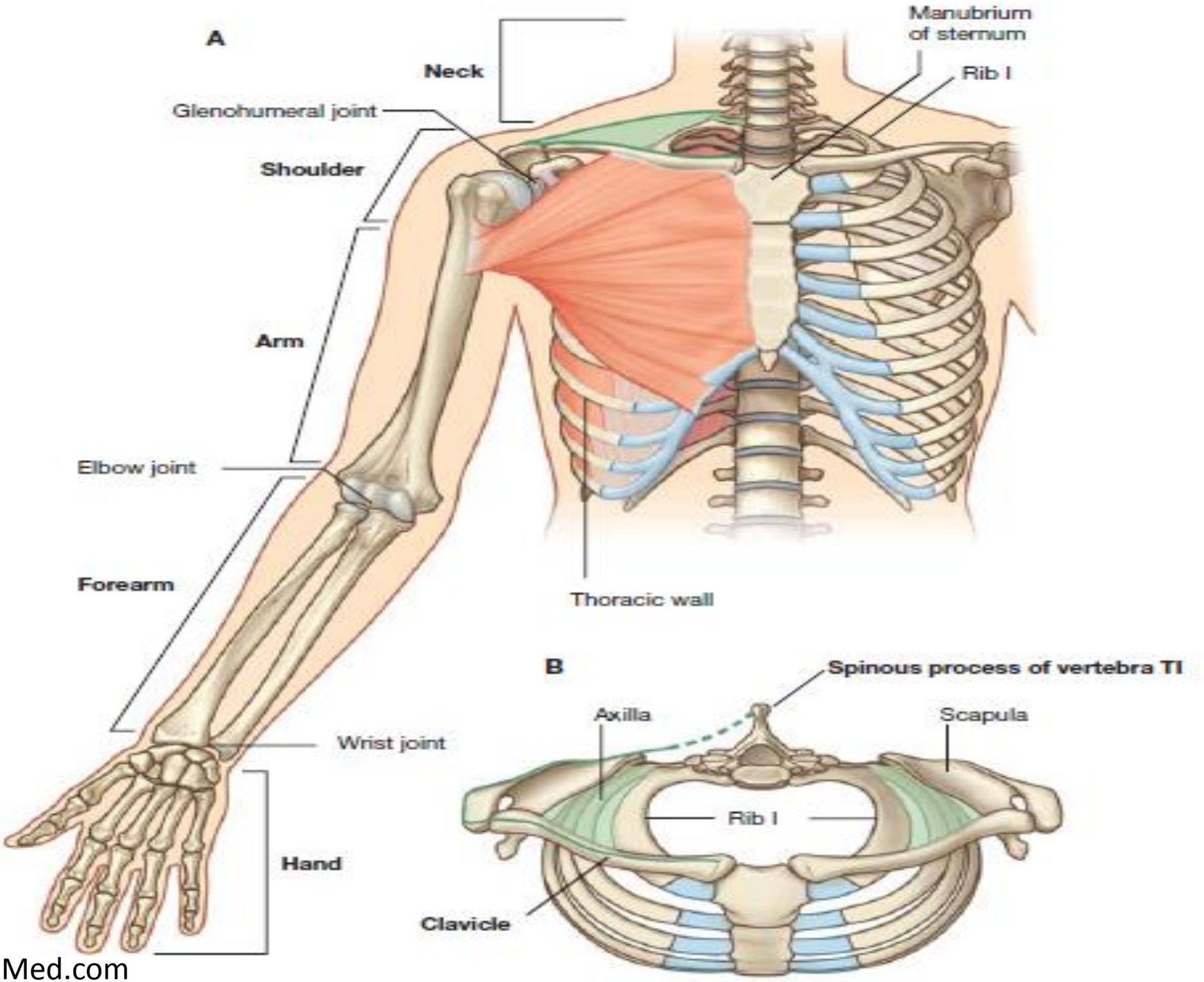
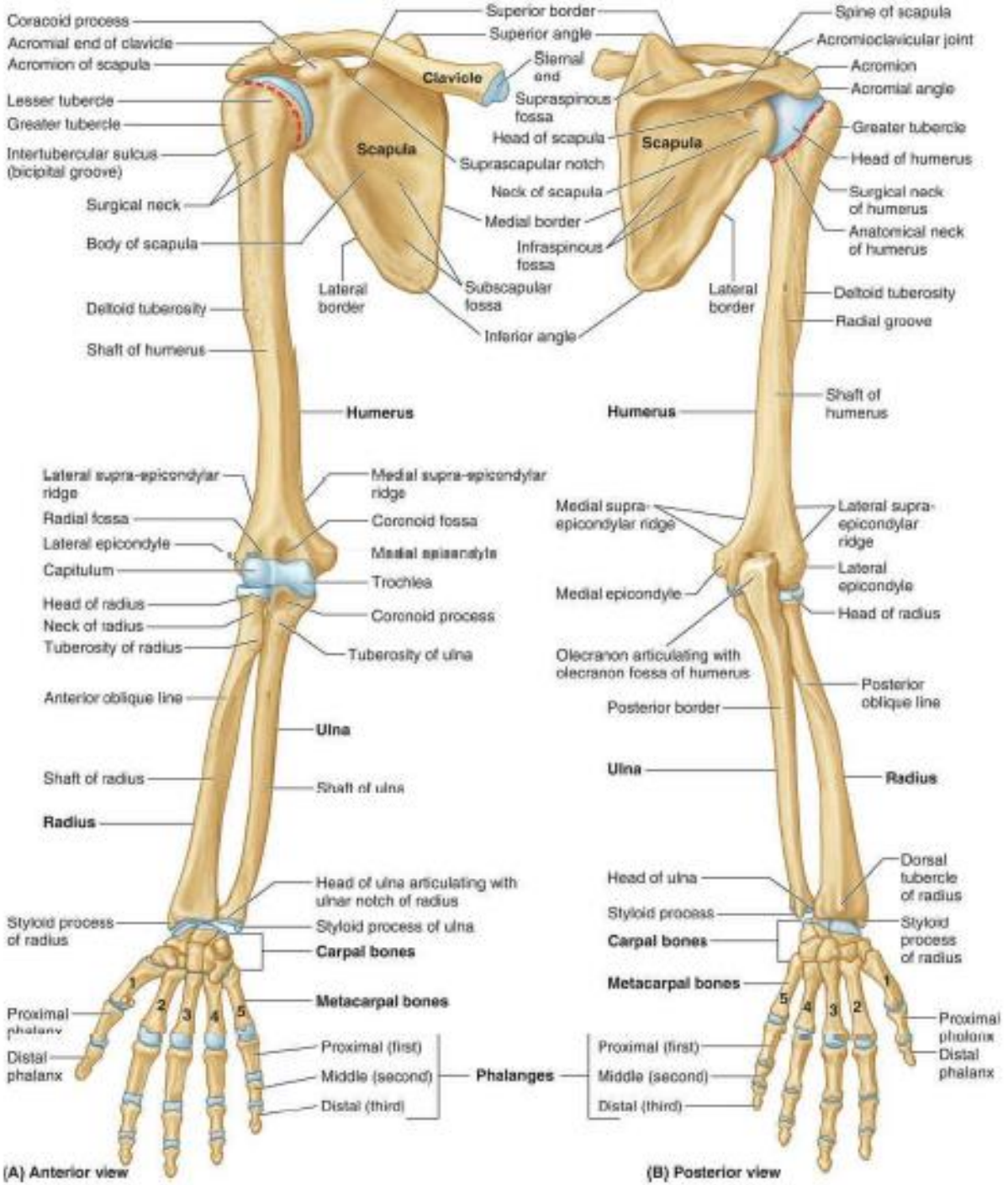
The Upper limb

Parts of the upper limb

The upper limb can be divided into the following four parts, they are:

1) Shoulder
2) Arm or brachium
3) Forearm or ante-brachium
4) Hand





Shoulder Region

- The shoulder region includes:

(a) Axilla or armpit,

(b) Scapular region or parts around the scapula (shoulder blade), and

(c) Pectoral or breast region on the front of the chest.

The bones of the shoulder region are:

(a) Clavicle (collar bone) and

(b) The scapula (shoulder blade).

- These bones are articulate with each other at the **acromioclavicular joint** and form the **shoulder girdle**.
- The shoulder girdle articulates with the rest of the skeleton of the body only at the small **sternoclavicular joint.**

Arm or brachium

- It is a part of the upper limb between the shoulder and elbow (or cubitus).
- The bone of the arm is humerus, which articulates with the scapula at the shoulder joint and upper ends of radius and ulna bones at the elbow joint.

Forearm or Ante-brachium

- It is a part of the upper limb between the elbow and the wrist.
- The bones of the forearm are radius and ulna.
- These bones articulate with the lower end of the humerus at the elbow joint and with each other forming radioulnar joints.

Hand/Manus

- The hand/manus consists of the following parts of the body, they are:

(a) wrist or carpus,

(b) Hand proper (or metacarpus), and

(c) Digits (thumb and fingers).

The wrist

- The wrist (carpus) consists of **eight carpal bones** arranged in two rows, each row consisting of four bones.

@ **S**he **L**ooks **T**o **P**retty. **T**ry **T**o **C**atch **H**er.

- **Scaphoid**, **lunate**, **triquetral**, **pisiform**, **trapezium**, **trapezoid**, **capitate**, and **hamate**.

❖The carpal bones articulate;

(a) with each other to form **intercarpal joints**,

(b) proximally with **radius** forming **radiocarpal/ wrist joint,** and

(c) distally with metacarpal bones to form **carpometacarpal joints**.

Had proper

- It consists of five metacarpal bones numbered one to five from lateral to medial side in anatomical position.
- They articulate;

(a) proximally with distal row of carpal bones forming **carpometacarpal joints**,

(b) with each other forming **intermetacarpal joints**, and

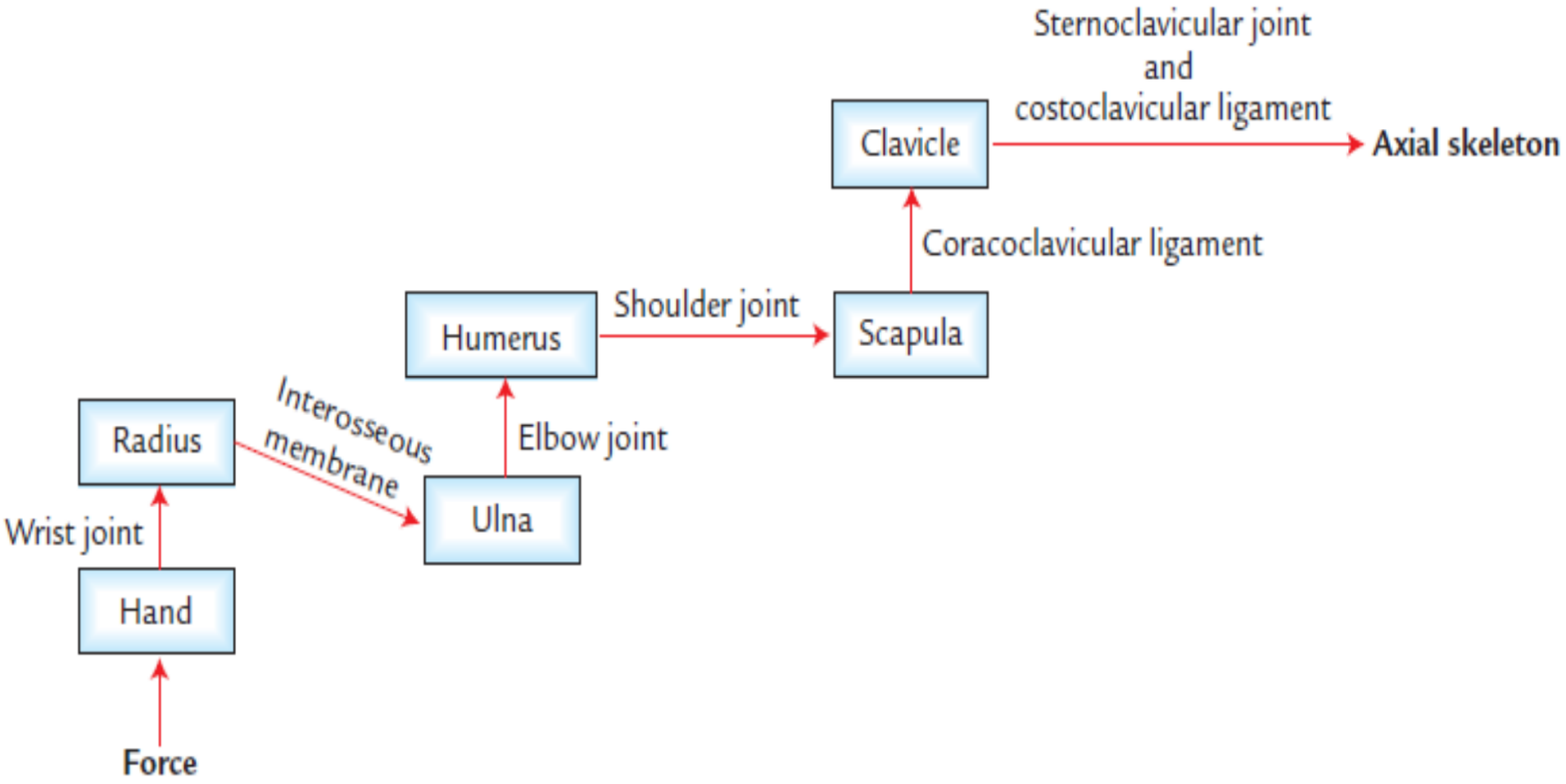
(c) distally with proximal phalanges forming **metacarpophalangeal joints**.

Digits

- The *digits* are five in number and numbered 1 to 5 from lateral to medial side.
- The first digit is called *thumb.*
- *The* remaining four digits are called *fingers*.
- Each digit is supported by three short long bones (the phalanges) except thumb, which is supported by only two phalanges.
- The phalanges form metacarpophalangeal joints with metacarpals and interphalangeal joints with one another.
- The first carpometacarpal joint has a separate joint cavity hence movements of thumb are much more free than that of any digit/finger.

Part	Subdivisions	Bones	Joints
Shoulder	• Pectoral region • Axilla • Scapular region	• Clavicle • Scapula	• Sternoclavicular • Acromioclavicular
Arm		Humerus	• Shoulder
Forearm		• Radius • Ulna	• Elbow • Radio-ulnar
Hand	• Wrist (carpus) • Hand proper (metacarpus) • Digits	• Carpal bones • Metacarpal bones • Phalanges	– Wrist/radio-carpal – Intercarpal – Carpometacarpal – Intermetacarpal – Metacarpophalangeal – Proximal and distal interphalangeal

Transmission of force in the upper limb



Flowchart: Lines of force transmission in the upper limb.

Muscle of the upper limb

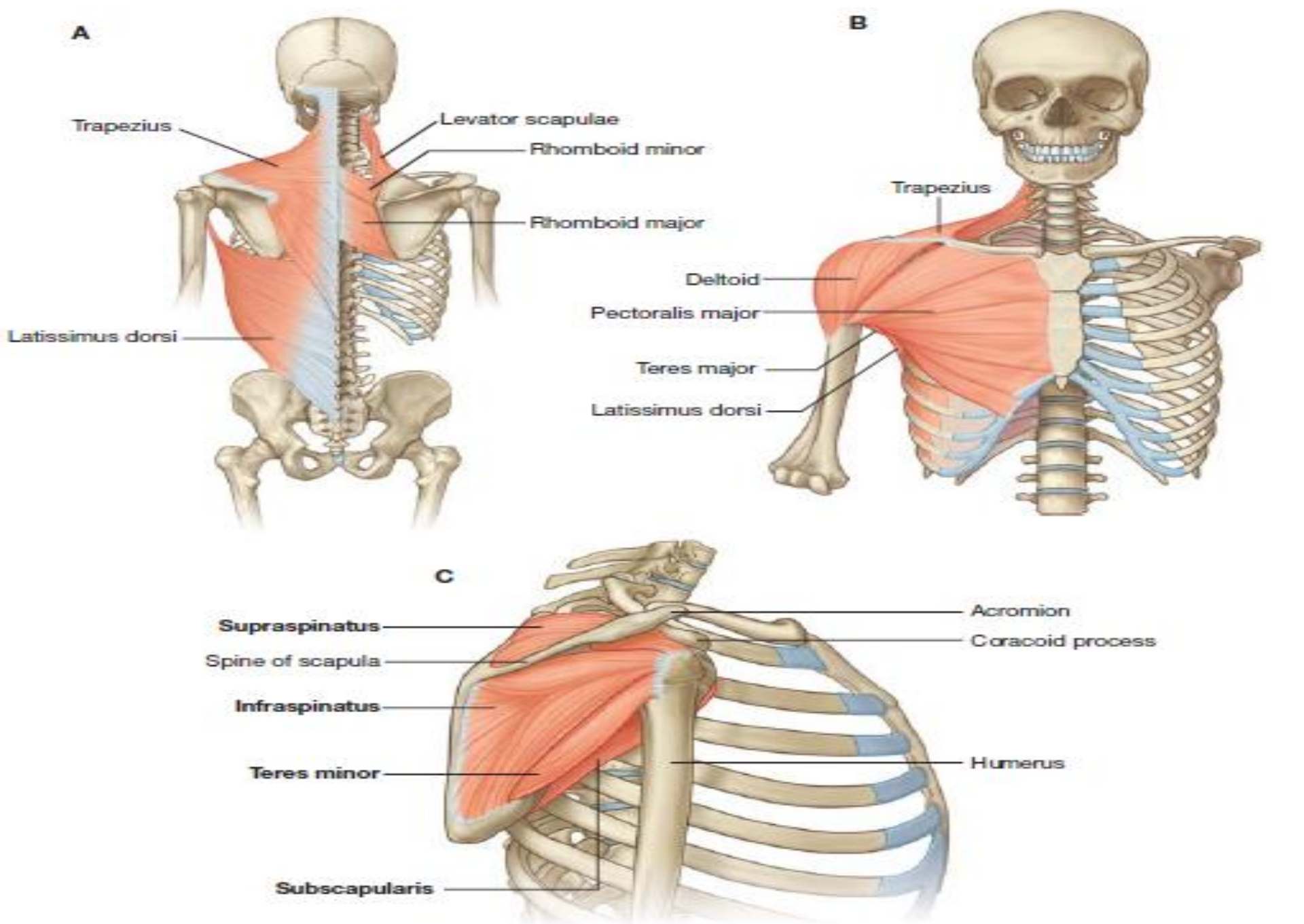
- The muscles include

(a) the muscles that attach the limb and girdle to the body and

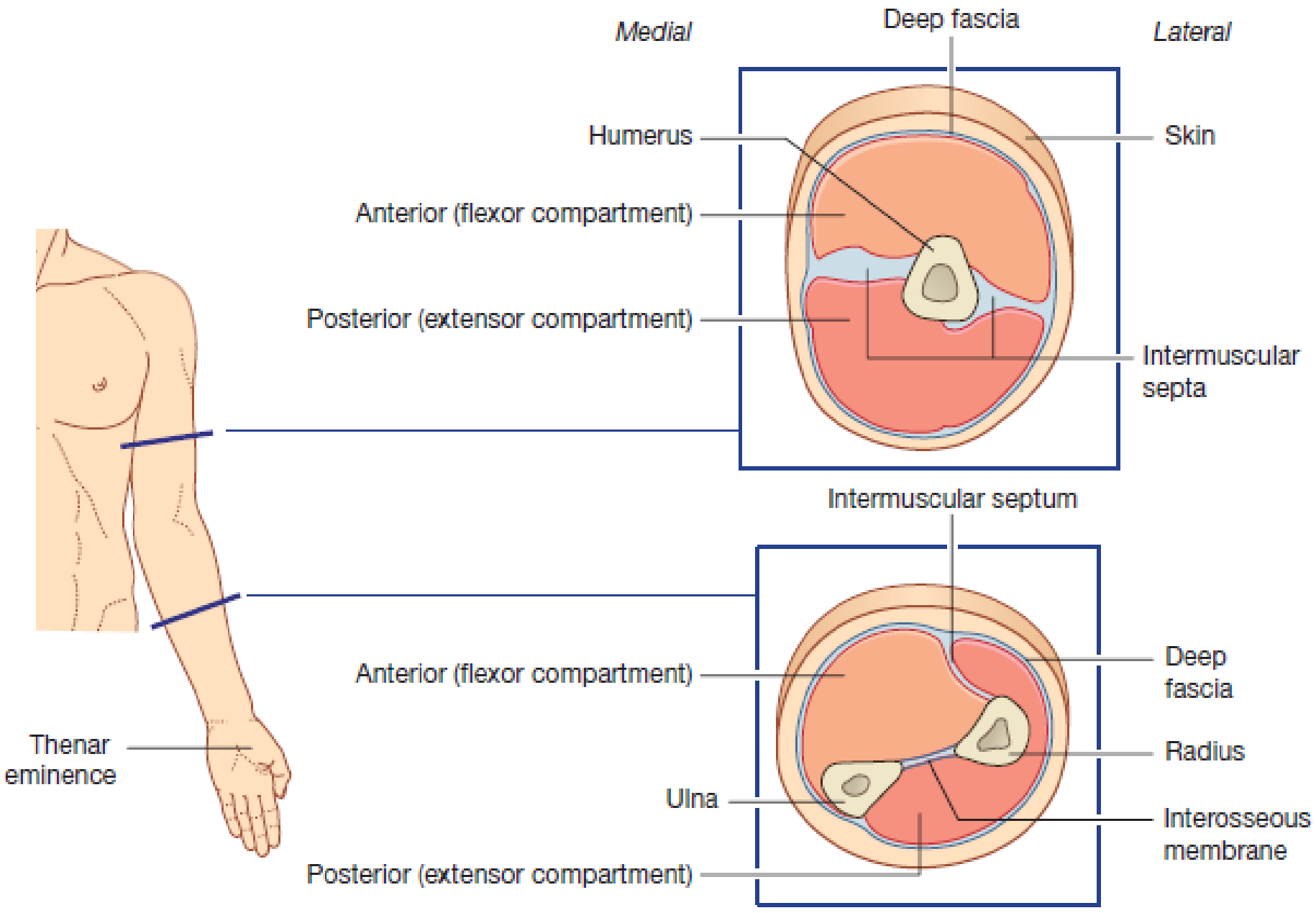
(b) the muscles of arm, forearm, and hand.

- ✓ The deltoid muscle covers the shoulder like a hood and is commonly used for **intramuscular injections**.

- ✓ The arm and forearm are invested in the deep fascia like a sleeve and are divided into anterior and posterior compartments by intermuscular septa.
- ✓ The muscles of anterior and posterior compartments mainly act synergistically to carry out specific functions.
- ✓ The muscles of anterior compartment are mainly flexors and those of posterior compartment extensors.
- ✓ The muscles of hand are responsible for its various skilled movements such as grasping, etc.



Muscles of the shoulder. **A.** Posterior shoulder. **B.** Anterior shoulder. **C.** Rotator cuff muscles.



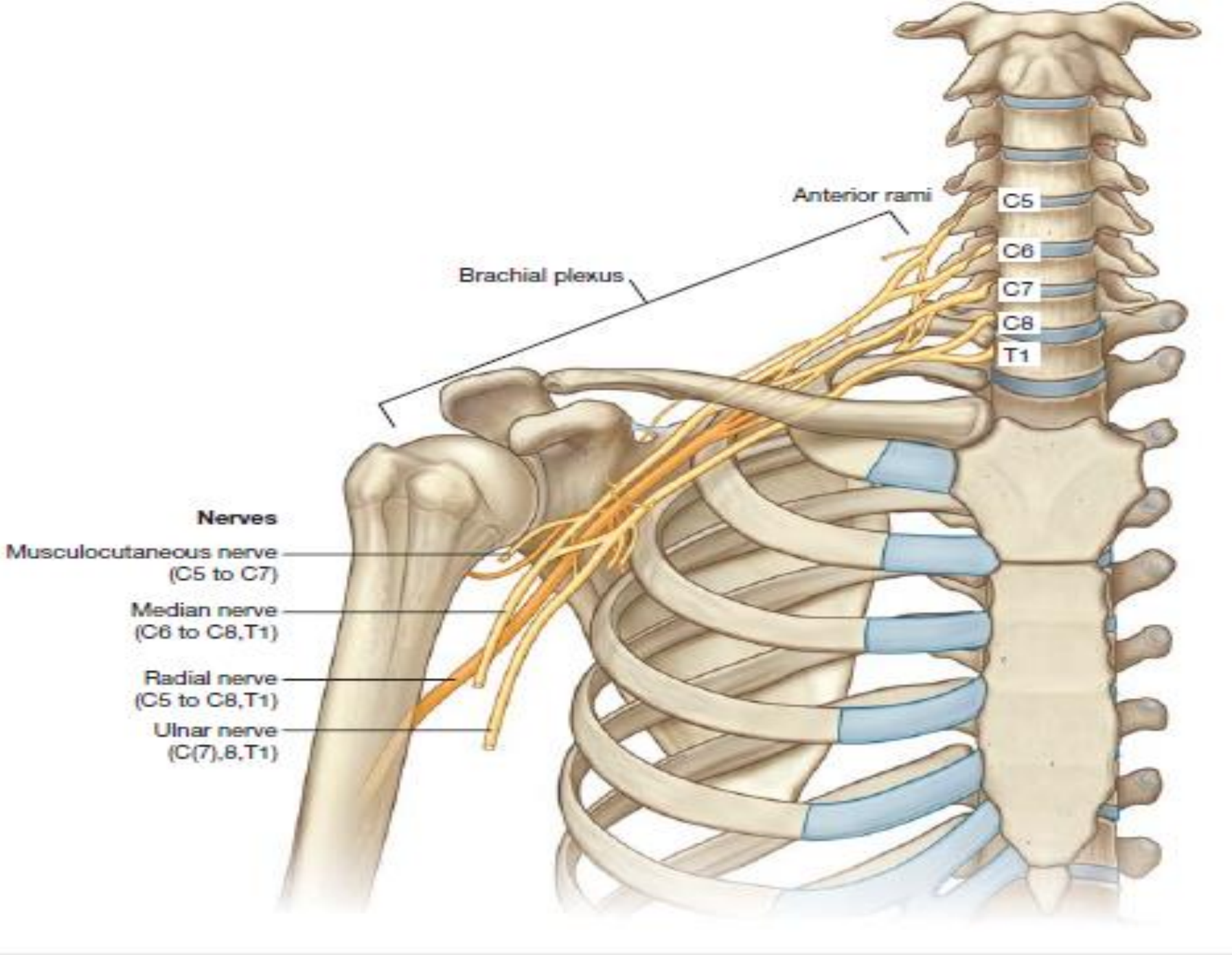
Muscle components in the arm and forearm.

Nerve supply

- The nerve supply to the upper limb is derived from the brachial plexus.
- The branchial plexus is formed by ventral rami of C5 to C8 and T1 spinal nerves.
- The five main braches of brachial plexus, they are;

1) Axillary nerve: Supplies the deltoid and Teres minor muscle.
2) Musculocutaneous nerve: Anterior (flexor) compartments of the arm and forearm.
3) Median nerve: Anterior (flexor) compartments of the arm and forearm.
4) Ulnar nerve: Anterior (flexor) compartments of the arm and forearm.
5) Radial nerve: Posterior compartments (extensor) of the arm and forearm.

N.B. All the intrinsic muscles of the hand are supplied by the ulnar nerve except muscles of thenar eminence and first two lumbricals muscle.



upper limb.

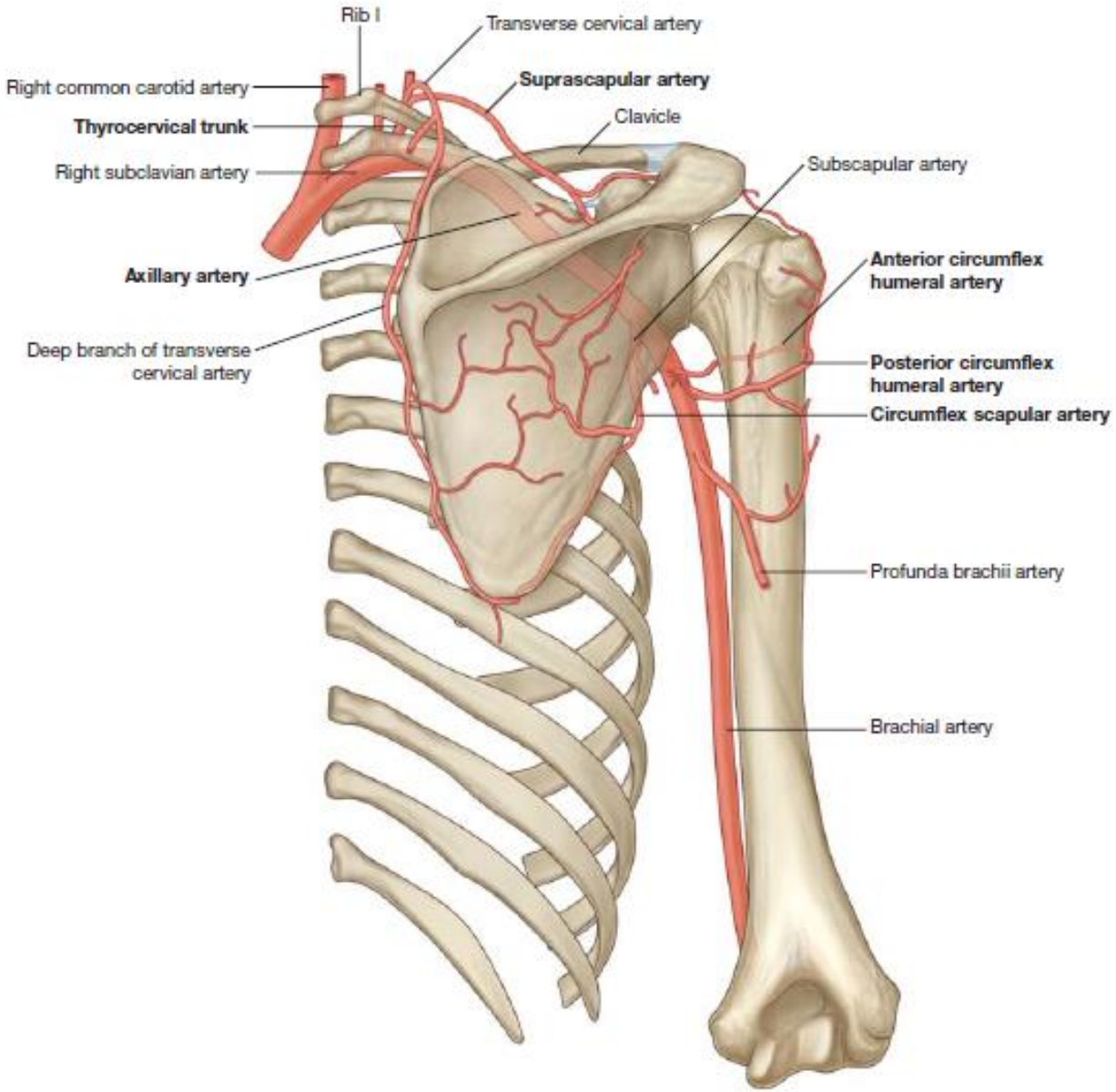
Arteries of the limb

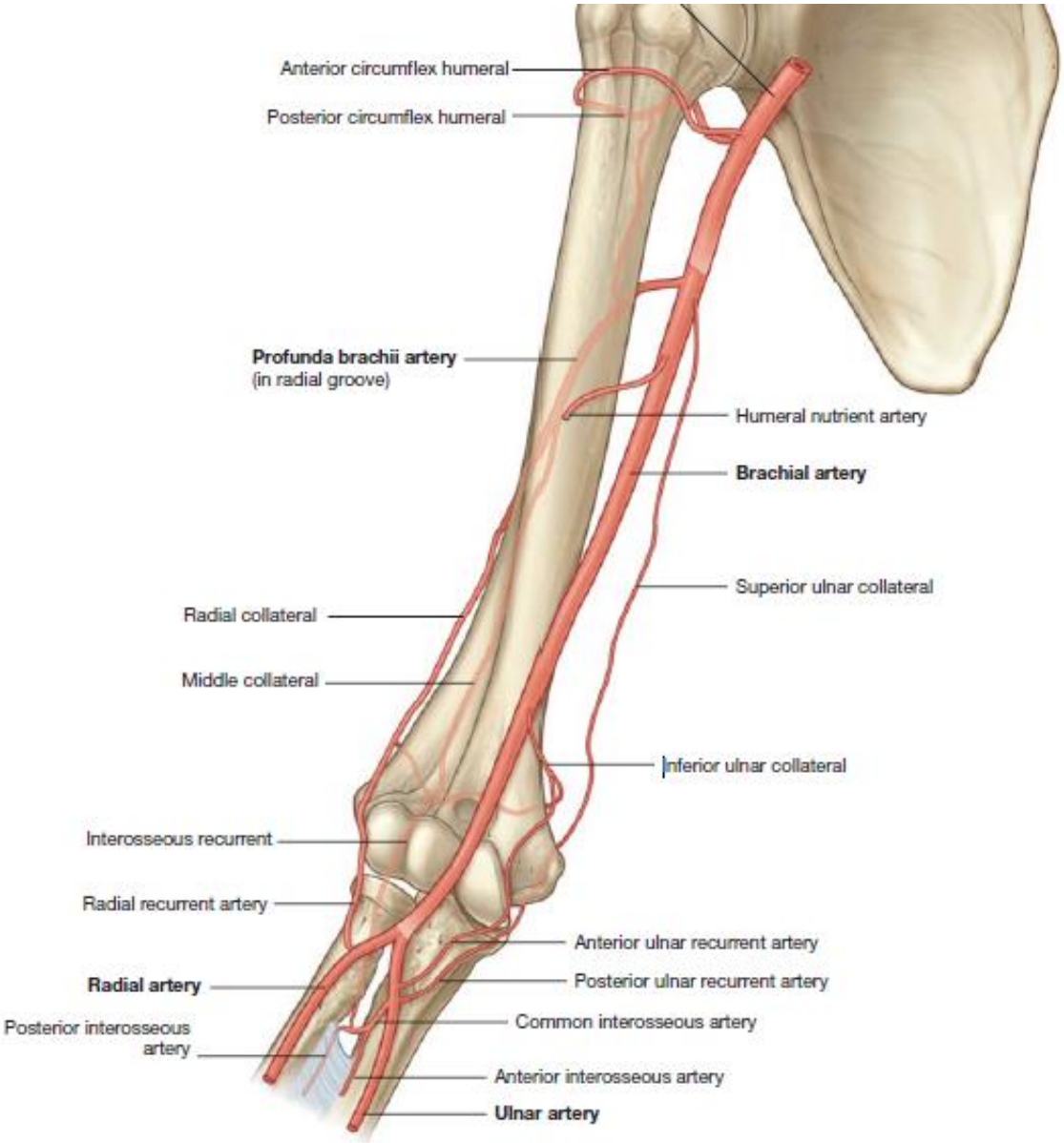
- It is supplied by four main arteries:

1) The ***axillary artery*** supplies the shoulder region.
2) The ***brachial artery*** supplies the anterior and posterior compartments of the arm.
3) The ***radial and ulnar arteries:*** It is supply the lateral and medial parts of the forearm, respectively.

Arteries of the limb

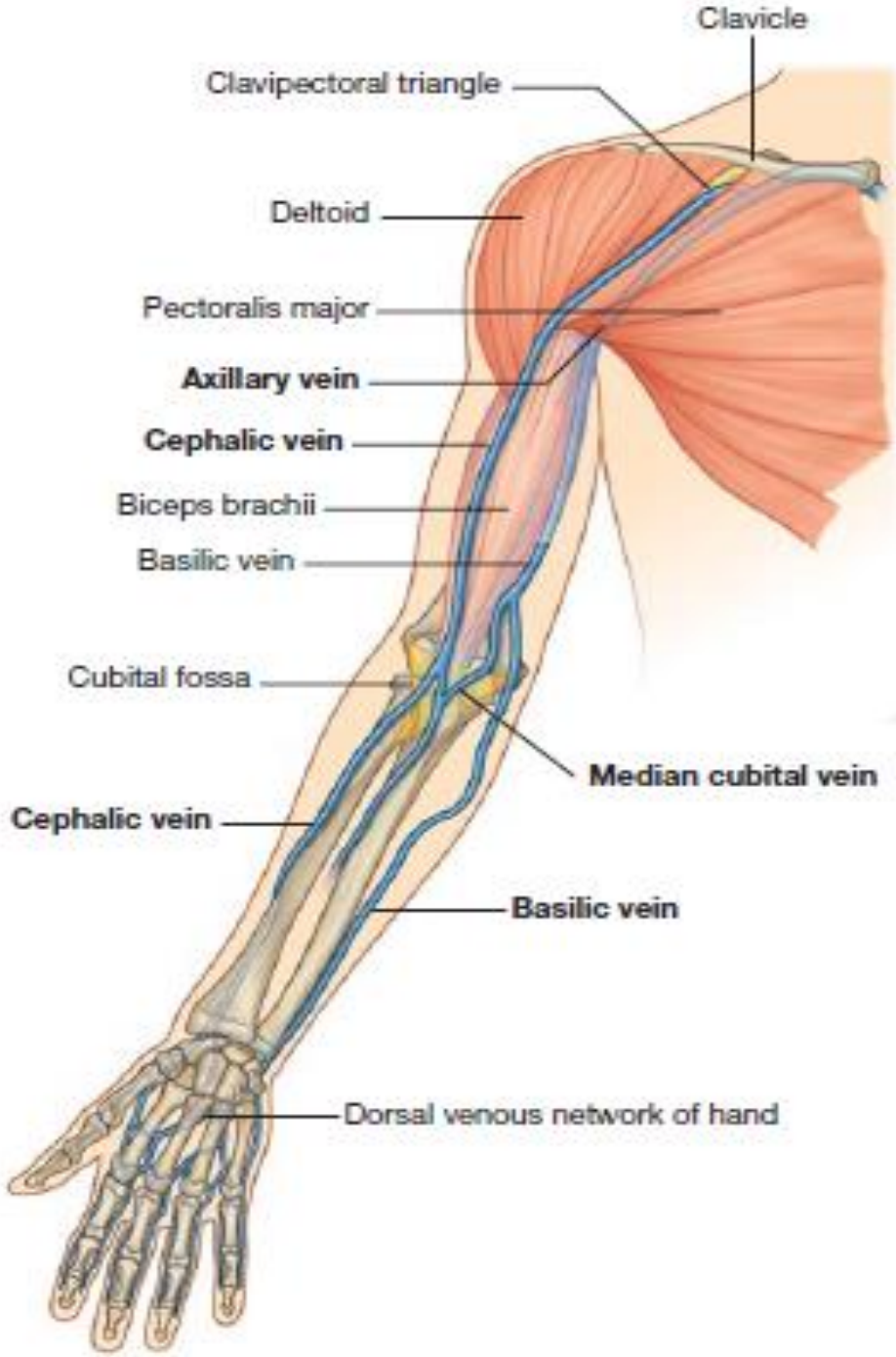
- The axillary is the continuation of subclavian artery.
- At the lower border of the teres major muscle its name is changed to brachial artery.
- The brachial artery continues down the arm and just distal to the elbow joint, it divides into radial and ulnar arteries, which follow the bones, after which they are named.
- In the hand, radial artery terminates by forming the deep palmar arch and ulnar artery terminates by forming the superficial palmar arch.





Venous drainage

- The **deep veins of the upper limb** follow the arteries and run superiorly towards the axilla, where **axillary vein** travels superiorly and becomes subclavian vein at the outer border of the 1st rib.
- The subclavian vein continues towards the root of the neck where it joins the internal jugular vein to form the **brachiocephalic vein**.
- The two **brachiocephalic veins** (right and left) join each other to form **superior vena cava**, which drains into the heart.



Venous drainage

- The **superficial veins of the upper limb** originate from the **dorsal venous arch** of the hand.
- The **lateral end of the dorsal venous arch** forms the **cephalic vein**, which runs along the lateral aspect of the upper limb and terminates into the **axillary vein** in the axilla.
- The **medial end of the dorsal venous arch** forms the **basilic vein**, which ascends along the medial aspect of the upper limb and empties into **the axillary vein** as well.
- Anterior to the elbow, the **cephalic vein** is connected to the **basilic vein** via the **median cubital vein**.

Lymphatic drainage

- The lymphatics of the upper limb originate in the hand.
- The superficial lymph vessels follow the superficial veins.
- The deep lymph vessels follow the deep arteries (viz. **radial, ulnar, and brachial**) and pass superiorly to the axilla where they drain into the **axillary lymph nodes**.

Applied anatomy

- Dislocation of shoulder joint (most commonly dislocated joint in the body), elbow joint, and lunate bone of the hand.
- Fractures of clavicle (most commonly fractured bone in the body), humerus, radius, and scaphoid.
- The scaphoid is the most commonly fractured bone of the hand.
- Nerve injuries of brachial plexus, median nerve, radial nerve, and ulnar nerve.

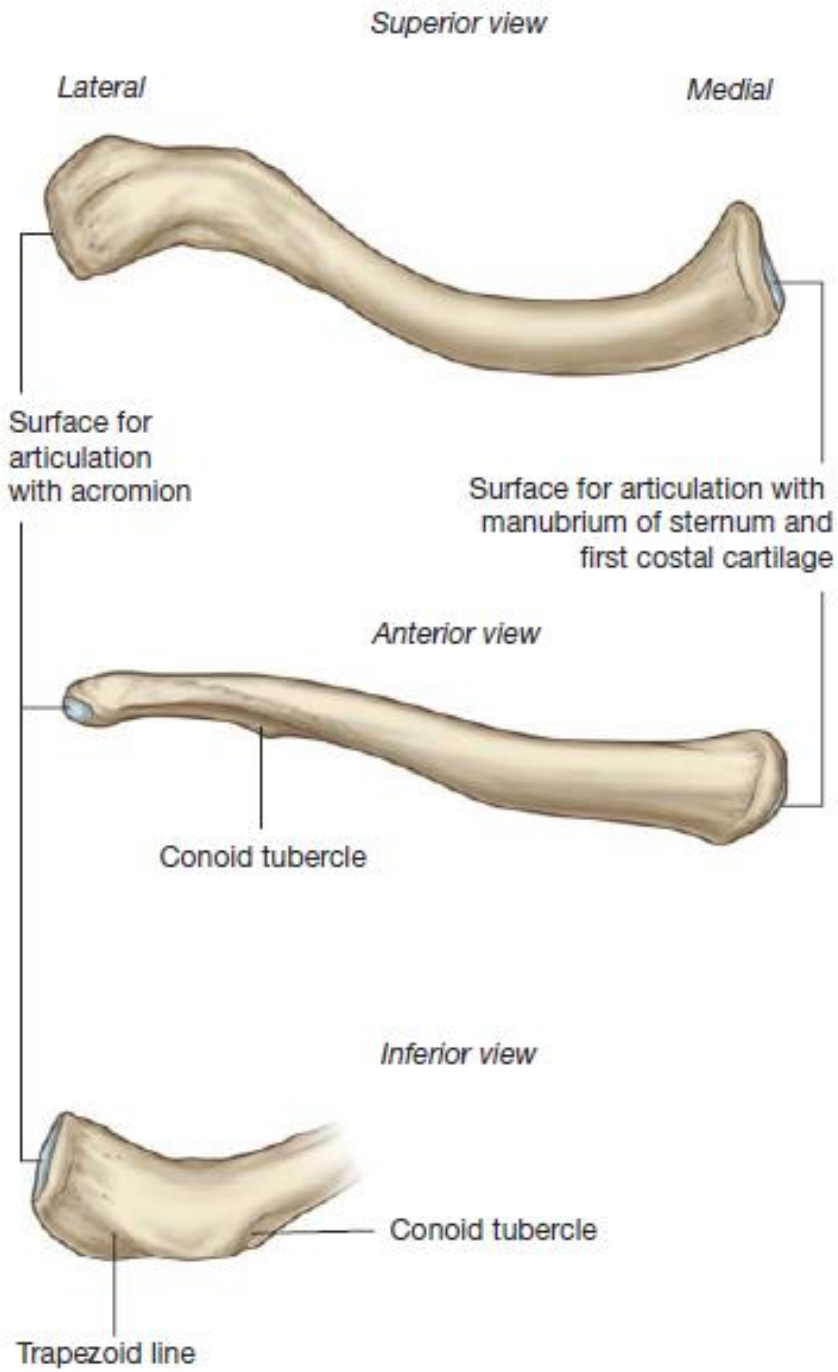
Upper limb

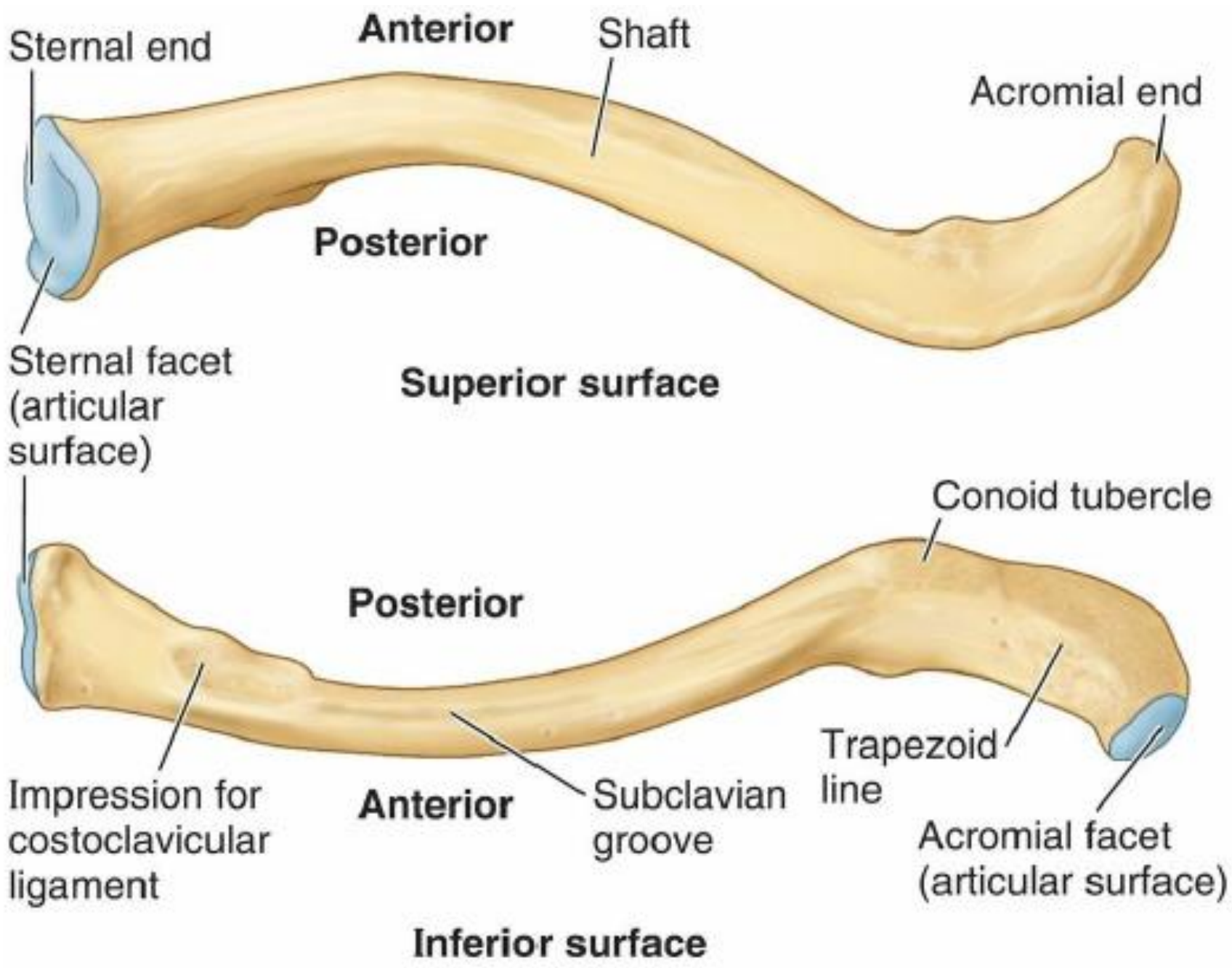
Each upper limb contains 32 bones.

- **Scapula,** the shoulder blade (1).
- **Clavicle,** the collar bone (1).
- **Humerus**, the bone of arm (1).
- **Radius and ulna**, the bones of forearm (2).
- **Carpal bones**, the bones of wrist (8).
- **Metacarpals**, the bones of hand (5).
- **Phalanges**, the bones of digits (fingers) (14).

CLAVICLE

- The clavicle (latin, Clavicle=key) or collar bone is the modified long bone, with a slight S-shaped.
- The clavicle bone is located horizontally on the anterior aspect of the body at the junction of root of the neck and trunk.
- It articulates medially with the sternum and 1st rib cartilage and laterally with the acromion process of the scapula.
- It is subcutaneous and hence it can be palpated through its entire extent. It is the only bony attachment between the trunk and upper limb.





Functions

1. It acts as a strut for holding the upper limb far from the trunk so that it can move freely. This allows free swing of the upper limb for various prehensile acts such as holding, catching, etc.
2. It transmits forces from the upper limb to the axial skeleton (sternum).
3. It provides an area for the attachment of muscles.

Some peculiarities

1. It is the only long bone which lies horizontally.
2. It has no medullary cavity.
3. It is subcutaneous throughout its extent.
4. It is the first bone to start ossifying (between the fifth and sixth week of intrauterine life) and last bone to complete its ossification (at 25 years).
5. It is the only long bone which ossifies by two primary centers.
6. It is the only long bone which ossifies in membrane except for its medial end (cf. long bones ossify in cartilage).
7. It may be pierced through and through by cutaneous nerve (intermediate supraclavicular nerve).

Parts of the clavicle

- It consists of three parts: Two ends (lateral and medial) and a shaft.

a) **Lateral (acromial) ends**:
   Flattened above downwards and articulates with medial margin of the **acromion process**.

b) **Medial (sternal) end:**
   Enlarged and quadrilateral and it articulates with the clavicular notch of the **manubrium sterni**.

Shaft:

- Curved and its medial two-third is round and convex forwards, and its lateral one-third is flattened and concave forwards.

- The inferior surface of the shaft possesses a small longitudinal groove in its middle third.

Anatomical position and side determination

The side determination of clavicle ;

-The bone is holding the bone horizontally in such a way that its flattened end is on the lateral side and its enlarged quadrilateral end is on the medial side.

-The convexity of its medial two-third and concavity of its lateral one-third face forwards with longitudinal groove in the middle third of shaft facing inferiorly.

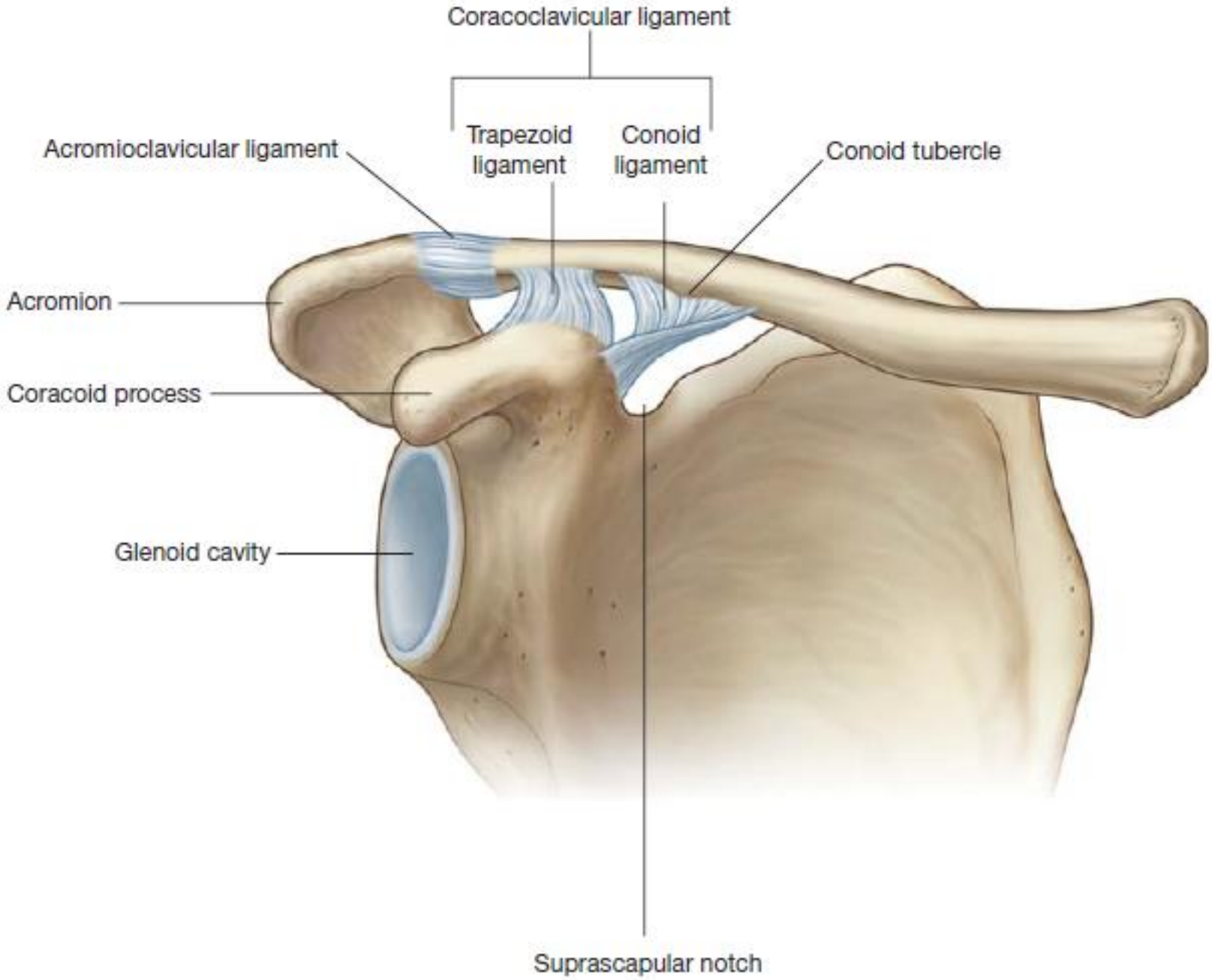
General features and attachments

Lateral End/Acromial End:

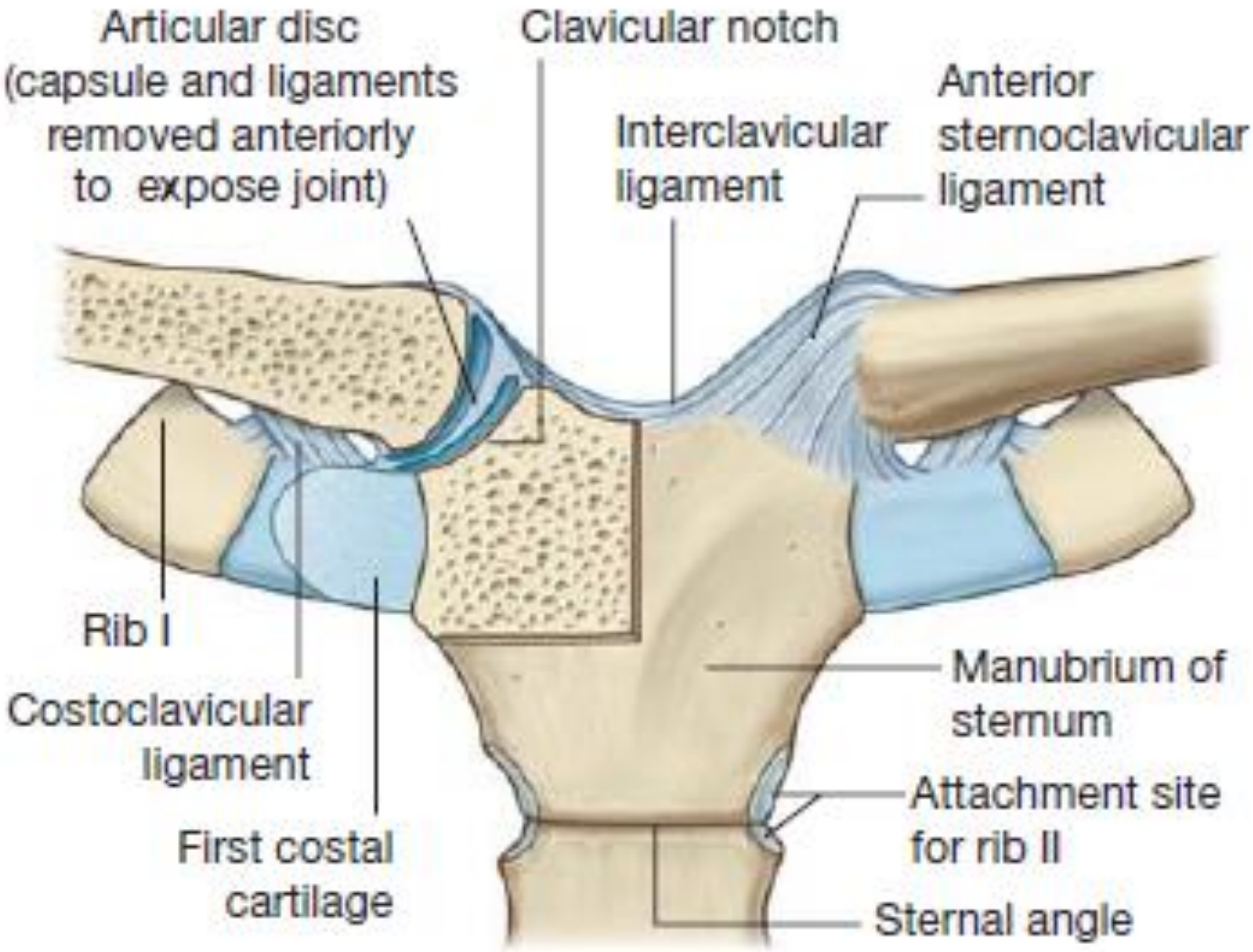
- It is flattened above downwards.
- An oval facet on this end articulates with the facet on the medial margin of the acromion to form **acromioclavicular joint**.
- The lateral end provides attachment to fibrous capsule of acromioclavicular joint.

Medial End/Sternal End:

- The enlarged medial end has a saddle-shaped articular surface, which articulates with the clavicular notch of manubrium sterni to form **sternoclavicular joint**.
- It provides attachment to (a) fibrous capsule (b) articular disc, and (c) interclavicular ligament.



Right acromioclavicular joint.



Shaft:

- The shaft of the clavicle is divided into two parts: lateral one-third and medial two-third. The medial two-third of shaft is convex forward and lateral one-third is concave forward.

Lateral One-third:

- It is flattened from above downwards. It has two surfaces, i.e., superior and inferior, and two borders, i.e., anterior and posterior.

Surfaces

1) **Superior surface:**

-It is subcutaneous between the attachments of deltoid and trapezius muscles.

2) **Inferior surface:**

-It presents a **conoid tubercle** and **trapezoid ridge, and** which provide attachments to conoid and trapezoid parts of ***coracoclavicular ligament***, respectively.

-The **conoid tubercle** is located on the inferior surface near the posterior border at the junction of the lateral one-fourth and medial three-fourth of the clavicle. The **trapezoid ridge** extends forwards and laterally from conoid tubercle.

Borders

1) Anterior border:

It is concave forwards and gives origin to deltoid muscle. A small tubercle called **deltoid tubercle** may be present on this border.

2) Posterior border:

It is convex backwards and provides insertion to the trapezius muscle.

Medial Two-third

It is cylindrical in shape and presents four surfaces: **anterior, posterior, superior, and inferior.**

1) Anterior surface:

It is convex forwards and gives origin to clavicular head of pectoralis major.

2) Posterior surface:

- It is concave backwards and gives origin to sternohyoid muscle near its medial end.
- The lateral part of this surface forms the anterior boundary of **cervico-axillary canal** and is related to the following structures:

1. Trunks of brachial plexus.
2. Third part of subclavian artery.

3) Superior surface:

The clavicular head of sternocleidomastoid muscle originates from medial half of this surface.

4) Inferior surface:

The following features:

1. **Costoclavicular ligament :** It is attached to an oval impression at its medial end.
2. ***Subclavius muscle :*** It is inserted into the subclavian groove on this surface.
3. ***Clavipectoral fascia:*** It is attached to the margins of subclavian groove.
4. ***Nutrient foramen of clavicle:*** It is located on the lateral end of the subclavian groove.

The muscles and ligaments attached to the clavicle are;

Muscles:

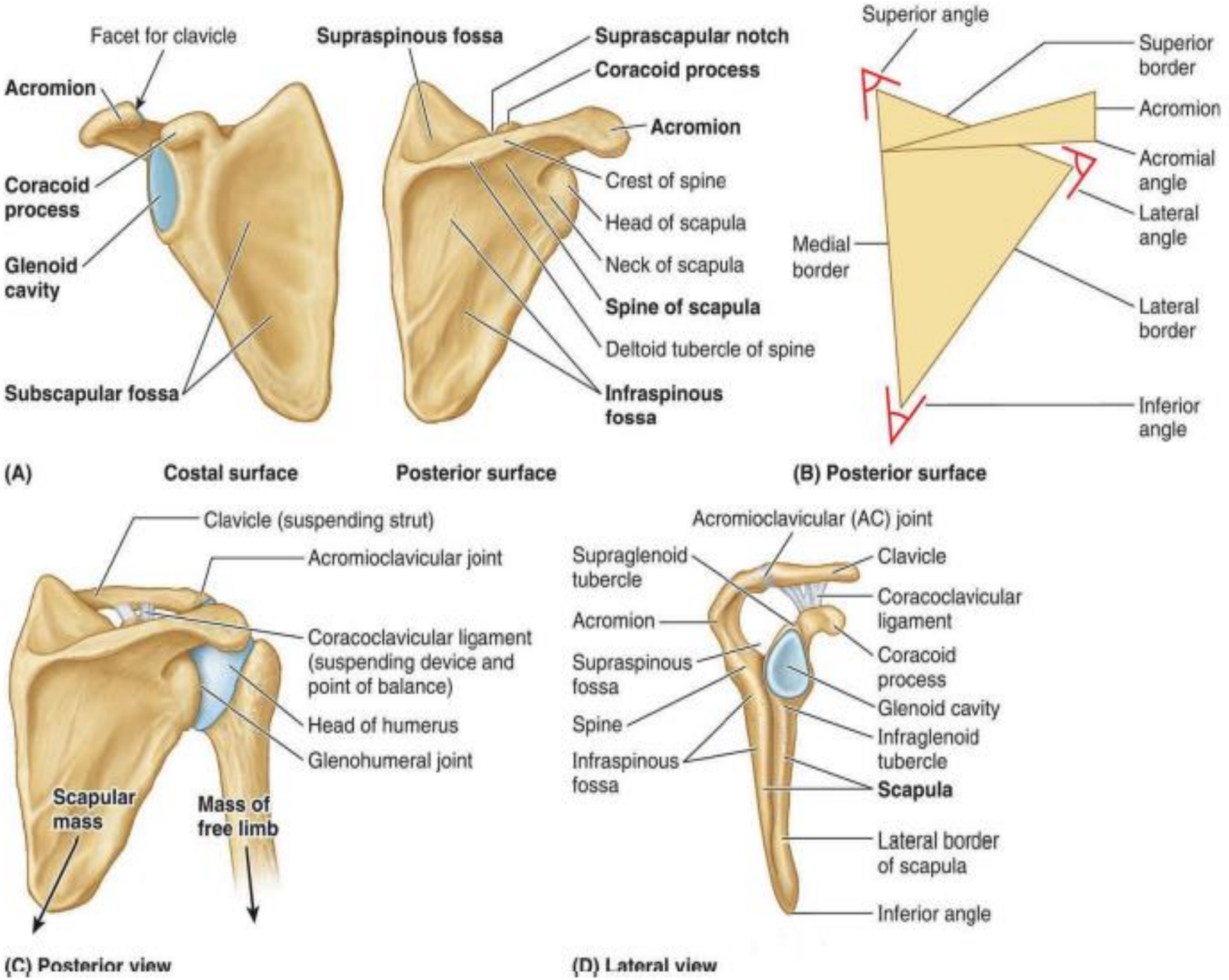
- Pectoralis major
- Sternocleidomastoid (clavicular head)
- Deltoid
- Trapezius
- Subclavius

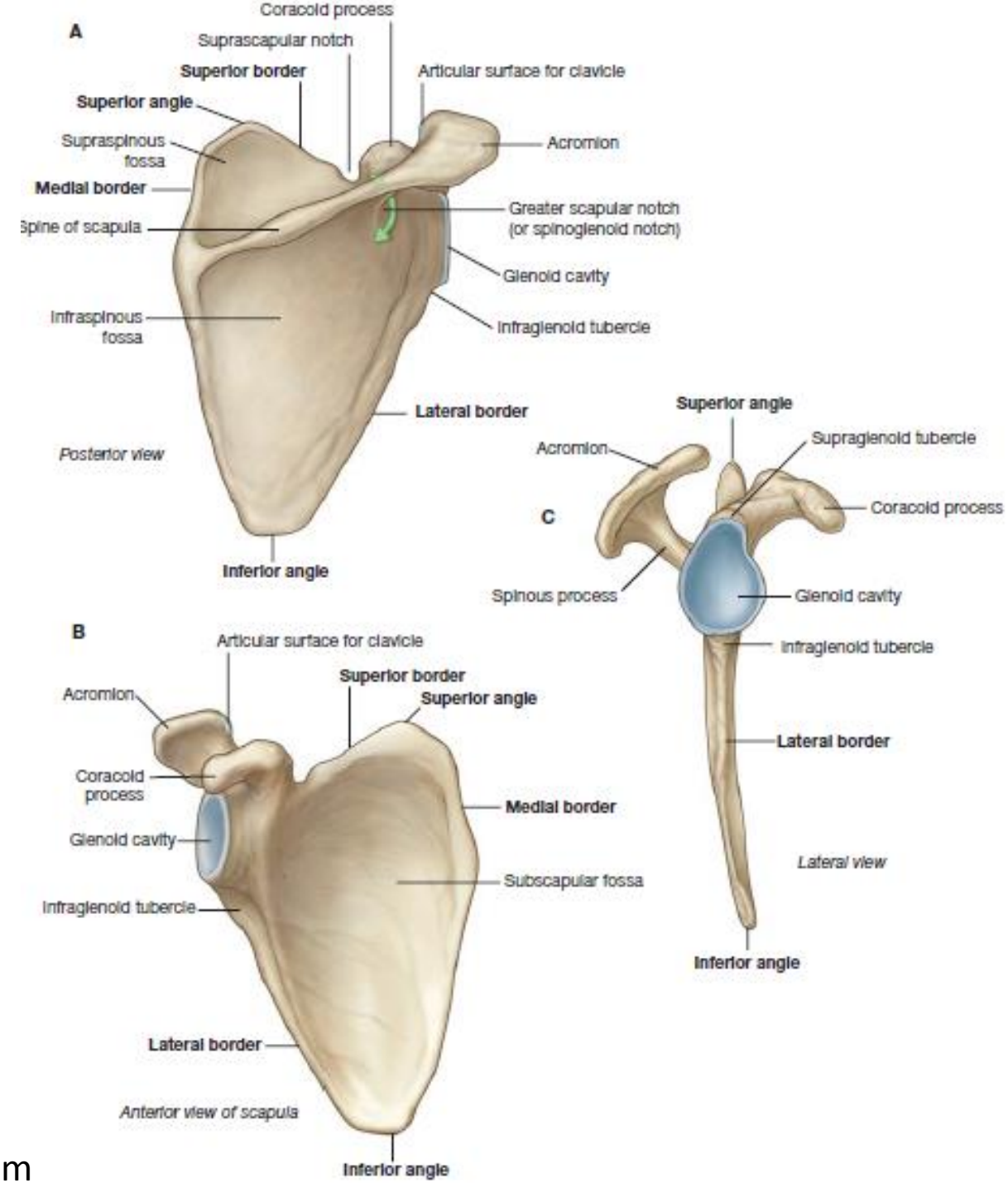
Ligaments:

- Coracoclavicular,
- Costoclavicular,
- Interclavicular.

Scapula

- It is a large, flattened, and triangular bone located on the upper part of the posterolateral aspect of the thorax, against 2nd to 7th ribs. It is highly mobile.





Parts

- It consists of four parts: a body and three processes:- spinous, acromian, and coracoid.

- **N.B.** Some books divide scapula into three parts, viz. head, neck, and body.

Body

It is triangular, thin, and transparent. The following features:

1) Two surfaces: (a) Costal and (b) dorsal.
2) Three borders:

(a) Superior,
(b) Lateral, and
(c) Medial.

3) Three angles:

(a) Inferior,
(b) Superior, and
(c) Lateral.

Dorsal surface:

It presents a shelf-like projection on its upper part called **spinous process**.

-The **lateral angle** is truncated to form an articular surface—the **glenoid cavity.**

-The lateral angle is thickened and called **head of the scapula,** which is connected to the plate-like body by an inconspicuous **neck**.

Anatomical position and side determination

1. The **glenoid cavity** faces laterally, forwards, and slightly upwards (at an angle of 45° from the coronal plane).
2. The **coracoid process** is directed forwards.
3. The shelf-like **spinous process** is directed posteriorly

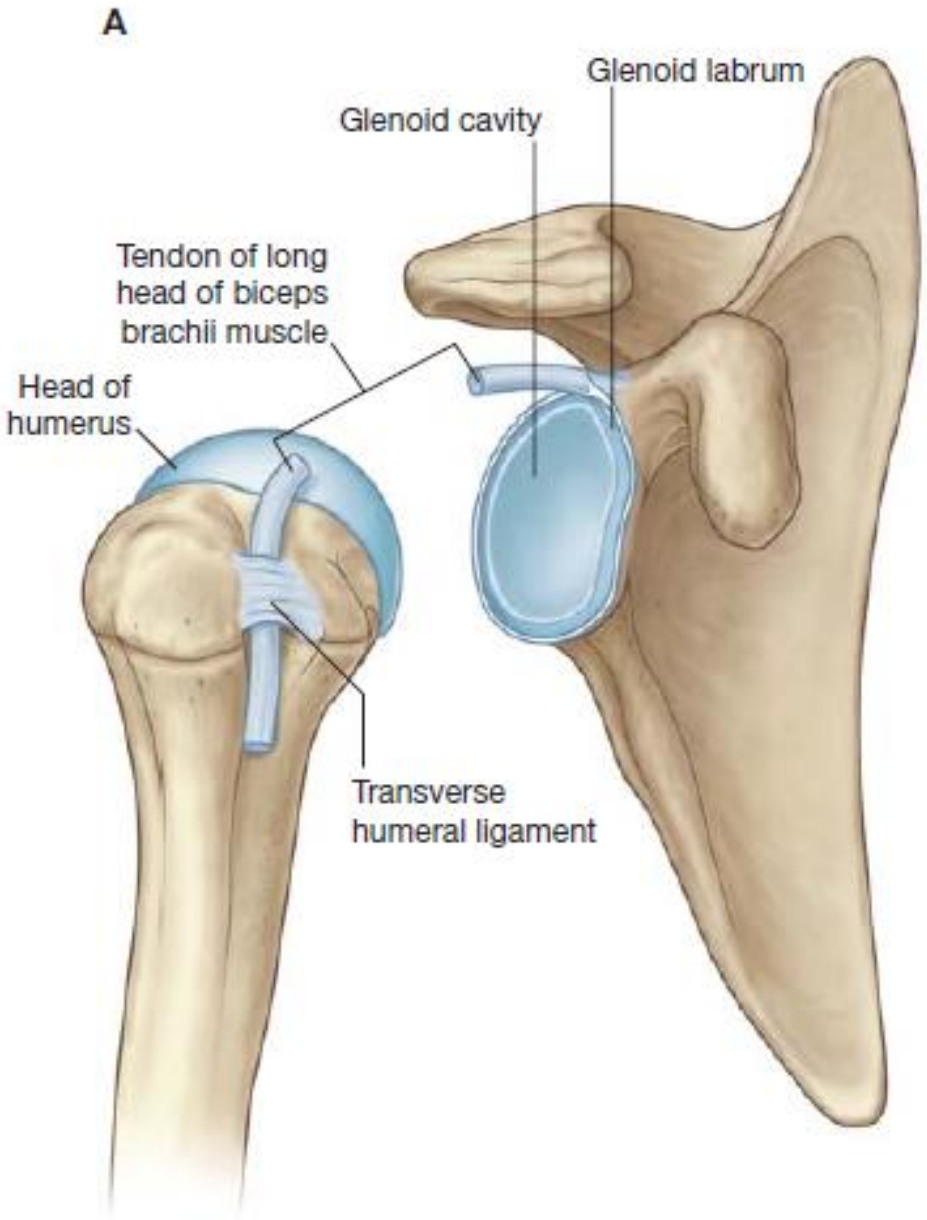


Fig. 7.25 Glenohumeral joint. **A.** Articular surfaces of right glenohumeral

Features and attachments

Costal surface (subscapular fossa):

1. It is concave and directed medially and forwards.
2. It presents three longitudinal ridges, which provide attachment to the intramuscular tendons of subscapularis muscle.
3. The **subscapularis muscle** (a multipennate muscle) arises from the medial two-third of subscapular fossa/costal surface except near the neck where a ***subscapular bursa*** intervenes between the neck and the subscapular tendon.
4. The **serratus anterior muscle** is inserted on this surface along the medial border and inferior angle.

Dorsal surface:

1. The surface is convex and presents a shelf-like projection called **spinous process.**
2. The spinous process divides the dorsal surface into supraspinous and infraspinous fossae. The upper, supraspinous fossa is smaller (one-third) and lower, infraspinous fossa is larger (two-third).
3. The **spinoglenoid notch** lies between lateral border of the spinous process and the dorsal surface of the neck of scapula. Through this notch supraspinous fossa communicates with the **infraspinous fossa** and **suprascapular nerve** and vessels pass from supraspinous fossa to the infraspinous fossa.

Dorsal surface

4) The **supraspinatus muscle** arises from medial two-third of supraspinous fossa.
5) The **infraspinatus muscle** arises from medial two-third of infraspinous fossa.
6) The **teres minor muscle** arises from the upper two-third of the dorsal surface of lateral border. This origin is interrupted by the ***circumflex scapular artery*****.**
7) The **teres major muscle** arises from the lower one-third of the dorsal surface of lateral border and inferior angle of scapula.
8) The **latissimus dorsi muscle** also arises from dorsal surface of the inferior angle by a small slip.

Borders

Superior border

1. The superior border is the shortest border and extends between superior and lateral angles.
2. The **suprascapular notch** is present on this border near the root of coracoid process.
3. The suprascapular notch is converted into **suprascapular foramen** by *superior transverse (suprascapular) ligament.*
4. The suprascapular artery passes above the ligament and suprascapular nerve passes below the ligament, through suprascapular foramen.
5. The **inferior belly of omohyoid** arises from the superior border near the suprascapular notch.

Lateral border

1. The lateral border is the thickest border and extends from inferior angle to the glenoid cavity.
2. The **infraglenoid tubercle** is present at its upper end, just below the glenoid cavity.
3. The **long head of triceps** muscle arises from the infraglenoid tubercle.

N.B. Lateral border of scapula is thick because it acts as fulcrum during rotation of the scapula.

Medial border (vertebral border)

1. It extends from superior angle to the inferior angle.
2. It is thin and angled at the root of spine of scapula.
3. The **serratus anterior muscle** is inserted on the costal surface of the medial border and the inferior angle.
4. The **levator scapulae muscle** is inserted on the dorsal aspect of the medial border from superior angle to the root of spine.
5. The **rhomboideus minor muscle** is inserted on the dorsal aspect of the medial border opposite the root of spine.
6. The **rhomboideus major muscle** is inserted on the dorsal aspect of the medial border from the root of spine to the inferior angle.

Angles

A) **Inferior angle:** It lies over the 7th rib or the 7th intercostal space.

B) **Superior angle:** It is at the junction of superior and medial borders, and lies over the 2nd rib.

Lateral angle (head of scapula)

1. It is truncated and bears a pear-shaped articular cavity called the **glenoid cavity,** which articulates with the head of humerus to form *glenohumeral (shoulder) joint*.
2. A fibrocartilaginous rim, the **glenoid labrum** is attached to the margins of glenoid cavity to deepen its concavity.
3. The **capsule of shoulder joint** is attached to the margins of glenoid cavity, proximal to the attachment of glenoid labrum.
4. The **long head of biceps brachii** arises from supraglenoid tubercle. This origin is intracapsular.

Processes

There are three processes. These are as follows:

1. **Spinous process**: It is a shelf-like bony projection on the dorsal aspect of the body.
2. **Acromion process**: It projects forwards almost at right angle from the lateral end of the spine.
3. **Coracoid process**: It is like a bird's beak and arises from the upper border of the head and bends sharply to project superoanteriorly.

Spinous process (spine of scapula)

1. It is a triangular shelf-like bony projection, attached to the dorsal surface of scapula at the junction of its upper one-third and lower two-third.
2. It divides the dorsal surface of scapula into two parts— upper supraspinous fossa and lower infraspinous fossa.
3. The spine has two surfaces: (a) superior and (b) inferior, and three borders: (a) anterior, (b) posterior, and (c) lateral.

Spinous process (spine of scapula)

Surfaces

(a) The ***superior surface*** *of spine* forms the lower boundary of supraspinous fossa and gives origin to supraspinatus.

(a) The ***inferior surface*** *of spine* forms the upper limit of infraspinous fossa and gives origin to infraspinatus.

Spinous process (spine of scapula)

Borders:

(a) The *anterior border of spine* is attached to the dorsal surface of scapula.

(b) The *lateral border of spine* bounds the **spinoglenoid notch** through which pass suprascapular nerve and vessels from supraspinous fossa to infraspinous fossa.

(c) The *posterior border of spine* is also called **crest of spine**. Trapezius is inserted to the upper lip of crest of spine, while posterior fibres of deltoid take origin from its lower lip.

Acromion process (acromion)

1. It projects forwards almost at right angle from the lateral end of spine and overhangs the glenoid cavity.
2. Its superior surface is subcutaneous.
3. It has a tip, two borders (medial and lateral), and two surfaces (superior and inferior).
4. The medial and lateral borders of acromion continue with the upper and lower lips of the crest of the spine of scapula, respectively.
5. Its superior surface is rough and subcutaneous.
6. Its inferior surface is smooth and related to **subacromial bursa**.

Acromion process (acromion)

7) The medial border of acromion provides insertion to the trapezius muscle. Near the tip, medial border presents a circular facet, which articulates with the lateral end of clavicle to form the acromioclavicular joint.
8) The lateral border of acromion gives origin to intermediate fibres of the deltoid muscle.
9) The **coracoacromial ligament** is attached to the tip of acromion.
10) The acromial angle is at the junction of lateral border of acromion and lateral border of the crest of the spine of scapula.

Coracoid process

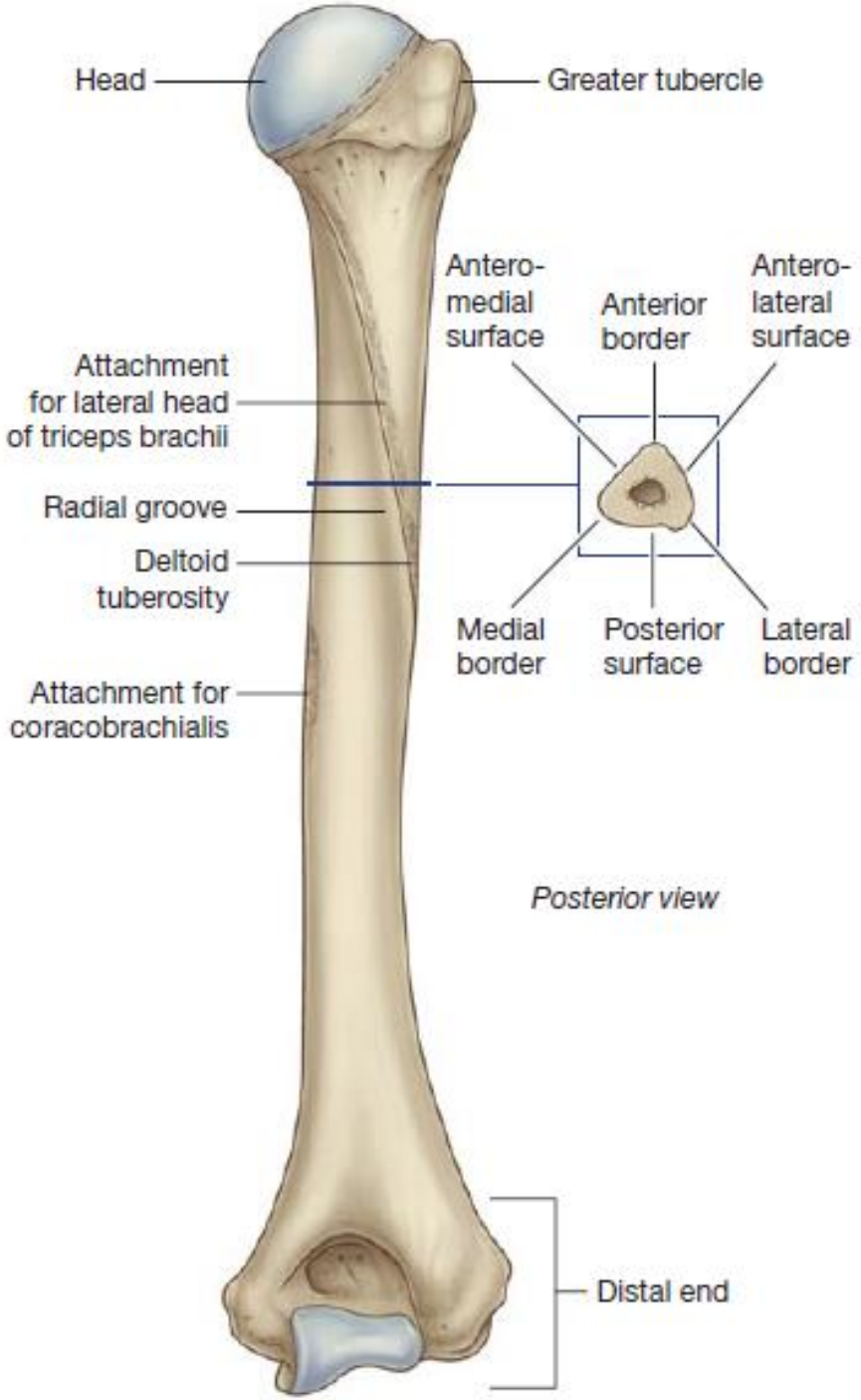
1. It arises from the upper part of the head of scapula and bent sharply so as to project forwards and slightly laterally.
2. The coracoid process provides attachment to **three muscles**—short head of biceps brachii, coracobrachialis, and pectoralis minor, and **three ligaments**: **coracoacromial, coracoclavicular, and coracohumeral**.
3. The *short head of* ***biceps brachii*** and ***coracobrachialis*** arise from its tip by a common tendon.
4. The ***pectoralis minor*** muscle is inserted on the medial border of the upper surface.

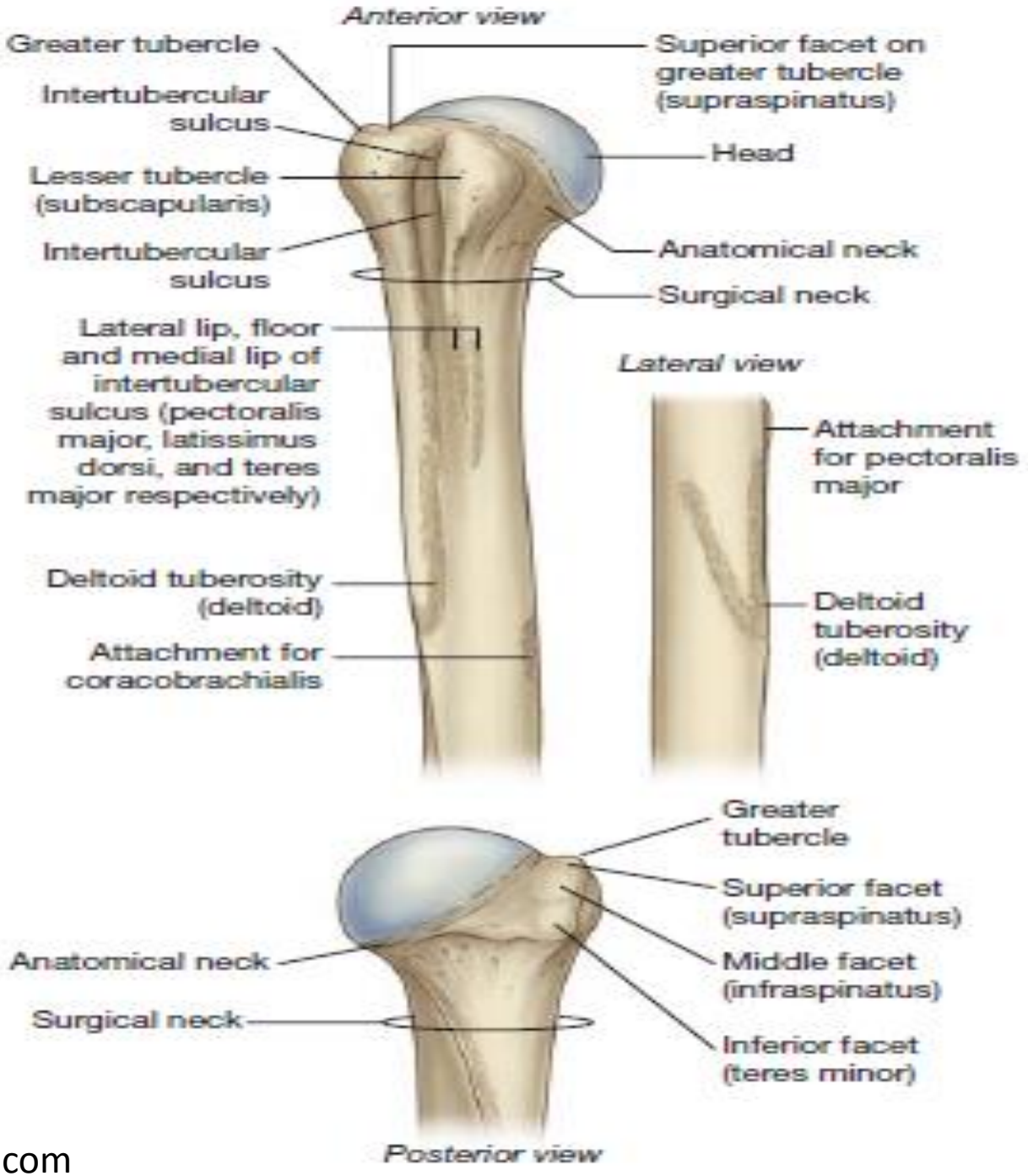
Coracoid process

5. The ***coracoacromial ligament*** is attached to its lateral border.
6. The *conoid part of the coracoclavicular ligament* (**rhomboid ligament**) is attached to its knuckle.
7. The *trapezoid part of the coracoclavicular ligament* (**rhomboid ligament**) is attached to a ridge on its superior aspect between the pectoralis minor muscle and coracoacromial ligament.
8. The ***coracohumeral ligament*** is attached to its root adjacent to the glenoid cavity.

Humerus

- It is the longest and strongest bone of arm of upper limb.
- It consists of three parts: Upper end, lower end, and shaft.





Anatomical position and side determination

1. The **rounded head** at the upper end faces medially, backwards and upwards.
2. The **lesser tubercle, greater tubercle,** and **vertical groove (intertubercular groove)** at the upper end faces anteriorly.
3. The **olecranon fossa** on the lower flattened end faces posteriorly.

Features and attachments

Upper End Head

1. It is smooth, rounded and forms one-third of a sphere.
2. It is covered by an articular hyaline cartilage, which is thicker in the center and thinner at the periphery.

Neck

The humerus has three necks:

A) Anatomical neck:

1. It is constriction at the margins of the rounded head.
2. It provides attachment to the capsular ligament of the shoulder joint, except—*superiorly* where the capsule is deficient, for the passage of tendon of long head of biceps brachii, *medially* the capsule extends down from the anatomical neck to the shaft for about 1–2 cm.

B) Surgical neck

1. It is short constriction in the upper end of the shaft below the greater and lesser tubercles/below the epiphyseal line.
2. It is related to axillary nerve and posterior and anterior circumflex humeral vessels.
3. It is the most important feature of the proximal end of the humerus because it is weaker than the more proximal regions of the bone, hence it is one of sites where the humerus commonly fractures leading to damage of associated nerves and vessels.

C) Morphological neck

1. It is the junction between diaphysis and epiphysis.
2. It is represented by an epiphyseal line in the adult bone.
3. It is a true junction of head with the shaft.

Greater tubercle

1. It is the most lateral part of the proximal end of humerus.
2. Its posterosuperior aspect bears three flattened facet-like impressions: upper, middle, and lower, which provide attachment to *supraspinatus, infraspinatus*, and *teres minor muscles*, respectively.

@SIT, (supraspinatus, infraspinatus, teres minor).

Lesser tubercle

1. It is small elevation on the front of upper end of humerus, just above the surgical neck.
2. It provides attachment to *subscapularis muscle.*

Intertubercular Sulcus/Bicipital Groove

1. It is a vertical groove between lesser and greater tubercles.
2. It contains (a) long head of biceps, enclosed in the synovial sheath and (b) ascending branch of anterior circumflex humeral artery.
3. Three muscles are attached in the region of this groove:

(a) Pectoralis major on the lateral lip of the groove.

(b) Teres major on the medial lip of the groove.

(c) Latissimus dorsi in the floor of the groove.

Shaft

- The upper part of the shaft is cylindrical and its lower part is triangular in cross section. It has three borders and three surfaces.

Borders

Anterior border:

- It starts from the lateral lip of the intertubercular sulcus, and extends down to the anterior margin of the deltoid tuberosity and become smooth and rounded in the lower half, where it ends in the radial fossa.

Medial border

1. It extends from the medial lip of the intertubercular sulcus down to the medial epicondyle. Its lower part is sharp and called medial **supracondylar ridge**. This ridge provides attachment to medial intermuscular septum.
2. A rough strip on the middle of this border provides insertion to the **coracobrachialis muscle**.
3. A narrow area above the medial epicondyle provides origin to the humeral head of the **pronator teres**.

Lateral border

1. Its upper part is indistinct while its lower part is prominent where it forms the **lateral supracondylar ridge**. Above the lateral supracondylar ridge, it is illdefined but traceable to the posterior part of the greater tubercle.
2. About its middle, this border is crossed by the radial groove from behind.
3. The lower part of this border, lateral supracondylar ridge, provides attachment to the lateral intermuscular septum.

Surfaces

Anterolateral surface

1. It lies between the anterior and lateral borders.
2. A little above the middle, this surface presents a characteristic V-shaped tuberosity–the **deltoid tuberosity** which provides insertion to the deltoid muscle.

Anteromedial surface

1. It lies between the anterior and medial borders.
2. The upper part of this surface forms the floor of the intertubercular sulcus.
3. About its middle and close to the medial border it presents a nutrient foramen directed downwards.

Posterior surface

1. It lies between the medial and lateral borders.
2. In the upper one-third of this surface, there is an oblique ridge directed downwards and laterally. This ridge provides origin to the lateral head of the triceps brachii.
3. Below and medial to the ridge, is the radial/spiral groove, which lodges radial nerve and profunda brachii vessels.
4. The entire posterior surface below the spiral groove provides origin to the medial head of the triceps brachii.

Lower End

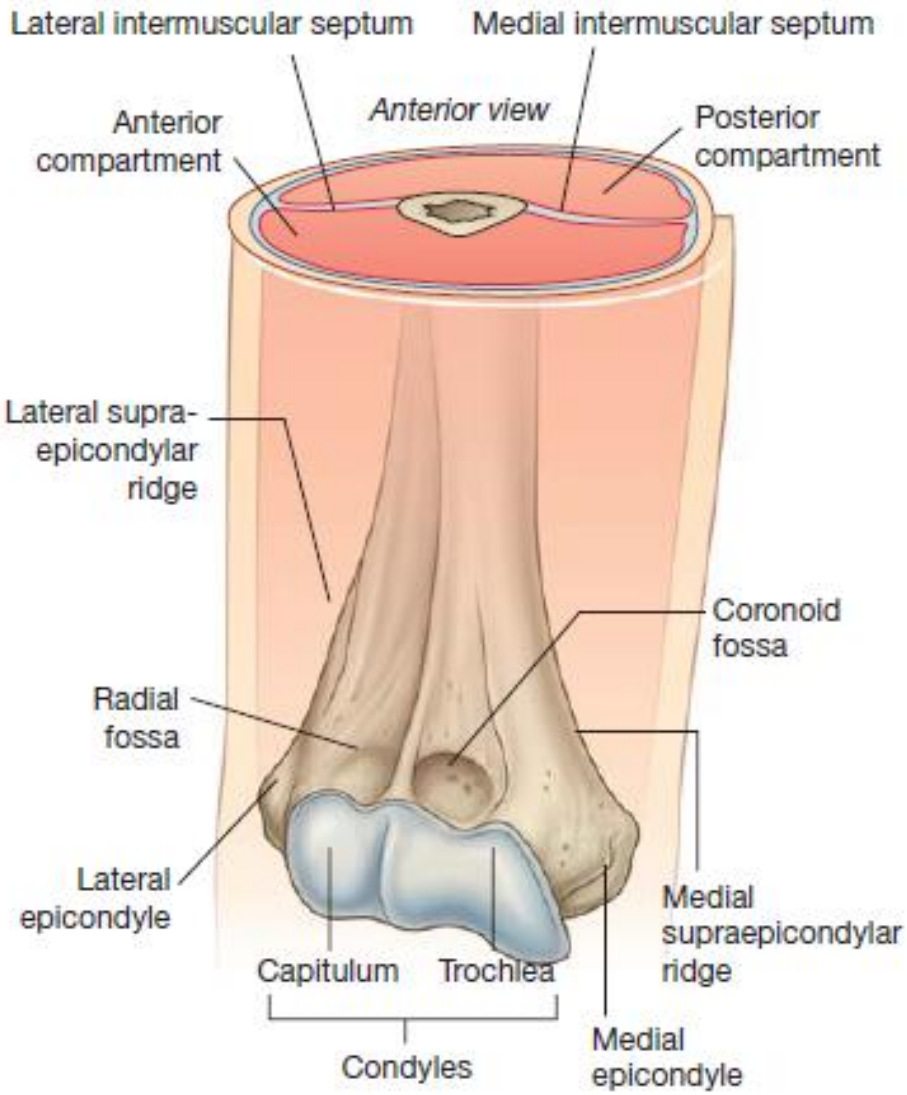
1. It is flattened from before backwards and expanded from side to side.
2. The capitulum (rounded convex projection laterally) articulates with the head of radius.
3. The trochlea (pulley-shaped projection medially) articulates with the trochlear notch of ulna.
4. The ulnar nerve is related to the posterior surface of the medial epicondyle.
5. The anterior surface of the medial epicondyle provides an area for common flexor origin of the superficial flexors of the forearm.
6. The anterolateral part of lateral epicondyle provides an area for common extensor origin.
7. The posterior surface of lateral epicondyle gives origin to anconeus muscle.

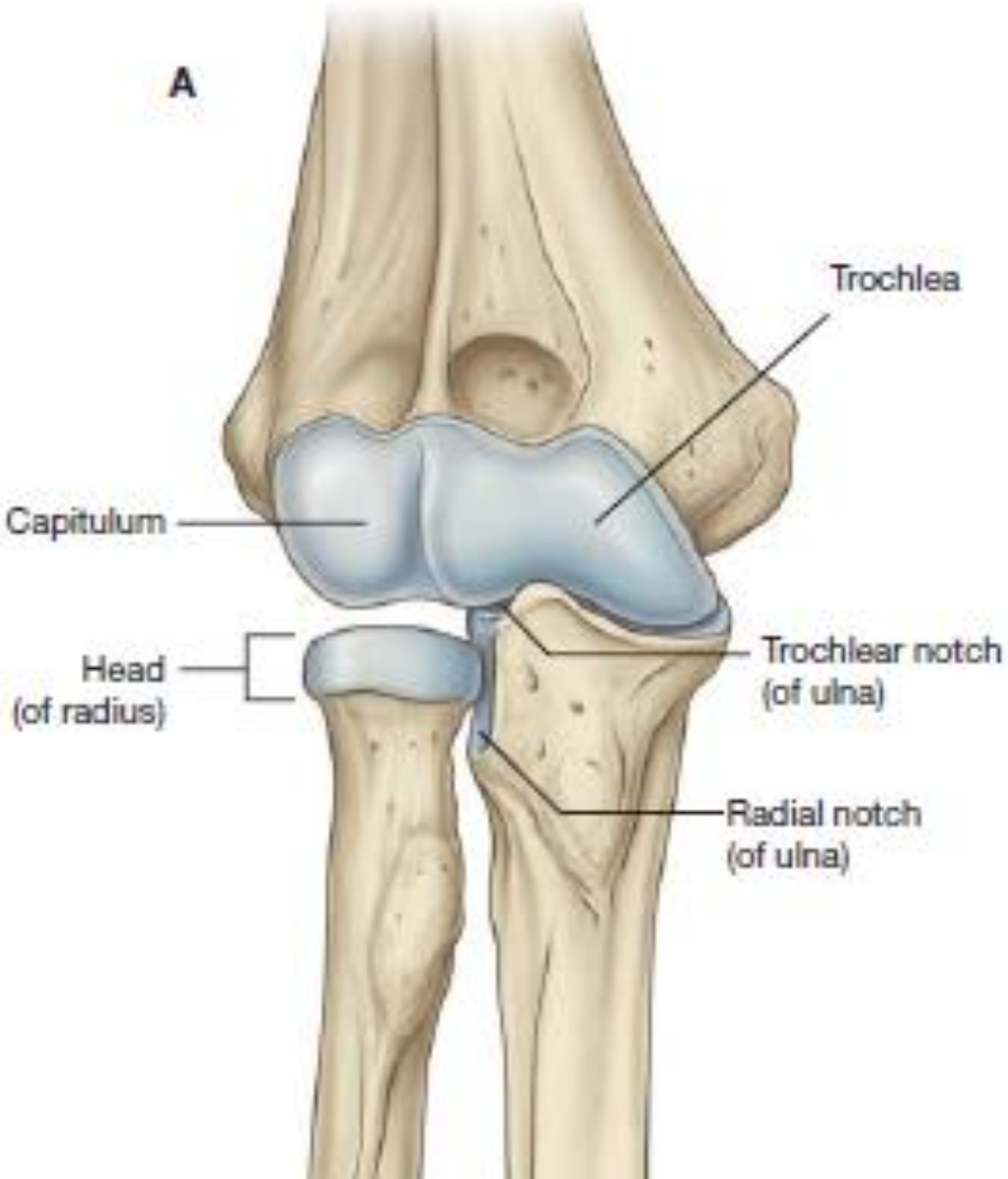
8. The coronoid process of ulna fits into coronoid fossa (above the trochlea) during full flexion of elbow.

9. The head of radius fits into radial fossa (above capitulum) during full flexion of elbow.

10. The olecranon process of ulna fits into olecranon (on posterior aspect above the trochlea) during full extension of elbow.

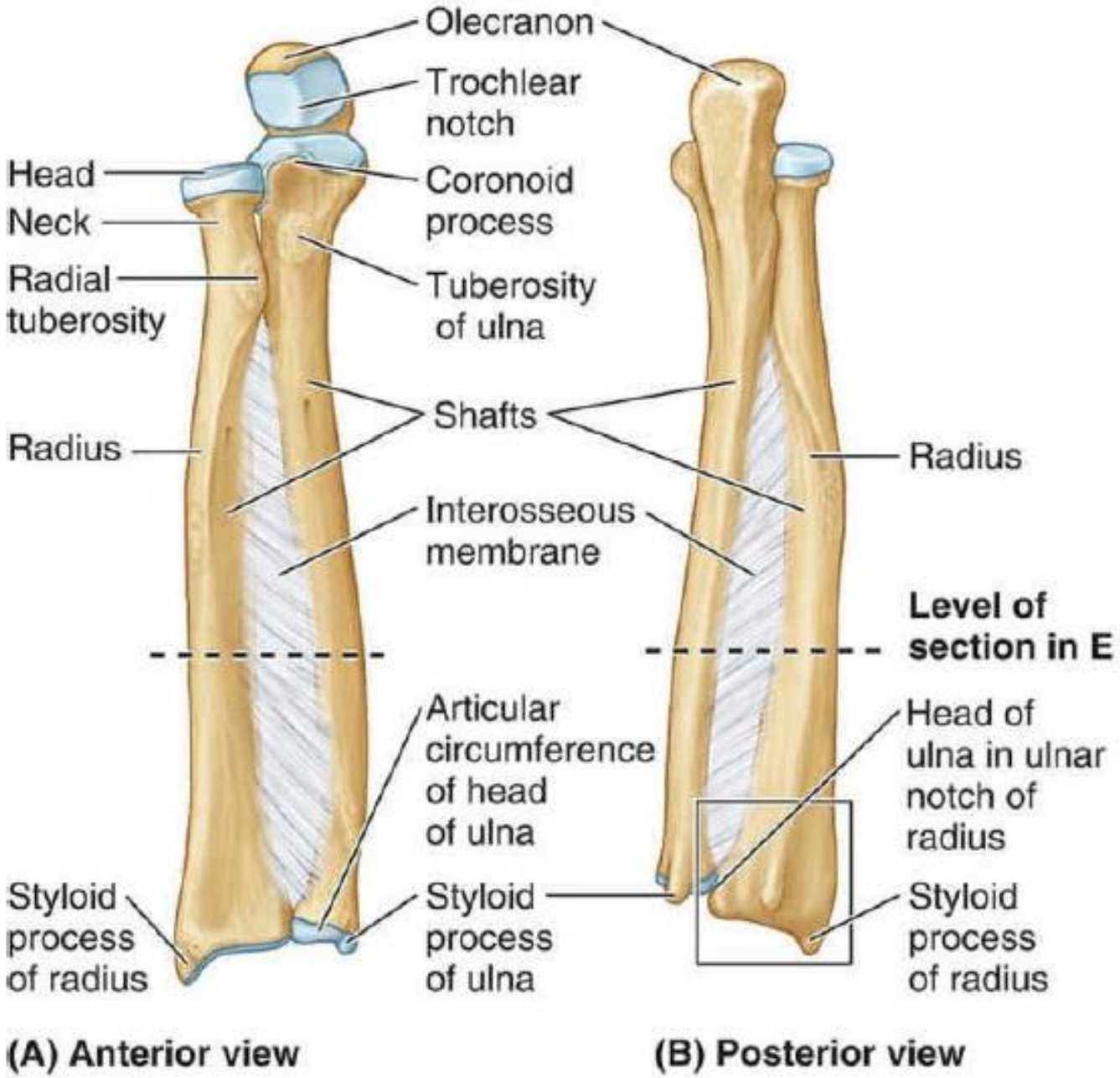
11. The capsule of elbow joint is attached above the coronoid and radial fossae anteriorly and above the olecranon fossa posteriorly.

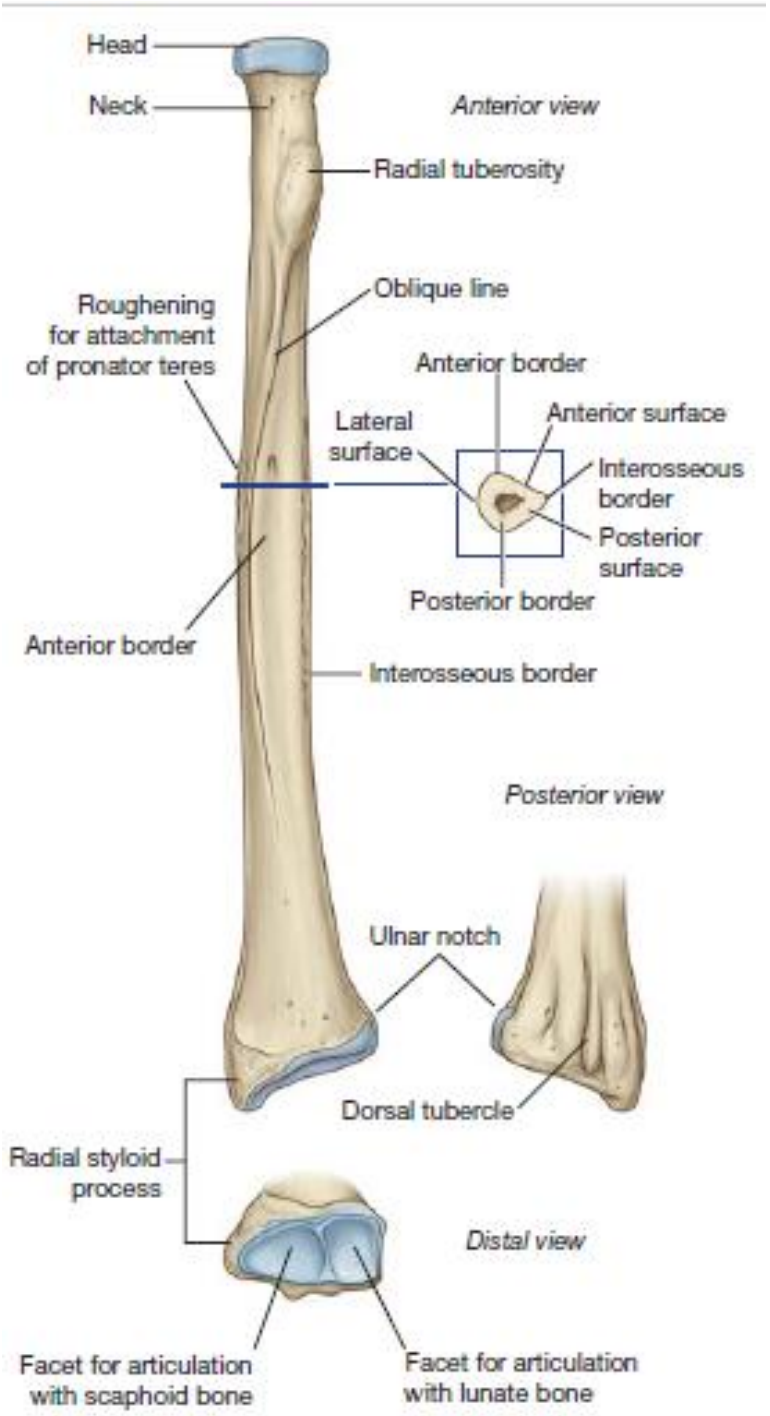




Radius

- The radius is the lateral bone of the forearm.
- It is homologous to the medial bone of the leg.
- The parts of the radius: Upper end, shaft and lower end.





Anatomical position and side determination

1. The **narrow disc-shaped end** (head) is directed upwards.
2. The **sharpest border (interosseous border)** of the shaft is kept medially.
3. The **styloid process** at the lower end is directed laterally and prominent tubercle (*Lister's tubercle*) at lower end faces dorsally.
4. The **convexity of shaft** faces laterally, and concave anterior surface of shaft faces anteriorly.

Features and attachements

Upper end presents head, neck, and radial tuberosity.

Head:

- Head is a disc like shaped and it is covered with an articular hyaline cartilage and articulates superiorly with capitulum to form *humero-radial articulation*. The circumference of head is smooth and articulates medially with the radial notch of ulna, rest of it is encircled by the *annular ligament*.

Neck:

Neck is the constricted part just below the head and is embraced by the lower part of annular ligament. The **quadrate ligament** is attached to the medial side of the neck.

Radial tuberosity:

a. Biceps tendon is inserted to its rough, posterior part.
b. A small synovial bursa covers its smooth anterior part and separates it from the biceps tendon.

Shaft:

The **long shaft** extends between the upper and lower ends and presents a lateral convexity. It widens rapidly towards the distal end and is concave anteriorly in its distal part. Its sharpest interosseous border is located on the medial side. It consist of three borders and three surfaces.

Borders

A. Anterior border:

1. It starts below the anterolateral part of radial tuberosity and runs downwards and laterally to the styloid process.
2. The upper part of this border is called **anterior oblique line** and lower part forms the sharp lateral border of the anterior surface.
3. Its anterior oblique line gives origin to radial head of flexor digitorum superficialis.

B. Posterior border:

- Well-defined only in its middle third of the shaft.
- Above it runs upwards and medially to the radial tuberosity and form the **posterior oblique line**.

C. Medial (interosseous) border:

- The sharpest border.

1. Extends above up to radial tuberosity and below its lower part forms the posterior margin of the small triangular area on the medial side of the lower end of the bone.
2. *Interosseous membrane* is attached to its lower three-fourth.

Surfaces

A) Anterior surface

- Concave and lies between anterior and interosseous borders.

1. *Flexor pollicis longus* originates from its upper two-fourth.
2. *Pronator quadratus* is inserted on its lower one-fourth.
3. *Nutrient foramen* is present a little above the middle of this surface in its upper part.

   The nutrient canal is directed upwards. Nutrient artery for radius is a branch from anterior interosseous artery.

B) Posterior surface

- Lies between the interosseous and posterior borders.

1. *Abductor pollicis longus* arises from the middle one-third of this surface.
2. *Extensor pollicis brevis* arises from lower part of this surface.

C) Lateral surface

- Lies between anterior and posterior borders.

1. *Supinator* is inserted on the widened upper one-third of this surface.
2. *Pronator teres* is inserted on the rough area in the most convex middle part of this surface.

Lower End

✓ Widest part of the bone and has five surfaces.

1. Anterior surface:

➢ A thick ridge, which provides attachment to *palmar radio-carpal ligament of wrist joint*.

2) Medial surface:

➢ Presents the ulnar notch for articulation with the head of ulna.

➢ *Articular disc of inferior radio-ulnar joint* is attached to the lower margin of ulnar notch.

3. Posterior surface:

- Presents the *dorsal tubercle of Lister* lateral to the groove for the tendon of *extensor pollicis longus*.
- Also presents grooves for other extensor tendons.

- ✓ The groove lateral to the Lister's tubercle is traversed by tendons of ***extensor carpi radialis longus*** and ***extensor carpi radialis brevis***.
- ✓ Through the groove medial to groove for ***extensor pollicis longus*** passes tendons of **extensor digitorum and extensor indicis.**

4) Lateral surface:

- The surface projects downward as the styloid process and is related to **tendons of *adductorpollicis longus*** and ***extensor pollicis brevis***.
- The ***brachioradialis*** is inserted to the base of styloid process and radial collateral ligament of wrist joint is attached to the tip of styloid process.

5) Inferior surface:

- The distal (inferior) surface presents a lateral triangular area for articulation with the scaphoid and a medial quadrangular area for articulation with the lateral part of the lunate.

Applied anatomy

- **Colles' fracture:**
  - Fracture at the distal end of radius the distal fragment is displaced backwards and upwards
- ***Smith's fracture:*** Reverse of Colles' fracture.
- ***Chauffeur's fracture:*** Fracture of styloid process of radius

Ulna

- Medial bone of forearm and is homologous to the lateral bone of leg is called the **fibula**.

- Consists of three parts:

- Upper end,
- lower end, and
- shaft.

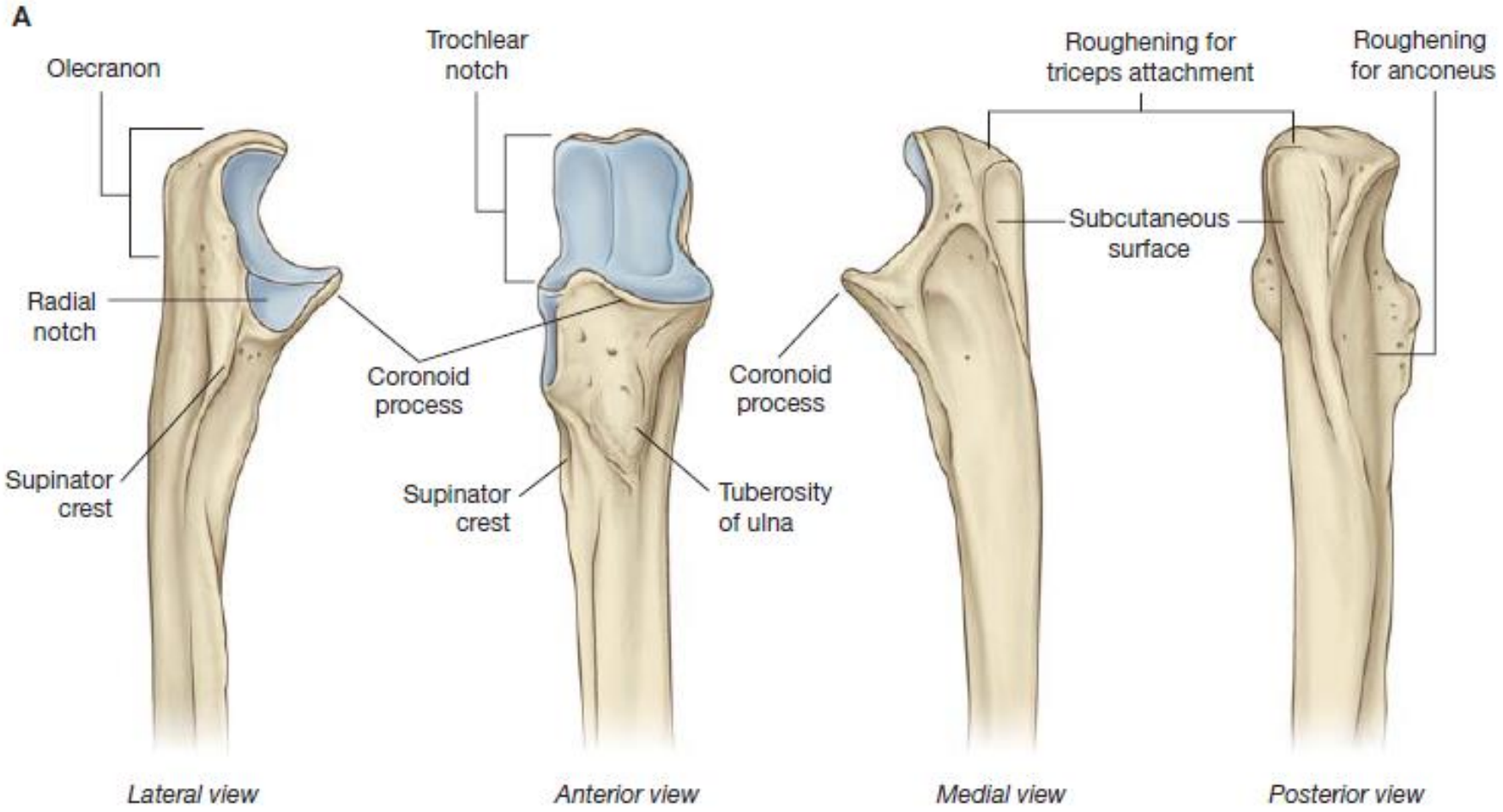
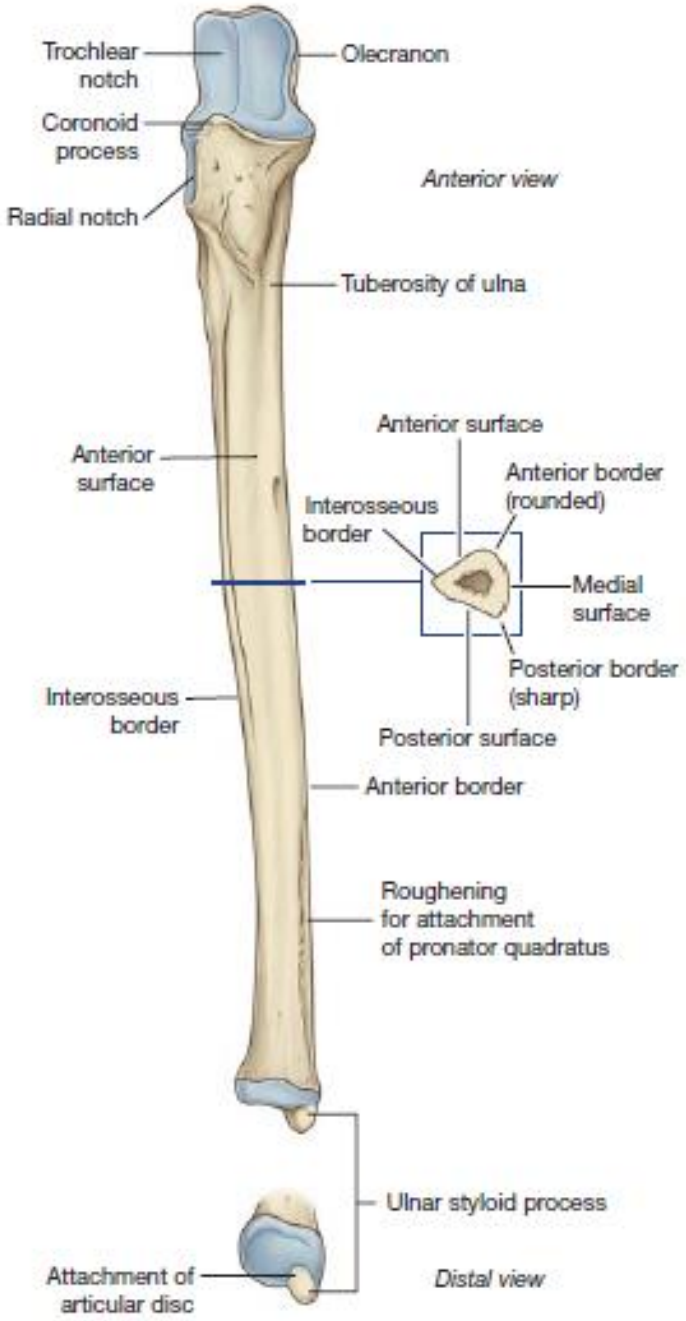


Fig. 7.63 A. Lateral, anterior, medial, and posterior views of the proximal end of the ulna.



Upper End

- It is expanded and hook-like with concavity of hook facing forwards. The concavity of upper end (**trochlear notch**) lies between large olecranon process above and the small coronoid process below.

Olecranon process

The process projects upwards from the upper end and bends forward at its summit like a beak and has the following five surfaces:

1. Upper surface

(a) Rough posterior two-third provides insertion to the ***triceps brachii***.

(b) Capsular ligament *of elbow joint* is attached anteriorly near its margins.

(c) A **synovial bursa** lies between the tendon of triceps and capsular ligament.

2. Anterior surface:

➢ Smooth and forms upper part of the trochlear notch.

Olecranon process

3. Posterior surface

(a) It forms a subcutaneous triangular area.

(b) A synovial bursa (**subcutaneous olecranon bursa**) lies between posterior surface and skin.

4. Medial surface: Its upper part provides attachments to three structures:

(a) ulnar head of flexor carpi ulnaris (origin),

(b) posterior, and

(c) oblique bands of ulnar collateral ligament.

Coronoid process:

- It is bracket-like projection from the front of the upper end of the ulna below the olecranon process.
- It has four surfaces: superior, medial, anterior, and lateral.

1. Superior surface:

- Smooth and forms the lower part of trochlear notch.

2) Medial surface:

- It gives origin to flexor digitorum profundus.

3) Anterior surface:

➢ It is **triangular in shape**.

(a) Its **lower corner** presents an **ulnar tuberosity.**

(b) Brachialis muscle is inserted to the whole of the anterior surface including ulnar tuberosity.

(c) The medial margin of the anterior surface is sharp and has a tubercle at its upper end called **sublime tubercle**.

The medial margin provides attachment to the following structures from proximal to distal:

(i) Anterior band of ulnar collateral ligament.

(ii) Oblique band of ulnar collateral ligament.

(iii) Humero-ulnar head of flexor digitorum superficialis.

(iv) Ulnar head of pronator teres.

(v) Ulnar head of flexor pollicis longus.

4. Lateral surface:

The upper part of this surface possesses a radial notch for articulation with the head of the radius.

(a) The ***annular ligament*** is attached to the anterior and posterior margins of the radial notch.

(b) The lower part of the lateral surface below radial notch has a depressed area called **supinator fossa***,* which accommodates radial tuberosity during supination and pronation.

(c) Supinator fossa is bounded behind by supinator crest. Supinator crest and adjoining part of supinator fossa gives origin to the *supinator muscle*.

Notches (articular surfaces):

Trochlear notch:

1. C-shaped (semilunar) and articulates with the trochlea of humerus.
2. a non-articular strip at the junction of its olecranon and coronoid parts.
3. Superior, medial, and anterior margins provide attachment to capsule of the elbow joint.

Radial notch

- Articulates with the head of radius to form the superior radio-ulnar joint.

Shaft

- It is the **long shaft** extends between the upper and lower ends.
- Thickness diminishes progressively from above downwards throughout its length. *The lateral border (interosseous border) is sharp crest-like.*
- It has three **borders—lateral, anterior, and posterior**; and three **surfaces—anterior, medial, and posterior.**

Borders

Lateral (interosseous) border

1. Sharpest and is continuous above with the supinator crest.
2. ill-defined below.
3. *Interosseous membrane* is attached to this border except for its upper part.

Anterior border:

1. Extends from the medial side of the ulnar tuberosity to the base of styloid process.
2. Thick and round.
3. Upper three-fourth gives origin to *flexor digitorum profundus*.

Posterior border:

1. Starts from the apex of triangular subcutaneous area on the back of olecranon process and descends to the styloid process.
2. It is subcutaneous throughout, hence can be palpated along its entire length.
3. Provides attachment to three muscles by a common aponeurosis. These muscles are:

(a) Flexor digitorum profundus.

(b) Flexor carpi ulnaris.

(c) Extensor carpi ulnaris.

Surfaces

Anterior surface:

1. lies between anterior and interosseous borders.
2. The ***flexor digitorum profundus*** arises from its upper 3/4th .
3. The ***pronator quadratus*** arises from an oblique ridge on the lower 1/4th of this surface.
4. The ***nutrient foramen*** is located a little above the middle of this surface and is directed upwards.

Medial surface:

1. lies between the anterior and posterior borders.
2. The ***flexor digitorum profundus*** arises from the upper 2/3rd of this surface.

Posterior surface:

1. lies between posterior and interosseous borders.
2. divided into smaller upper part and large lower part by an oblique line, which starts at the junction of upper and middle third of posterior border and runs towards the posterior edge of radial notch.
3. Area above the **oblique line** receives insertion of ***anconeus muscle***.
4. Area below the oblique line is divided into larger medial and smaller lateral parts by a **faint vertical line**. The lateral part provides attachment to three muscles form proximal to distal as follows:

(a) **Abductor pollicis longus** in the upper $1/4^{th}$.

(b) **Extensor pollicis longus** in the middle $1/4^{th}$.

(c) **Extensor indicis** in the next $1/4^{th}$.

(d) The distal $1/4^{th}$ is devoid of any attachments.

Lower End

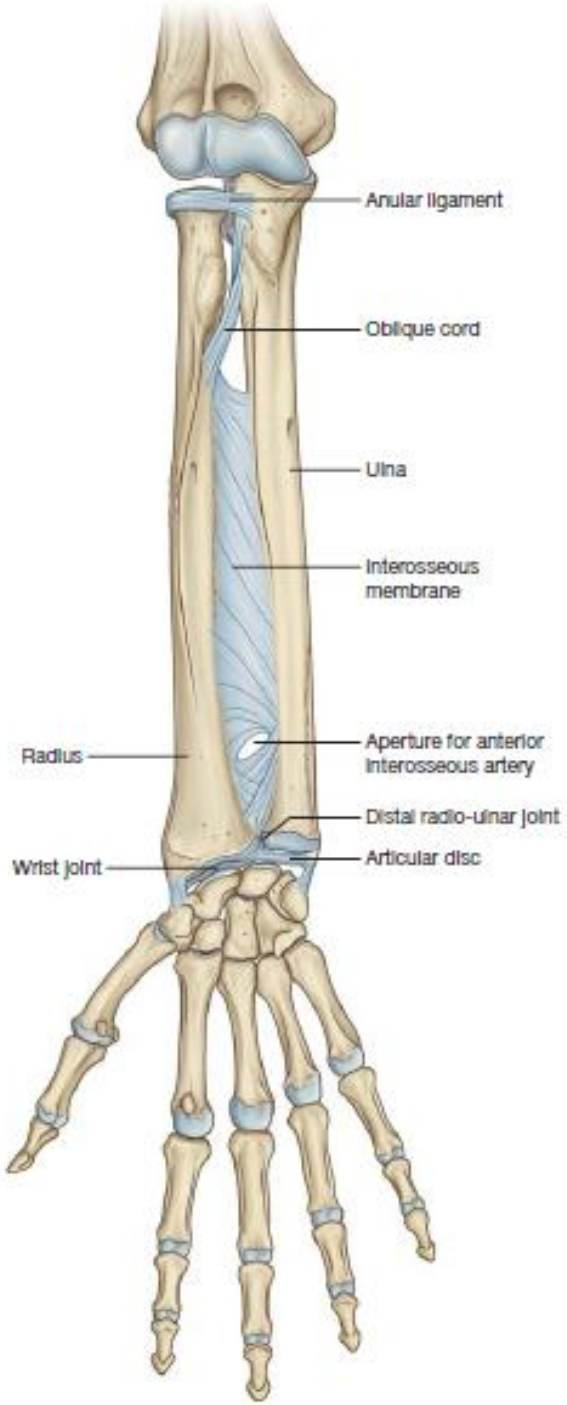
It is slightly expanded and has a *head* and *styloid process*.

Head:

1. It presents a convex articular surface on its lateral side for articulation with the ulnar notch of radius to form the **inferior radio-ulnar joint**.
2. Its inferior surface is smooth and separated from wrist joint by an articular disc of inferior radio-ulnar joint.

Styloid process:

1. It projects downwards from the posteromedial aspect of the head of ulna.
2. Its tip provides attachment to medial collateral ligament of wrist joint.
3. The apex of triangular articular disc is attached to the depression between head and base of styloid process.
4. **Tendon of extensor carpi ulnaris** lies in the groove between the back of the head of ulna and styloid process



Applied anatomy

- *Monteggia fracture dislocations.*
- *Galeazzi fracture dislocation.*
- *Night-stick fracture*

Carpal bones

- Greek. Corpus = wrist.
- It consists of eight carpal bones and arranged in two rows: proximal and distal. Each row consists of 4 bones.

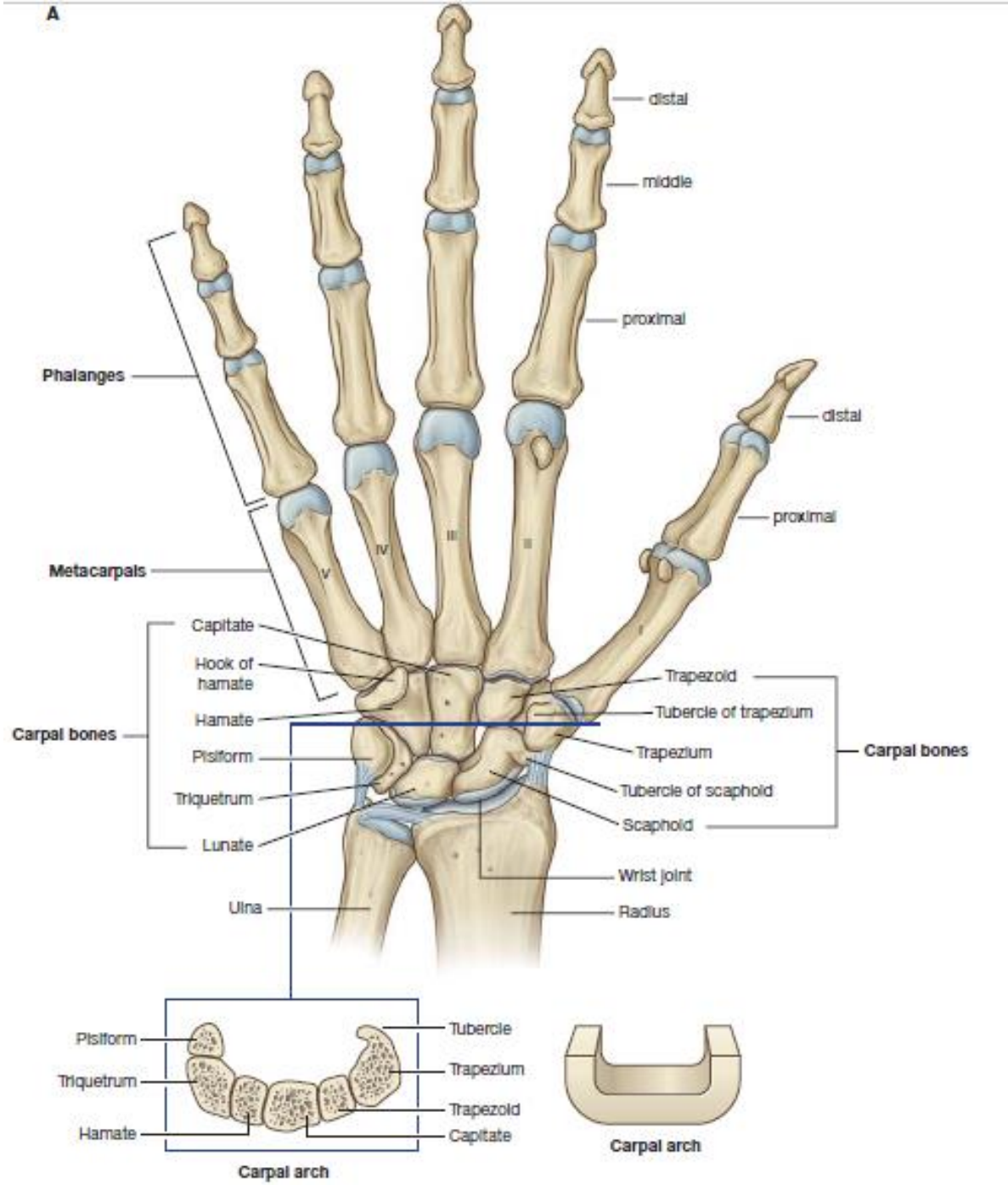
(@**S**he **L**ooks **T**oo **P**retty. **T**ry **T**o **C**atch **H**er.)

Proximal row: (lateral to medial side)

1. **S**caphoid.
2. **L**unate.
3. **T**riquetral.
4. **P**isiform.

Distal row: (lateral to medial side)

1. **T**rapezium.
2. **T**rapezoid.
3. **C**apitate.
4. **H**amate.



1. Scaphoid:

– Boat-shaped

– Has constriction (neck)

– Has tubercle on distal part of its palmar surface.

2. Lunate : Moon-shaped/crescentic.

3. Triquetral

– Pyramidal in shape

– Oval facet on the distal part of its palmar surface for articulation with pisiform.

4. Pisiform

– Pea-shaped/pea-like

– Oval facet on the proximal part of its dorsal surface

5. Trapezium

– Quadrilateral in shape

– Has groove and crest (tubercle) on its palmar surface

6. Trapezoid – Shoe-shaped

7. Capitate

– Largest carpal bone

– Has rounded head on its proximal surface

8. Hamate

– Wedge-shaped

– Hook-like process projects from distal part of its palmar surface

Metacarpal bones

It consists of five metacarpal bones and each metacarpal is a small long bone and consists of three parts: (a) head, (b) shaft, and (c) base.

Head:

- The **head** is at distal end and rounded.

Shaft:

- The **shaft** extends between head and base. It is concave on palmar aspect and on sides. The dorsal surface of shaft presents a triangular area in its distal part.

Base:

- The **base** is proximal end and expanded.

Peculiarities of the first metacarpal

1. The first metacarpal is the shortest and stoutest bone.
2. It is rotated medially through 90° so that its dorsal surface faces laterally.
3. Its base possesses concavo-convex (saddle-shaped) articular surface for articulation with trapezium.
4. The head is less convex and broader than other metacarpals.
5. The sesamoid bones glide on radial and ulnar corners of head and produces impressions of gliding.
6. Its base dose not articulate with any other metacarpal.
7. It has epiphysis at its proximal end unlike other metacarpals, which have epiphysis at their distal end.

Applied anatomy

- **Bennet's fracture:** It is an oblique fracture of the base of 1st metacarpal. It is intra-articular and may be associated with subluxation or dislocation of metacarpal.

- **Boxer's fracture :** It is fracture of neck of metacarpal, and most commonly involves neck of 5^{th} metacarpal.

Phalanges

There are 14 phalanges in each hand: two in thumb and three in each finger. Each phalanx is a short long bone and has three parts:

(a) base (proximal end),

(b) head (distal end), and

(c) shaft (extending between the two ends).

Base:

1. The bases of proximal phalanges have concave oval facet for articulation with the heads of metacarpals.
2. The bases of middle and distal phalanges possess pulley shaped articular surfaces.

Shaft:

1. The shaft tapers towards the head.
2. The dorsal surface is convex from side to side.
3. The palmar surface is flat from side to side but gently concave in the long axis.

Head:

1. The heads of proximal and middle phalanges are pulley shaped.
2. The heads of distal phalanges is non-articular and has rough horseshoe-shaped tuberosity.

References

- Gray's Anatomy for students-3rd edition.
- Moore Clinically Oriented Anatomy-8th edition