarsals and phalanges.
- They are numbered I-V (medial to lateral).
- Each metatarsal has a similar structure.
- They consist of a distal head and proximal base, which are joined by a shaft of bone. They have three or four articulations:
  - **Proximally**: Tarsometatarsal joint between the metatarsal bases and the cuneiforms or cuboid bones.
  - **Laterally**: Intermetatarsal joint(s) between the metatarsal and the adjacent metatarsals.
  - **Distally**: Metatarsophalangeal joint between the metatarsal head and the proximal phalanx.



Phalanges

- The phalanges are the bones of the toes.
- Most toes have three phalanges; proximal, intermediate and distal.
- The great toe only has proximal and distal phalanges.
- Each phalanx consists of a body, a proximal extremity and a distal extremity.



Questions?

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