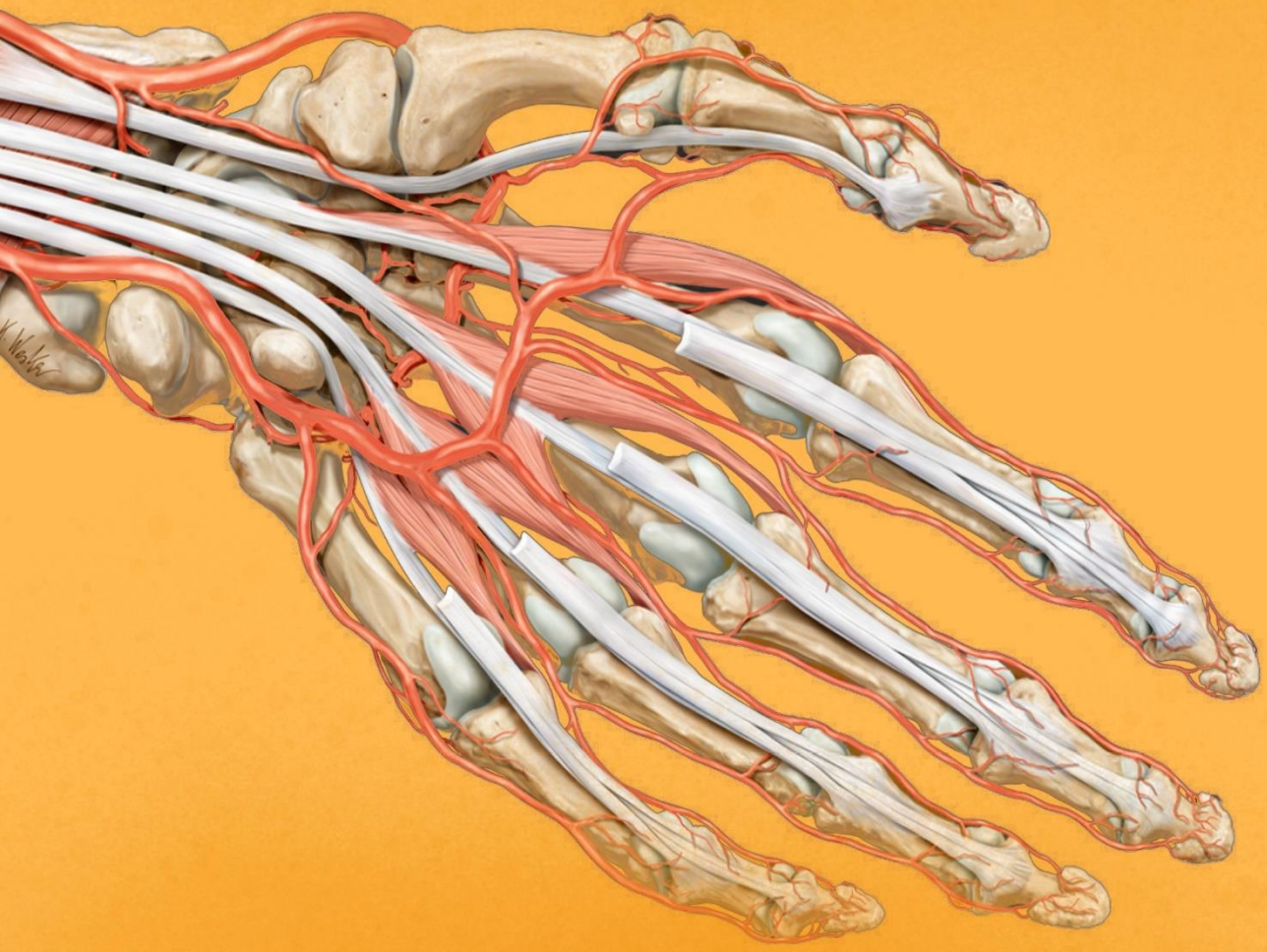
HATAHET ANATOMY



Appendicular skeleton: Upper limbs

Lecture: 3

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Lecture 2: Appendicular Skeleton: Upper Limbs

The human skeleton is composed of **206 bones**, but it is difficult to study as a whole, so anatomists came up with a classification:

❶ **Axial skeleton**, consists of 80 bones located in the midline (axis) of the body, these bones are:

A. Skull: **Cranial bones**, **Facial bones**
B. Vertebral column
C. Auditory ossicles: **Malleus**, **Incus**, **Stapes**
D. Mandible
E. Thorax: **Sternum**, **Ribs**
F. Hyoid bone

❷ **Appendicular skeleton**, consists of 126 located away from the midline (laterally), these bones are:

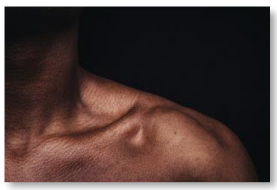
A. Upper limbs (Upper extremities): **Humerus**, **Radius**, **Ulna**, **Carpals**, **Metacarpals**, **Phalanges**
B. Lower limbs (Lower extremities): **Femur**, **Tibia**, **Fibula**, **Patella**, **Tarsals**, **Metatarsals**, **Phalanges**
C. Girdles, sets of bones that help attaching the appendicular skeleton with the axial skeleton; because upper & lower limbs are not attached directly to the axial skeleton. Girdles include:

① **Shoulder girdle (Pectoral girdle)**, attaches the upper limbs with the axial skeleton, includes: **Scapula** & **Clavicle**
② **Pelvic girdle (Hip girdle)**, attaches the lower limbs with the axial skeleton, includes: **2 Hip (Coxal) bones**

Shoulder Girdle

Clavicle (Collar bone)

General

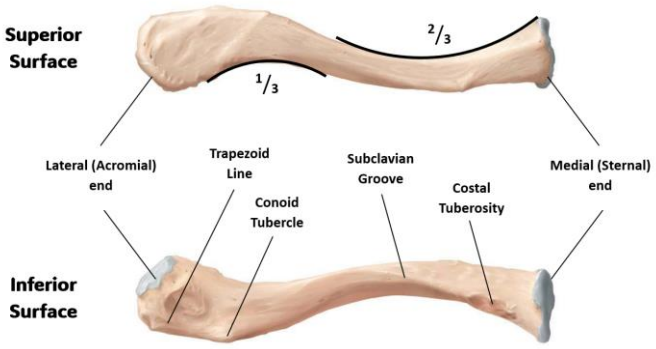


- the clavicle is a transverse, curved long bone that has an S-shape with
- it doesn't contain bone marrow
- it is the only horizontal bone in the appendicular skeleton
- clavicle is subcutaneous, which means that it can be felt under the skin by physical examination
- the first bone to ossify in the embryo skeleton, and one of the most frequent bones to break, especially in the center

Position

- located between the sternum and scapula, and superior to the 1st rib
- both clavicles are met medially at the sternum

Geometry



- has 2 borders:

① **Anterior border**
② **Posterior border**

- has 2 curves

① **Medial curve** (2/3), convex anteriorly
② **Lateral curve** (1/3), concave anteriorly

- has 2 ends:

① **Medial (Sternal) end**, squared and bulky, articulates with clavicular notch of manubrium sterni of sternum
② **Lateral (Acromial) end**, flat and it articulates with acromial process of scapula

- has 2 surfaces:

① **Superior surface**, smooth with no landmarks
② **Inferior surface**, rough, it contains attachment points for muscles and ligaments

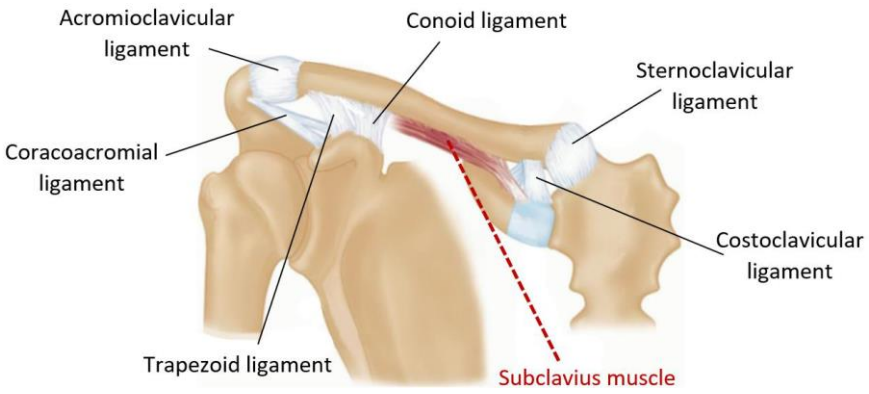
Anatomy

- **Sternal end (Medial end)**
- **Acromial end (Lateral end)**
- **Costal tuberosity**, where the ligament that attaches the clavicle with the 1st rib is located
- **Trapezoid line**, where the trapezoid ligament connects with the clavicle
- **Conoid tubercle**, where the conoid ligament connects with the clavicle
- **Subclavian groove**, runs from the costal tuberosity to conoid tubercle, serves as attachment point for the Subclavius muscle

Attachments

- **Sternoclavicular ligament**, between the medial end of clavicle and clavicular notch of manubrium sterni of sternum
- **Costoclavicular ligament**, between the costal tuberosity of clavicle and the 1st rib
- **Conoid ligament**, between conoid tubercle of clavicle and coracoid process of scapula
- **Trapezoid ligament**, between the trapezoid line of clavicle and coracoid process of scapula
- **Coracoacromial ligament**, between the coracoid process of scapula and acromial process of scapula
- **Acromioclavicular ligament**, between the lateral end of clavicle and acromial process of scapula
- **Subclavius muscle**, a small muscles that attaches to the subclavian groove of clavicle

***Note**: The only attachment of the upper limbs with the axial skeleton is in the **Sternoclavicular Joint**



Scapula (Shoulder blade)

General

- scapula is a flat, triangular-shaped bone
- it has no attachment with the axial skeleton, and is held in place only by muscles

Position

- the scapula is located between the (2nd - 7th) ribs posteriorly
- articulates with the clavicle and the humerus

Geometry

- has 2 surfaces:

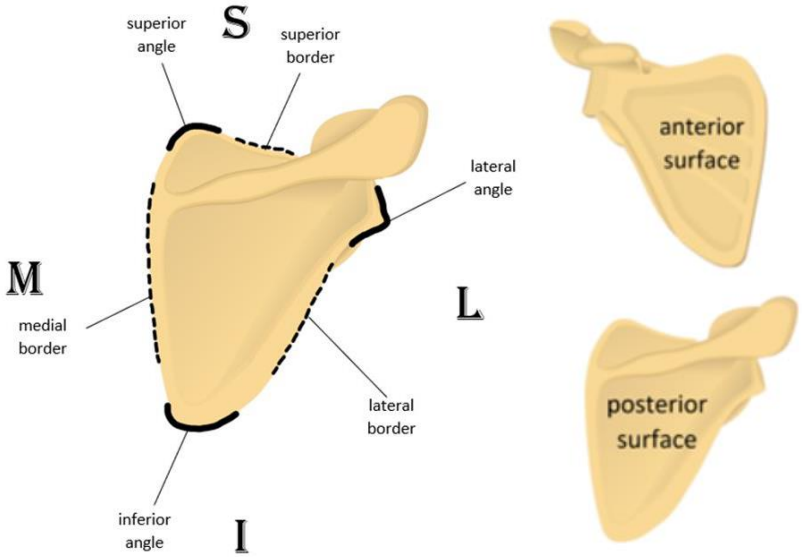
  ① **Anterior surface**
  ② **Posterior surface**

- has 3 borders:

  ① **Superior border**
  ② **Medial (Vertebral) border**
  ③ **Lateral (Axillary) border**

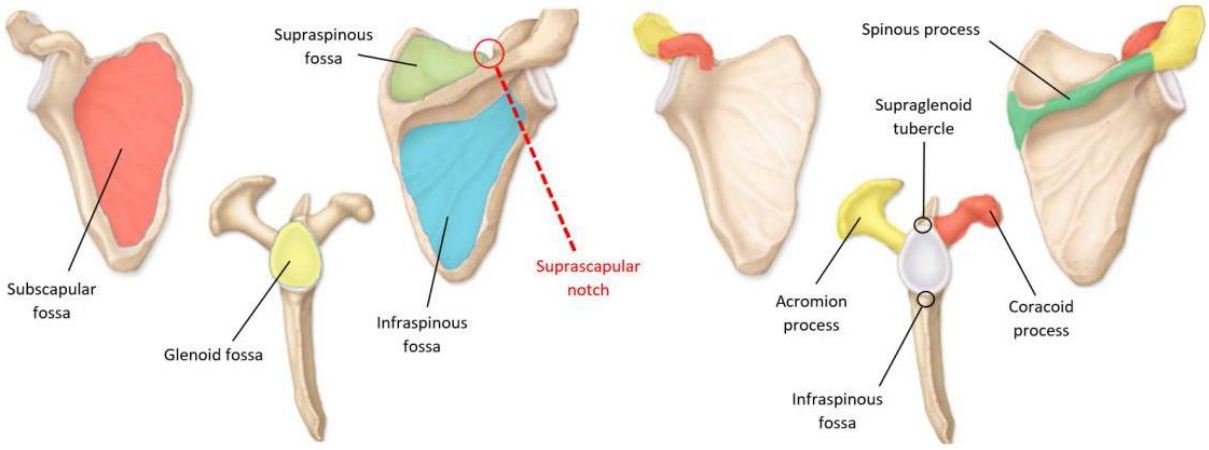
- has 3 angles:

  ① **Superior angle**, at the level of 2nd rib
  ② **Inferior angle**, at the level of 7th rib
  ③ **Lateral angle**, forms the Shoulder joint



Anatomy

- **Spinal process (Scapular spine)**, transverse process that divides the posterior surface into superior and inferior regions
- **Acromion process**, the flattened lateral end of the spinal process, **it marks the most superior point in the shoulder**
- **Coracoid process**, a beak-like process of the lateral angle of scapula
- **Subscapular (Costal) fossa**, located at the anterior surface, and described as a fossa only if looked from the lateral view
- **Infraspinous fossa**, the fossa below the spinal process
- **Supraspinous fossa**, the fossa above the spinal process
- **Glenoid fossa**, the fossa that receives the head of the humerus and forms the **Glenohumeral (Shoulder) joint**
- **Supraglenoid notch**, the notch above the glenoid fossa
- **Infraglenoid notch**, the notch below the glenoid fossa
- **Suprascapular notch**, a notch at the superior border of the scapula where the **Suprascapular nerve** passes



Free Upper Limbs

Humerus

Humerus is the long bone that forms the **Shoulder joint** proximally, and the **Elbow joint** distally

Proximal (Upper) end

- **Head**, less than half-a-sphere structure covered with hyaline cartilage, it articulates with the glenoid fossa to form the shoulder joint
- **Anatomical neck**, oblique groove distal to the head, and it is the epiphyseal plate in the humerus
- **Surgical neck**, a constriction distal to the tubercles, it is the point where humerus is commonly fractured; hence the name **"Surgical"**
- **Greater tubercle**, elevation in the lateral side of the upper end and lateral to the head. It is the most lateral point in the humerus
- **Lesser tubercle**, elevation in the anterior side of the upper end and inferior to the head
- **Intertubercular (Bicipital) sulcus**, long groove between both tubercles where a tendon of **Biceps brachii** passes

Shaft (Body)

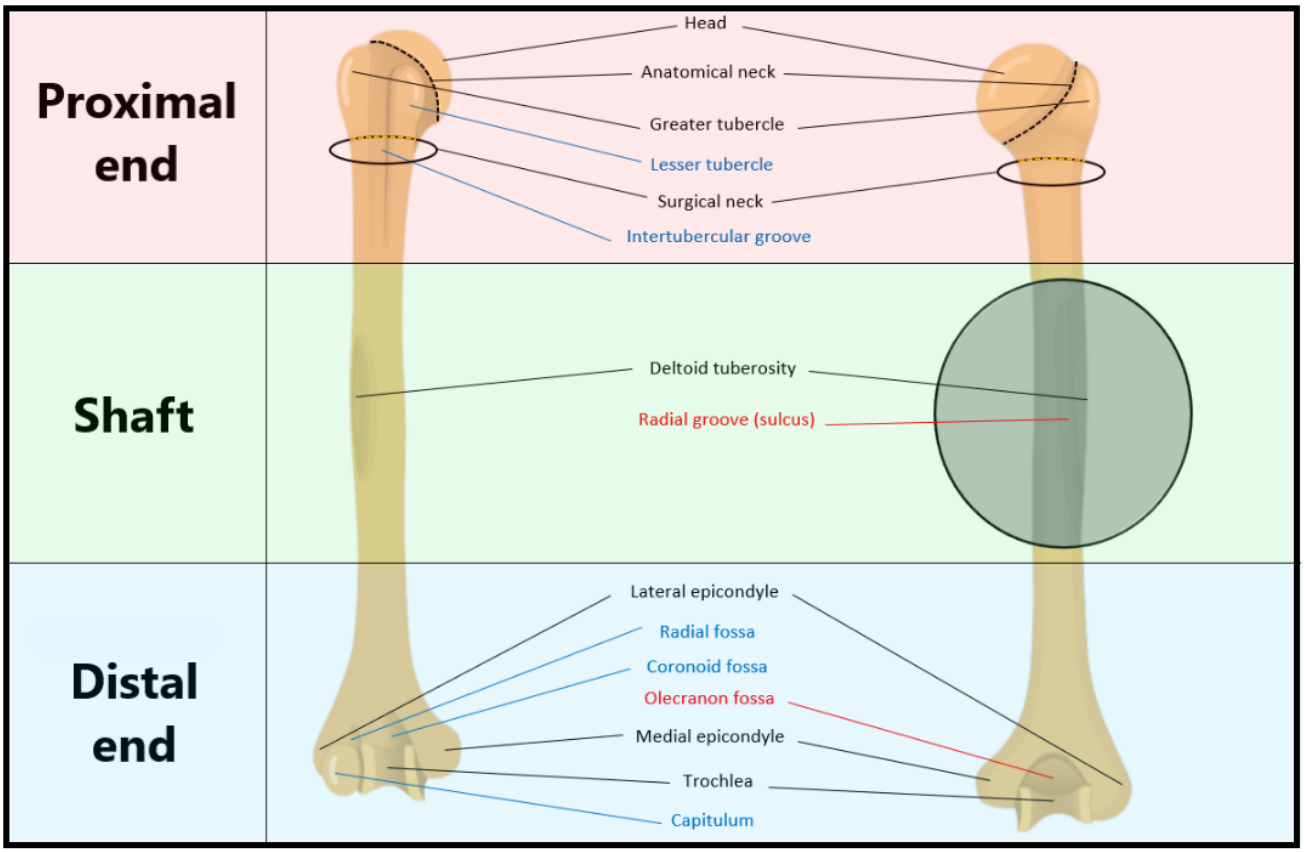
- **Deltoid tuberosity**, V-shaped elevation in the middle of the lateral part of the shaft, functions as an insertion of the **Deltoid muscle**
- **Radial groove**, groove that runs along the deltoid tuberosity and descends posteriorly, and it is where the **Radial nerve** runs through

Distal (Lower) end

- **Trochlea**, pulley-shaped (شبه البكرة) medial structure elevated in both sides of the distal end and has a depression in between
- **Capitulum**, bulky and rounded knob at the lateral side
- **Medial epicondyle**, the larger epicondyle, it is subcutaneous and can be felt in the medial side of the elbow joint. The **Ulnar nerve** passes beneath the medial epicondyle
- **Lateral epicondyle**
- **Lateral supracondylar ridge**, long elevated bony structure located laterally and above the capitulum
- **Radial fossa**, anterior depression above the capitulum
- **Coronoid fossa**, anterior depression above the trochlea
- **Olecranon fossa**, posterior depression above the condyles

For the next image:

- **Anterior only**
- **Posterior only**
- **Both sides**



Forearm bones

➢ **Ulna**, (longer) the medial bone that makes the dominant articulation with humerus, starts cylindrical and ends flat

- **Olecranon process**, sits in the olecranon fossa of humerus when we extend (straighten) our elbow. Olecranon process makes the edge of the elbow when we flex our joint
- **Coronoid process**, sits in the coronoid fossa of the humerus when we flex our elbow
- **Trochlear notch**, notch that receives the trochlea to form a part of the Elbow joint
- **Radial notch**, depression inferior to the trochlear notch, it is where the head of the radius bone will sit in
- **Intercostal crest**, sharp surface at the medial side of where the interosseus membrane attaches
- **Head**, located in the distal/inferior end and articulates with the radius at the ulnar notch
- **Styloid process**, a pen tip-like process at the distal end of the ulna

➢ **Radius**, the lateral bone that makes the dominant articulation with wrist bones, starts flat and ends cylindrical

- **Head**, has 2 parts:

  - **Disc** → articulates with the radial notch of the ulna
  - **Socket** → articulates with the capitulum of the humerus

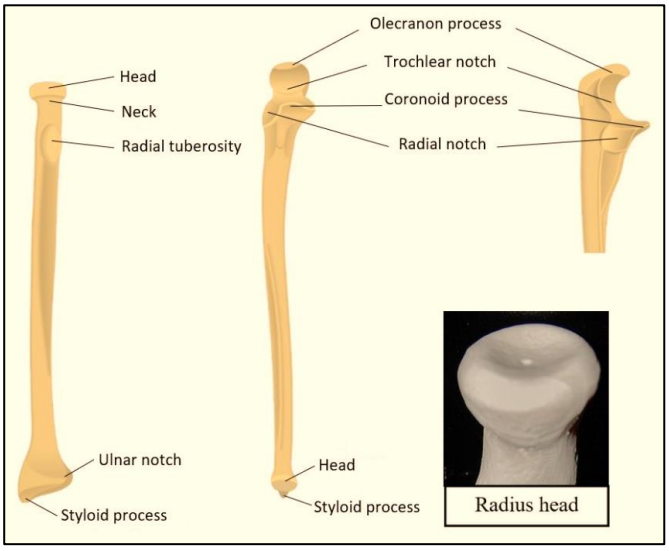
- **Neck**, small constriction below the head of the radius
- **Radial tuberosity**, oval elevation in the anterior side of the radius, serves as an attachment point for the **Biceps brachii**
- **Ulnar notch**, notch that allows the radius to pivot around the head of the ulna during pronation and supination of the forearm
- **Styloid process**, a pen tip-like process at the distal end of the radius

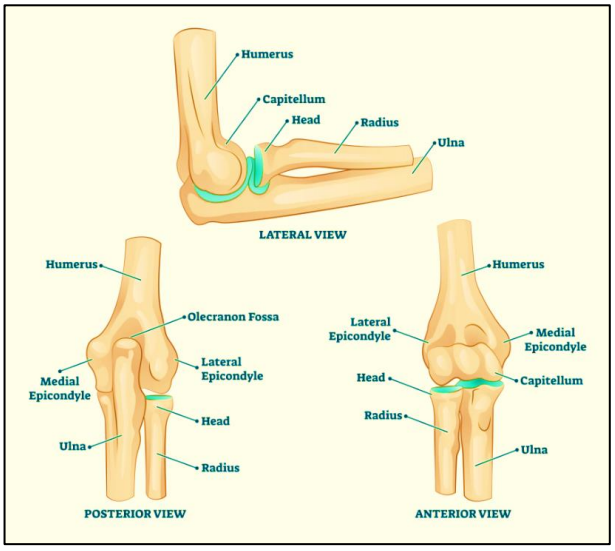
Attachments

Radius and Ulna are attached together in 3 different points:

❶ **Proximal radioulnar joint** → Head of radius + Radial notch of ulna
❷ **Distal radioulnar joint** → Head of ulna + Ulnar notch of radius
❸ **Interosseus membrane** → Shaft of radius + shaft of ulna

▪ **Interosseus membrane**: fibrous connective tissue that connects radius with ulna & tibia with fibula





***Note: Only the **Radius** articulates with 2 of the wrist bones, but the **Ulna** does NOT make any articulation with wrist bones; because it is separated from them by a **Fibrocartilage disc**

Hand bones

Carpals, these are the 8 wrist bones that has several joints between them, these bones serve to attach the hand with the forearm bones. Carpals can be divided into 2 rows, each one consists of 4 bones, which are

❶ Proximal row (lateral-to-medial):

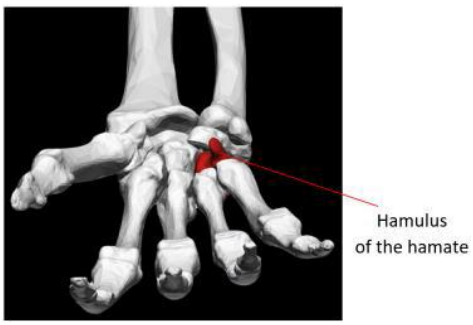
- **Scaphoid** [boat-shaped], the most frequently fractured carpal bone, articulates with the lower end of the radius
- **Lunate** [moon-shaped], articulates with the lower end of the radius
- **Triquetrum** [3 corners]
- **Pisiform** [pea-shaped]

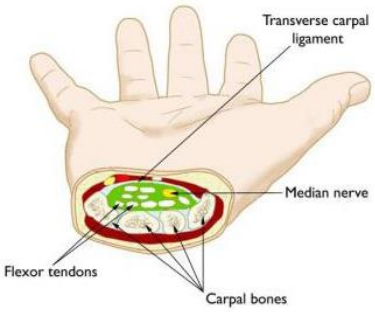
❖Mnemonic for Carpals❖

Scaphoid	Lunate	Triquetrum	Pisiform	Trapezium	Trapezoid	Capitate	Hamate
Sara	Left	The	Party	To	Take	Cathy	Home

❷ Distal row (lateral-to-medial):

- **Trapezium** [4-sided → sides are unparallel to each other], articulates with the thumb
- **Trapezoid** [4-sided → 2 sides are parallel to each other], articulates with the index
- **Capitate**, the largest carpal bone, it articulates with the middle finger
- **Hamate**, has a small hook-like process called **(Hamulus)**, it articulates with both ring and little (pinky) fingers





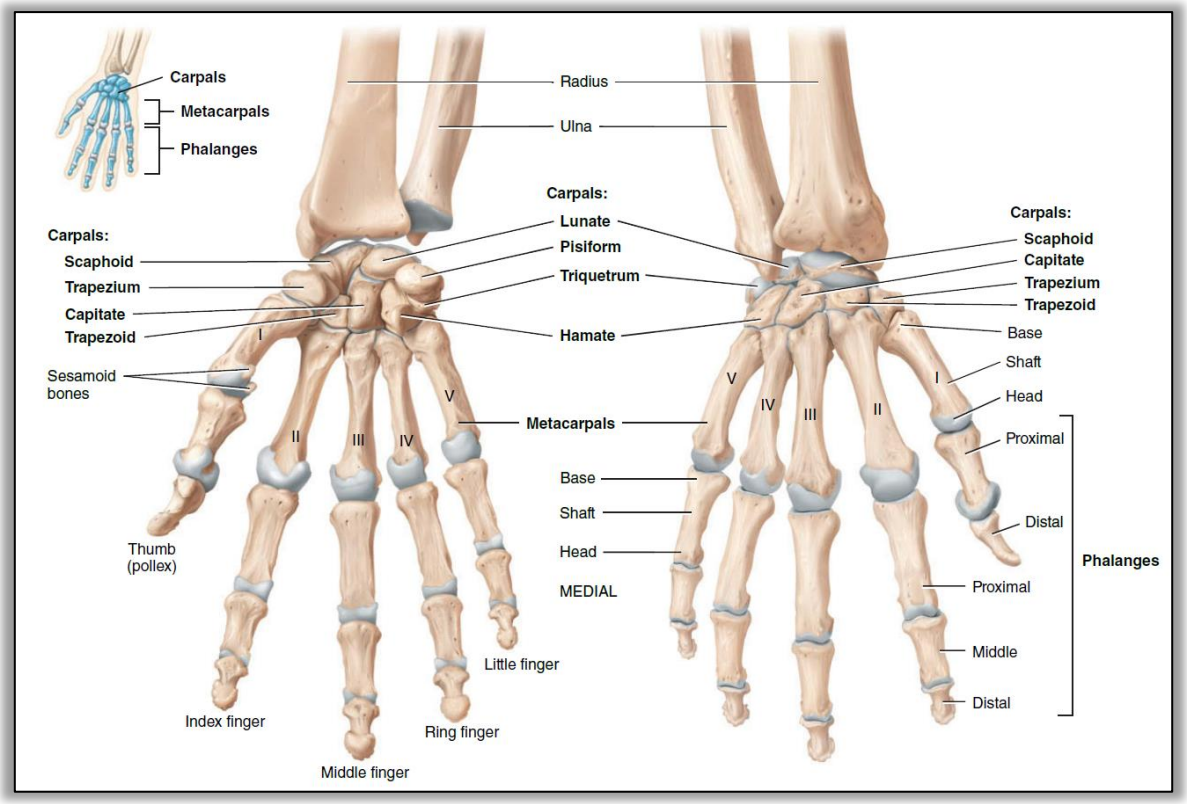
✪ **Clinical correlation: Carpal Tunnel Syndrome**

- **Carpal tunnel** is a passageway formed by the carpal bones and the transverse carpal ligament
- many structures pass through this tunnel, most importantly the **Median nerve**
- strenuous use of the forearm muscles, ex: (office jobs, bakery) will cause swelling of the tendons of these muscles
- this exerts pressure on the median nerve, causing numbness and pain in the hand
- this syndrome is managed by a simple surgical procedure called **(Carpal tunnel release)**

Metacarpals, 5 long bones that make the palm of the hand, they connect the carpals with phalanges, and each metatarsal has: **proximal base**, **shaft**, **distal head**

Phalanges, each finger contains 3 phalanges except for the thumb which lacks one phalanx, these bones are divided into 3 groups:

❶ **Proximal phalanges**
❷ **Intermediate (Middle) phalanges**, the thumb lacks an intermediate phalanx
❸ **Distal phalanges**



➢ Joints of all bones of the hand and wrist can be listed as the following:

① **Intercarpal joints** → between carpals themselves
② **Carpometacarpal joint** → between each one of carpals and their associated metacarpals
③ **Metacarpophalangeal joint** → between metacarpals and phalanges, forming the knuckles
④ **Interphalangeal joint** → between the phalanges of each finger, can be proximal or distal except for the thumb
⑤ **Radiocarpal joint** → between radius and the carpals (Scaphoid & Lunate)

***Notes:**

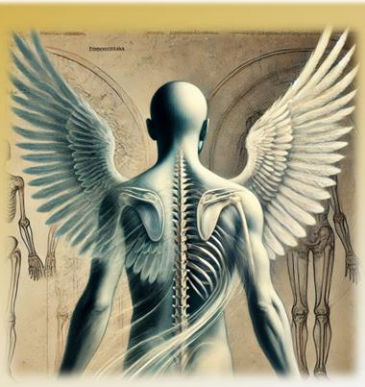
- Metacarpals of each hand can be labelled with the numbers (I-V) starting with the **thumb (I)** to the **little finger (V)**
- The thumb is called **(Pollex)** and the big toe is called **(Hallux)**

The Fallen Angle theory

Ancient European scholars once believed the **scapula** was the leftover base of wings humans had lost over time, like fallen angels or forgotten fliers.

The broad, flat shape reminded them of a bird's wing joint, fueling myths that we were once airborne.

Of course, as anatomy advanced, scientists realized the scapula's real job is: anchoring muscles for arm movement, not lost flight. But hey, at least now we know why angels in paintings always have wings sprouting from their shoulders!



Multiple Choice Questions

1) The appendicular skeleton includes which of the following?

A. Skull, Vertebral Column
B. Humerus, Radius, and Ulna
C. Sternum, Ribs
D. Auditory ossicles

Answer: B

2) Which of the following statements about the clavicle is TRUE?

A. It is the only vertical bone in the appendicular skeleton
B. It contains bone marrow
C. It is the first bone to ossify in the embryo
D. It does not articulate with the scapula

Answer: C

3) The glenoid fossa of the scapula articulates with which bone?

A. Clavicle
B. Humerus
C. Radius
D. Ulna

Answer: B

4) The medial epicondyle of the humerus is significant because:

A. It articulates with the ulna
B. The ulnar nerve passes beneath it
C. It serves as an insertion point for the deltoid muscle
D. It forms the glenohumeral joint

Answer: B

5) Which carpal bone is the most frequently fractured?

A. Lunate
B. Hamate
C. Capitate
D. Scaphoid

Answer: D

6) The coracoid process is a found on which bone?

A. Humerus
B. Radius
C. Ulna
D. Scapula

Answer: D

7) Which ligament connects the clavicle to the coracoid process of the scapula?

A. Acromioclavicular ligament
B. Costoclavicular ligament
C. Conoid ligament
D. Sternoclavicular ligament

Answer: C

8) What is the primary function of the interosseous membrane between the radius and ulna?

A. It facilitates wrist movement
B. It separates the forearm from the hand
C. It connects the shafts of the radius and ulna
D. It prevents supination and pronation

Answer: C

9) The subclavius muscle attaches to which part of the clavicle?

A. Subclavian groove
B. Acromial end
C. Sternal end
D. Conoid tubercle

Answer: A

10) Which structure of the humerus forms a pulley-like articulation with the ulna?

A. Capitulum
B. Radial groove
C. Trochlea
D. Deltoid tuberosity

Answer: C

11) Which bone does not participate in forming the wrist joint?

A. Scaphoid
B. Lunate
C. Ulna
D. Radius

Answer: C

12) The trapezoid line of the clavicle serves as an attachment site for:

A. Trapezoid ligament
B. Conoid ligament
C. Acromioclavicular ligament
D. Sternoclavicular ligament

Answer: A

13) The head of the radius articulates with which structure of the humerus?

A. Olecranon fossa
B. Trochlea
C. Capitulum
D. Medial epicondyle

Answer: C

14) The radial tuberosity serves as an attachment point for which muscle?

A. Triceps brachii
B. Deltoid
C. Biceps brachii
D. Brachioradialis

Answer: C

15) Which of the following statements is FALSE about the scapula?

A. It is a flat, triangular bone
B. It articulates directly with the axial skeleton
C. It contains the glenoid fossa
D. It is held in place by muscles

Answer: B

16) Which of the following bones is part of the distal row of carpal bones?

A. Scaphoid
B. Lunate
C. Capitate
D. Pisiform

Answer: C

17) Which part of the humerus is most commonly fractured?

A. Anatomical neck
B. Surgical neck
C. Greater tubercle
D. Lateral epicondyle

Answer: B

18) What structure passes through the suprascapular notch?

A. Radial nerve
B. Ulnar nerve
C. Median nerve
D. Suprascapular nerve

Answer: D

19) A 35-year-old office worker presents with numbness and tingling in the thumb, index, and middle fingers. He reports worsening symptoms after prolonged typing sessions. What is the most likely diagnosis?

A. Carpal Tunnel Syndrome
B. Radial nerve palsy
C. Ulnar nerve compression
D. Glenohumeral dislocation

Answer: A

20) A 22-year-old basketball player falls on an outstretched hand and experiences severe wrist pain. Imaging reveals a fracture in one of the carpal bones. Which bone is most commonly and likely to be affected?

A. Capitate
B. Hamate
C. Scaphoid
D. Pisiform

Answer: C