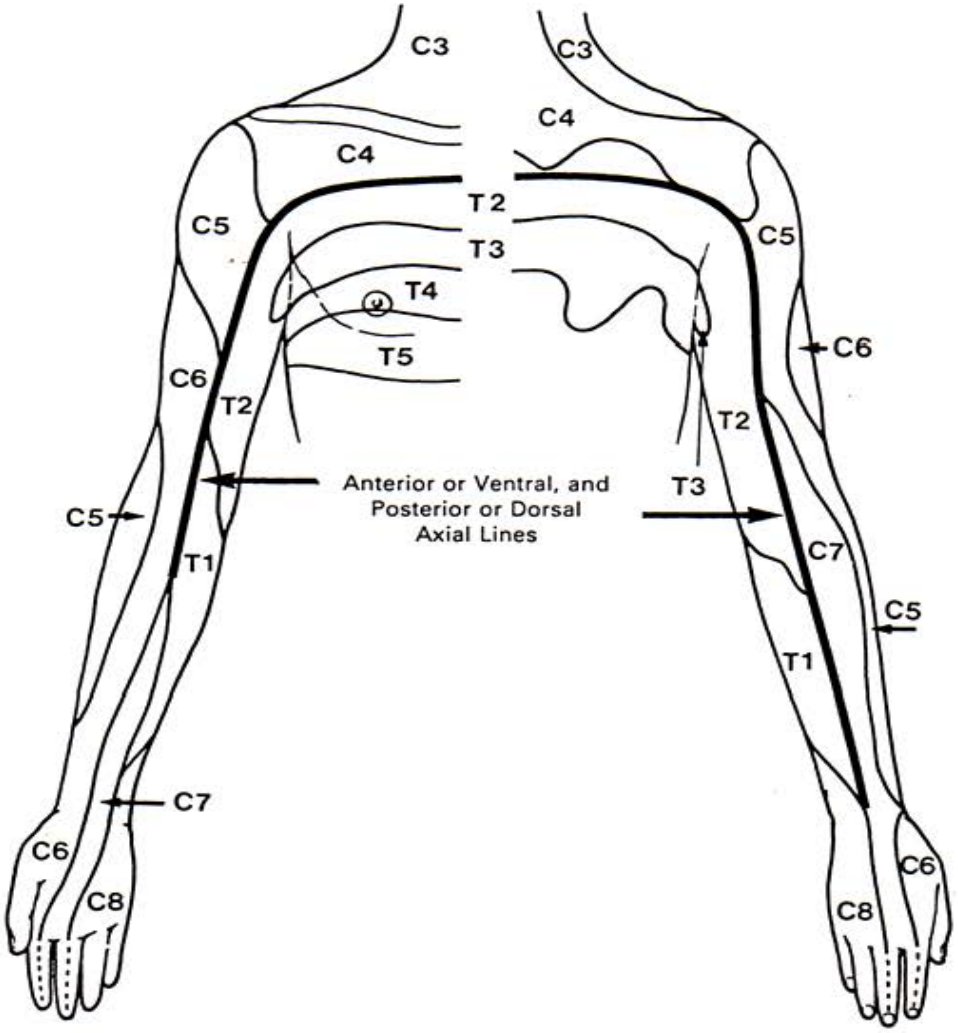
LECTURES OF ANATOMY

ON

UPPER LIMB



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BREASTS (MAMMARY GLANDS)

- Specialized accessory glands of the skin that capable of secreting milk
- Present in both sexes

Breasts of males and immature females (Fig. 1);

- They are similar in structure.
- The nipples are small and surrounded by areola (coloured area of skin).
- The breast tissue consists of a system of ducts embedded in connective tissue that does not extend beyond margin of areola.
- Male breast may enlarge in some diseases (gynaecomastia) and may rarely be affected by malignancy.

Breasts at puberty in females:

- Gradually enlarge in size
- Assume their hemispherical shape under the influence of ovarian hormones.
- The ducts elongate
- The increased size of the glands is mainly from deposition of fat.
- The base of the breast extends from the 2nd to the 6th rib and from lateral margin of the sternum to the mid-axillary line.
- Nipple of breast lies in 4th intercostal space 4 inches from the median plane.
- Lies in superficial fascia, except axillary tail (pierces deep fascia at lower border of pectoralis major and enters axilla).
- Consists of 15-20 lobes; radiate out from the nipple separated by fibrous septa.
- Septa in upper part of the gland are well developed and extend from skin to deep fascia to serve as *suspensory ligaments of Cooper*. In cancer breast, malignant cells may spread through these septa leading to dimpling of the skin (peau d'orange) due to shrinkage of these septa.
- Main duct of each lobe opens separately on summit of nipple and posses a dilated *ampulla* just before its termination.
- The areola has tiny tubercles produced by underlying areolar glands.
- Breasts are separated from deep fascia covering underlying muscles by an area of loose connective tissue (*retromammary space)*, responsible for its mobility. In cancer breast this space is infiltrated by malignant cells leading to its fixation.

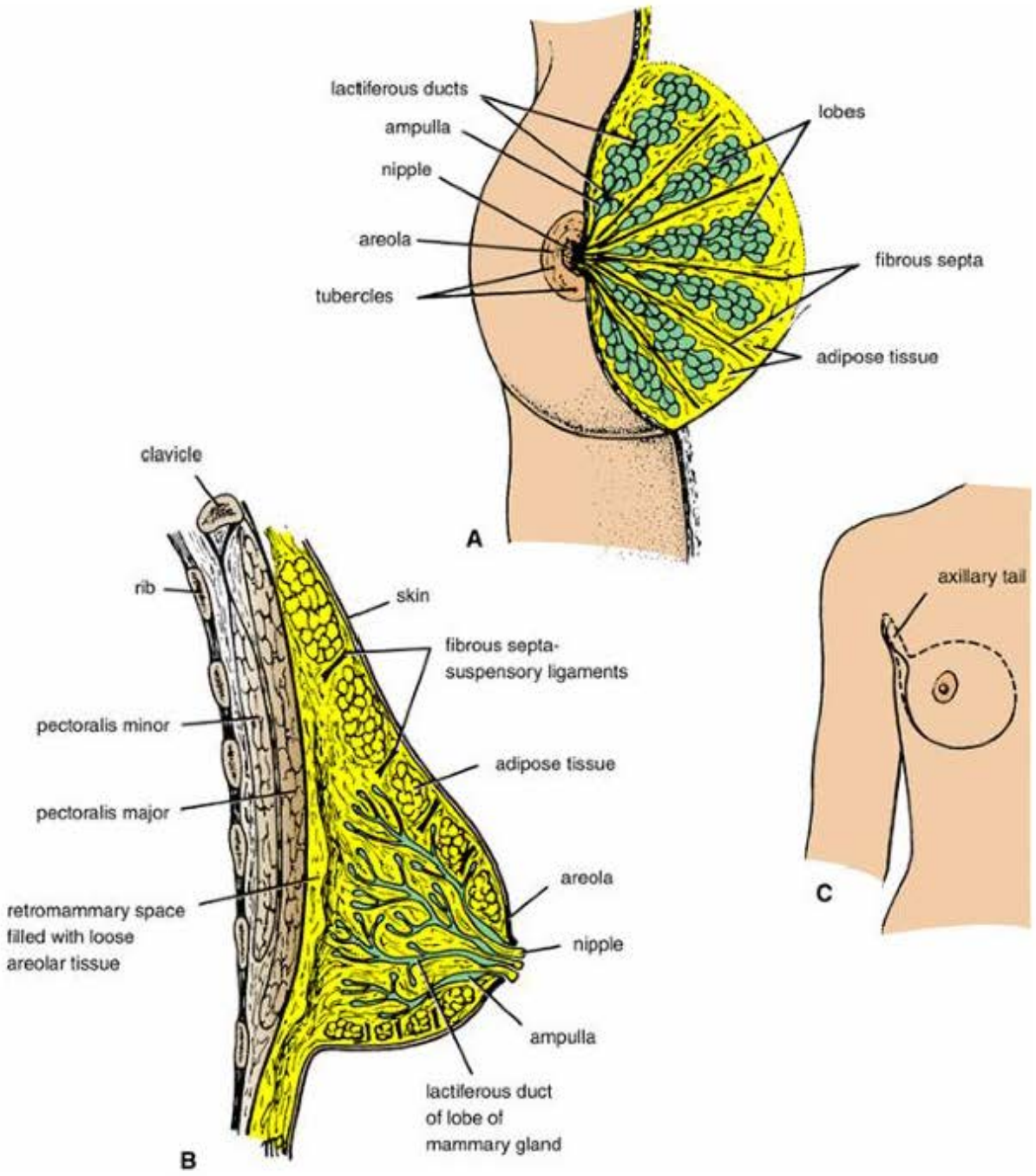


Fig. 1: Mature breast in the female. A. Anterior view with skin partially removed to show internal structure. B. Sagittal section. C. The axillary tail, which pierces the deep fascia and extends into the axilla.

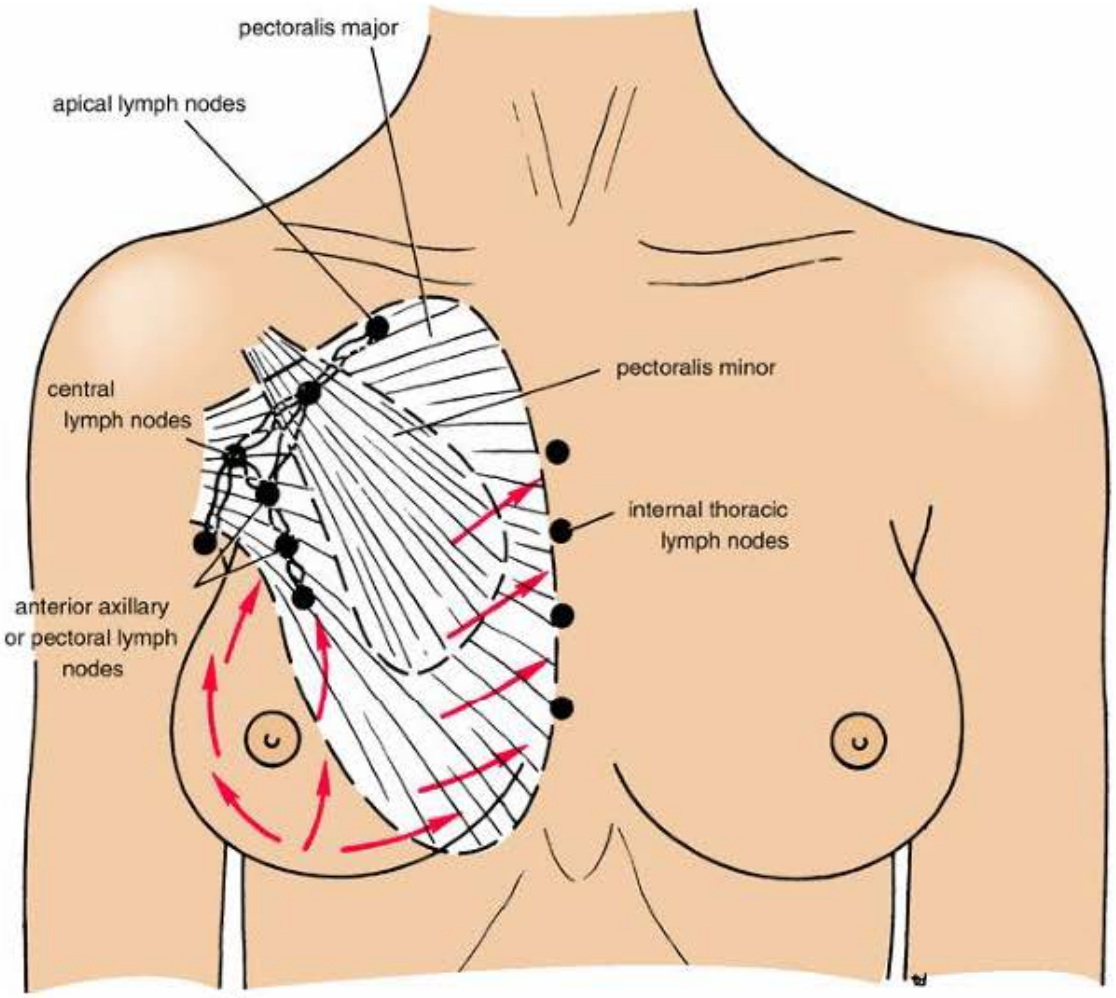


Fig. 2: Lymph drainage of the breast

Breast lies over 3 muscles (muscle bed):-

1. Pectoralis major
2. Serratus anterior
3. External oblique muscle of the abdomen

Arterial Supply of Breast:

1. Perforating branches of internal thoracic A.
2. Intercostal arteries
3. Lateral thoracic artery
4. Thoraco-acromial artery

Venous Drainage of Breast:

1. Axillary vein
2. Intercostal veins
3. Internal thoracic vein

Lymphatic Drainage of Breast (Fig. 2):

Lymph vessels inside breast are arranged in:

1. Interlobular plexus: Lies between lobules
2. Subareolar plexus: Lies beneath the areola

Lymph vessels drain 4 quadrants of breast:

1. Lateral quadrants: Drain into anterior axillary (pectoral) group of nodes (75%).
2. Medial quadrants: Drain into parasternal nodes (along internal thoracic artery) (25%).
3. Few lymph vessels follow posterior intercostal arteries to drain into posterior intercostal lymph nodes (Lateral Quadrants).
4. Some vessels communicate with lymph vessels of the other breast (Medial Quadrants).
5. Inferior quadrants vessels: Join with lymph vessels of anterior abdominal wall (plexus on rectus sheath & subphrenic plexus)
6. Upper quadrants: Drain into apical nodes.

MUSCLES OF PECTORAL REGION

Pectoralis Major: (Fig. 3)

Origin:

- Clavicular head: Anterior surface of medial half of clavicle
- Sternocostal head: Front of sternum, front of upper 6 costal cartilages and aponeurosis of external oblique muscle

Insertion:

Lateral lip of bicipital groove of humerus

Nerve supply:

Medial and lateral pectoral nerves

Action:

Adduction, flexion and medial rotation of arm

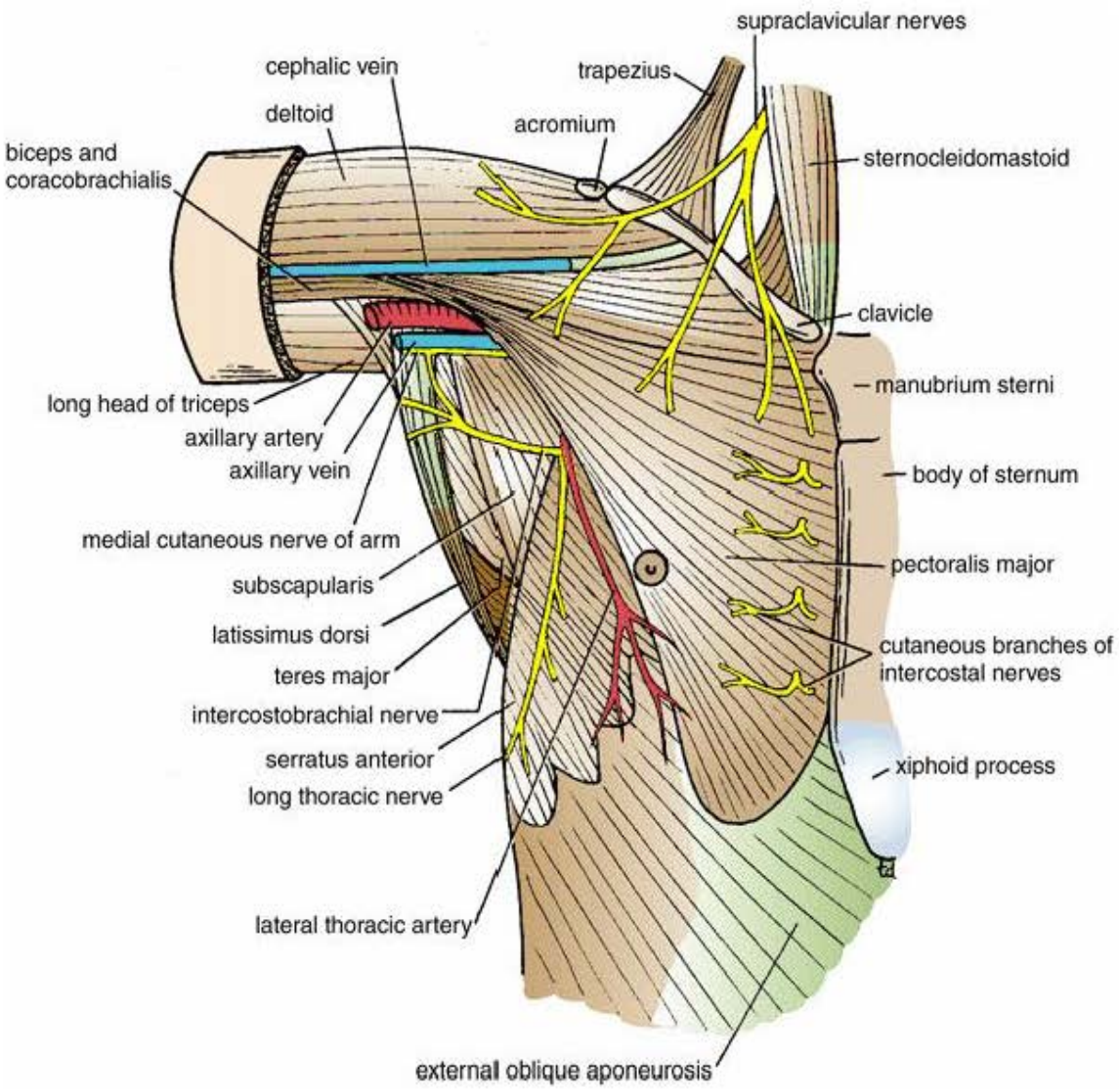


Fig. 3: Pectoral region and axilla.

Pectoralis Minor: (Fig. 4)
Origin: The 3rd, 4th and 5th ribs
Insertion: Medial border and upper surface of coracoid process of scapula
Nerve supply: Medial pectoral nerve
Action: Depression and protraction of scapula

Subclavius: (Fig. 4)
Origin: 1st rib at its costochondral junction
Insertion: groove on inferior surface of clavicle
Nerve supply: Nerve to subclavius (upper trunk)
Action: Steadies clavicle during movements of shoulder girdle.

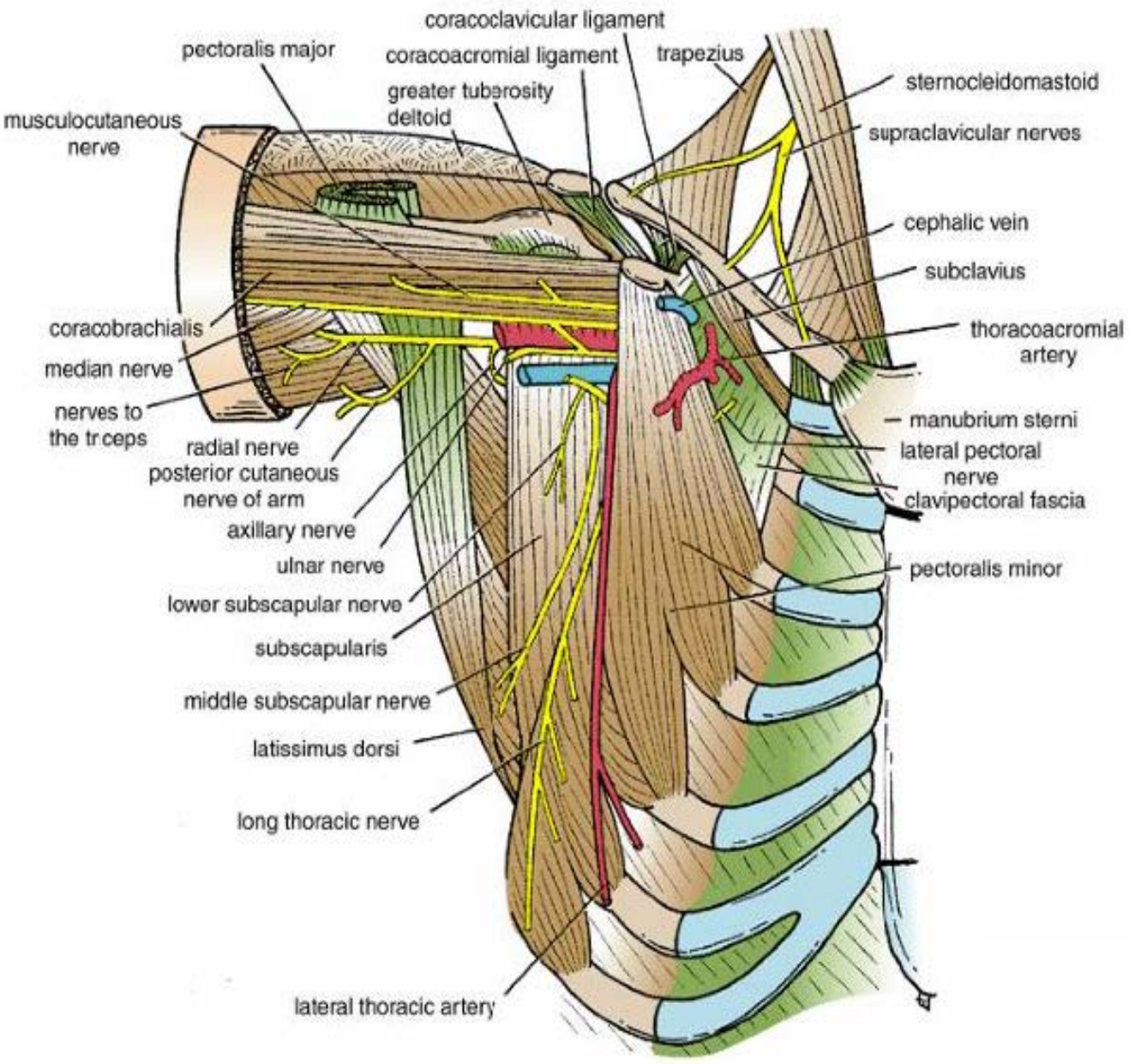


Fig. 4: Pectoral region and axilla; the pectoralis major muscle has been removed to display the underlying structures

Delto-Pectoral Groove:

It is a groove between adjacent borders of pectoralis major and deltoid.

Structures lie in delto-pectoral groove:

1. Uppermost part of cephalic vein
2. Deltoid branch of thoraco-acromial artery
3. Deltopectoral lymph nodes

Clavipectoral Fascia: (Fig. 5)

- A strong fibrous sheet lies deep to clavicular head of pectoralis major.
- Extends from pectoralis minor (below) to clavicle (above) where it splits to enclose subclavius
- Its upper border, along lower border of subclavius, thickened to form *costo-coracoid ligament* that extends from anterior end of 1st rib medially to coracoid process laterally.

Structures piercing the clavipectoral fascia:

1. Cepalic vein, ends in axillary vein
2. Acromio-thoracic artery, branch of 2nd part of axillary artery
3. Lateral pectoral nerve, supplies pectoralis major
4. Lymph vessels, connect superficial lymph vessels with deep apical nodes

AXILLA

- A pyramid-shaped space between upper part of the arm and side of the chest (Figs. 5-6).
- Forms an important passage for nerves, blood, and lymph vessels from root of the neck to the upper limb.

Apex (upper end) of axilla:

- **Front:** Clavicle
- **Behind:** Upper border of scapula
- **Medial:** Outer border of 1st rib

Base (lower end) of axilla:

- **Front:** Anterior axillary fold (pectoralis major)
- **Behind:** Posterior axillary fold (tendon of latssmus dorsi and teres major)
- **Medial:** Chest wall
- Skin stretched between anterior and posterior axillary walls

Anterior wall of axilla (Pectoral Region):

- Pectoralis major
- Pectoralis minor
- Subclavius
- Clavipectoral fascia

Posterior wall of axilla:

- Subscapularis
- Latissmus dorsi
- Teres major

Medial wall of axilla:

- Upper 4-5 ribs
- Intercostal spaces
- Serratus anterior

Lateral wall of axilla:

- Coracobrachialis
- Biceps brachii
- Bicipital groove of the humerus

Contents of Axilla:

1. Axillary artery and its branches
2. Axillary vein and its tributaries
3. Brachial plexus; cords and branches
4. Axillary lymph vessels and lymph nodes
5. Fat

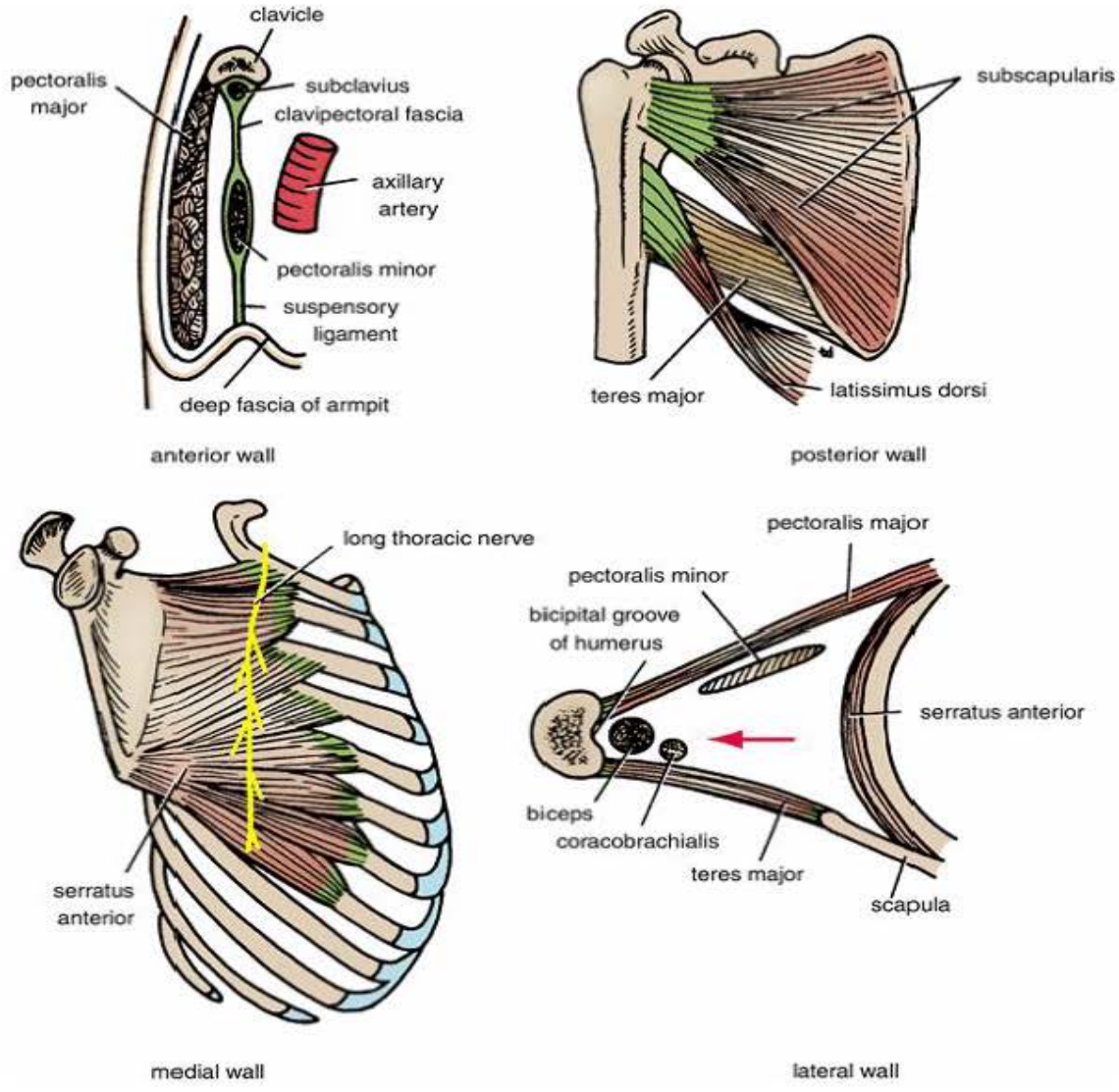


Fig. 5: Structures that form the walls of the axilla. The lateral wall is indicated by the arrow.

AXILLARY ARTERY (Fig. 7)

Beginning of axillary artery:

- Continuation of subclavian artery
- At outer border of first rib

End of axillary artery:

- Continues as brachial artery
- At lower border of teres major muscle

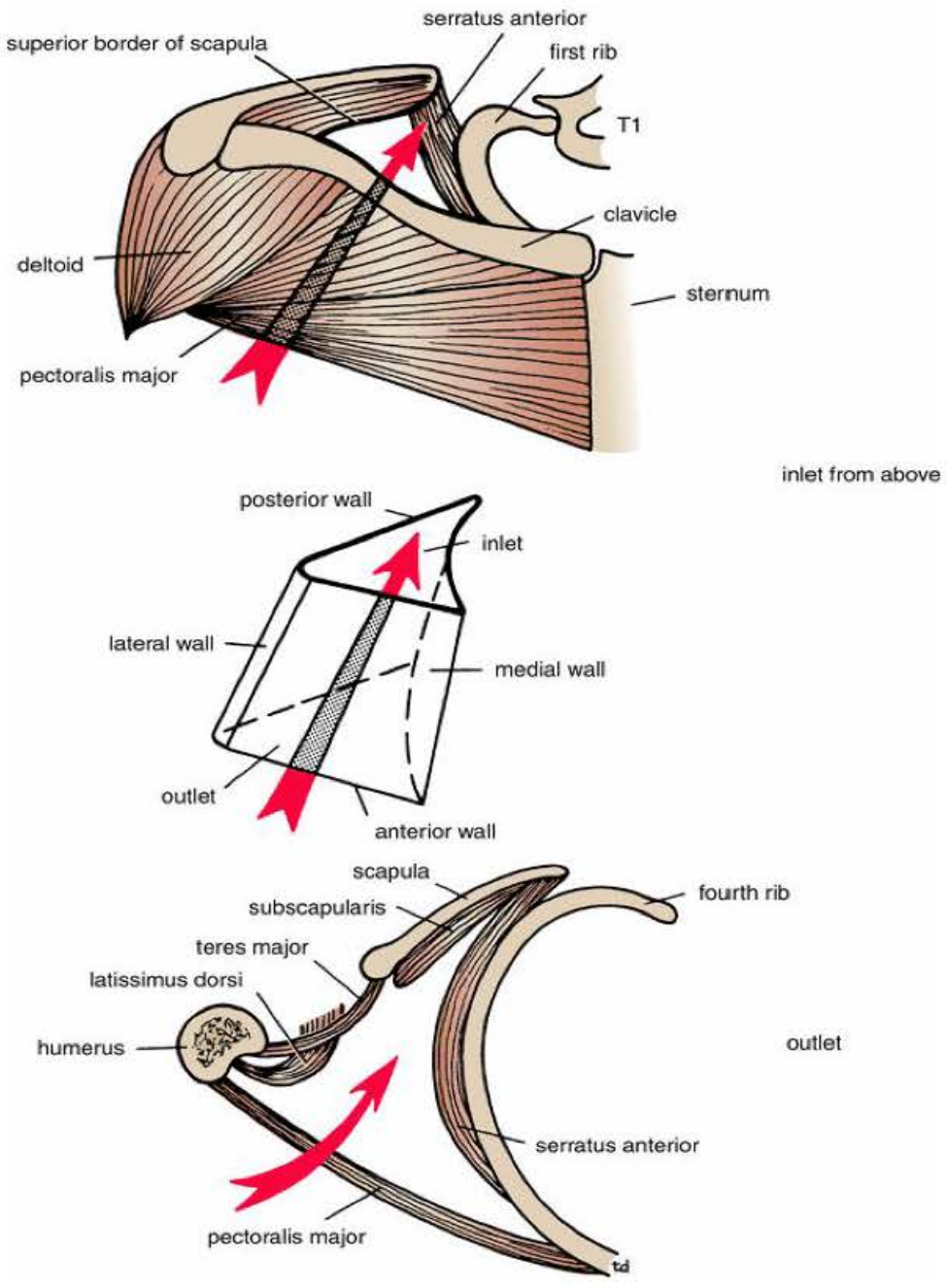


Fig. 6: Inlet, walls, and outlet of the right axilla.

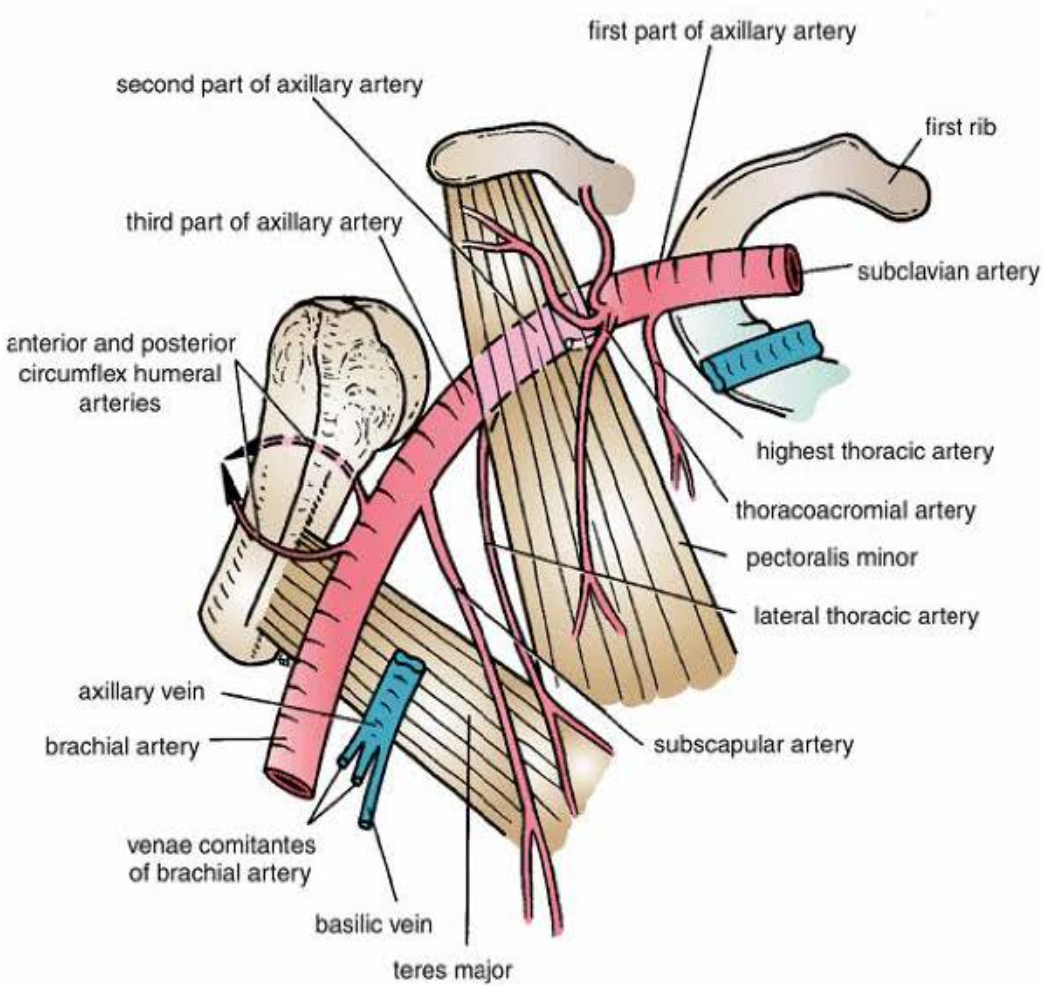


Fig. 7: Parts of the axillary artery and its branches. Note formation of the axillary vein at the lower border of the teres major muscle.

Parts of axillary artery:

1. First part: Part above pectoralis minor
2. Second part: Part deep to pectoralis minor
3. Third part: Part below pectoralis minor

Relations of first part of axillary artery:

Enclosed with axillary vein and cords of brachial plexus in axillary sheath

Anterior relations of 1st part of axillary artery:

1. Clavicular part of pectoralis major
2. Clavipectoral fascia
3. Crossed by:
   - Lateral pectoral nerve
   - Communication between lateral and medial pectoral nerves
   - Cephalic vein

Posterior relations of 1st part of axillary artery:

1. First digitations of serratus anterior
2. Medial cord of brachial plexus
3. Long thoracic nerve

Lateral relations of 1st part of axillary artery:

1. Lateral cord of brachial plexus
2. Posterior cord of brachial plexus

Medial relations of 1st part of axillary artery:

1. Axillary vein
2. Apical group of axillary lymph nodes

Relations of 2nd part of axillary artery:

Anterior relations of 2nd part of axillary artery:

1. Pectoralis major 2. Pectoralis minor

Posterior relations of 2nd part of axillary artery:

1. Subscapularis
2. Posterior cord of brachial plexus

Lateral relations of 2nd part of axillary artery:

1. Coracobrachialis
2. Lateral cord of brachial plexus

Medial relations of 2nd part of axillary artery:

1. Axillary vein
2. Medial cord of brachial plexus

Relations of 3rd part of axillary artery:

Anterior relations of 3rd part of axillary artery:

1. Upper part covered by pectoralis major
2. Lower part covered only by skin and fascia

Posterior relations of 3rd part of axillary artery:

1. Subscapularis
2. Tendon of insertion of teres major
3. Tendon of insertion of latissmus dorsi
4. Radial nerve 5. Axillary nerve

Lateral relations of 3rd part of axillary artery:

1. Coracobrachialis 2. Median nerve
3. Musculocutaneous nerve

Medial relations of 3rd part of axillary artery:

1. Axillary vein
2. Ulnar nerve
3. Medial cutaneous nerve of forearm

Branches of 1st part of axillary artery:

Superior thoracic artery:

Supplies upper part of front of chest wall

Branches of 2nd part of axillary artery:

1. **Thoraco-acromial artery: Divides into:-**
   a. Acromial: Towards acromion
   b. Pectoral: Passes between 2 pectoral muscles
   c. Clavicular: Towards sternoclavicular joint
   d. Deltoid: Supplies deltoid & Pectoralis major
2. **Lateral thoracic artery:**
   - Gives lateral mammary branches to breast
   - Anastomoses with superficial epigastric A.

Branches of 3rd part of axillary artery:

1. **Subscapular artery:**
   - Gives circumflex scapular artery to infraspinous fossa.
   - Continuous as thoracodorsal artery to latissimus dorsi
2. **Anterior circumflex humeral artery:**
   - Runs front surgical neck of humerus.
   - Gives ascending branch at bicipital groove to shoulder joint
3. **Posterior circumflex humeral artery:**
   - Runs behind surgical neck of humerus
   - Gives descending branch.

Surface anatomy of axillary artery:

With arm raised to right angle with trunk (abducted), axillary artery is represented by a line drawn from mid-clavicular point to medial side of middle of arm where pulsation can be felt

Anastomosis around scapula(fig.8):

1. Subscapular artery and its circumflex scapular branch (axillary artery)
2. Suprascapular artery (subclavian artery)

3. Deep branch of transverse cervical artery (thyrocervical trunk of subclavian artery)
4. Lateral and dorsal branches of posterior intercostal arteries(descending thoracic aorta)

Anastomosis around surgical neck of humerus:

1. Anterior circumflex humeral artery
2. Posterior circumflex humeral artery
3. Ascending branch of profunda brachii artery

Anastomosis around shoulder joint:

1. Acromial and deltoid branches of thoraco-acromial artery (axillary artery)
2. Suprascapular artery (subclavian artery)
3. Ascending branch of anterior circumflex humeral artery (axillary artery)

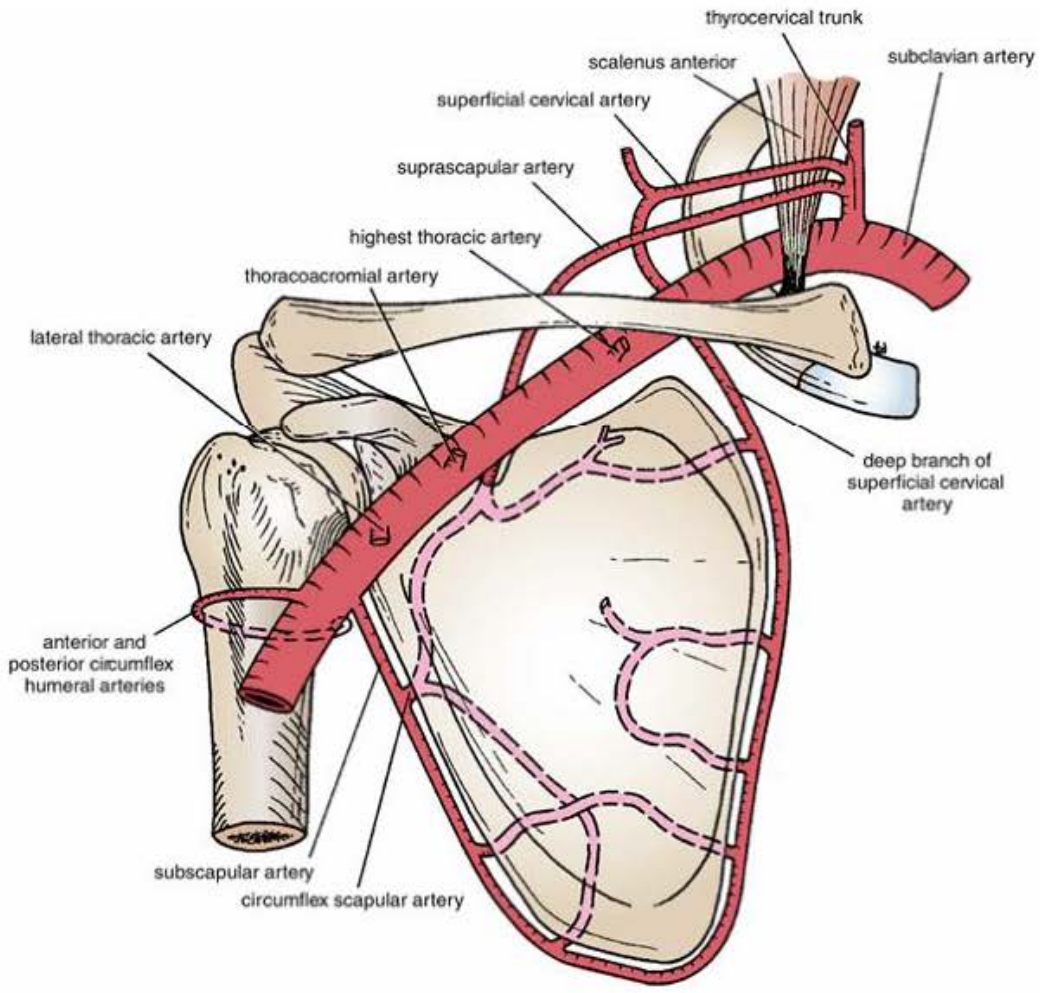


Fig. 8: Arteries that take part in anastomosis around the shoulder joint

AXILLARY VEIN (Fig. 9)

Beginning of axillary vein:

- Continuation of basilica vein
- At lower border of teres major

End of axillary vein:

- Continues as subclavian vein
- At outer border of first rib

Relations of axillary vein:

Laterally; axillary artery, separated from it by medial cord of brachial plexus, ulnar nerve and medial cutaneous nerve of forearm.

Medially; lateral and apical groups of axillary lymph nodes and medial cutaneous nerve of arm

Tributaries of axillary vein:

1. Basilic vein
2. Venae comitantes of the brachial artery
3. Cephalic vein
4. Superior thoracic vein
5. Lateral thoracic vein
6. Thoracoacromial vein
7. Subscapular vein
8. Anterior circumflex humeral vein
9. Posterior circumflex humeral vein

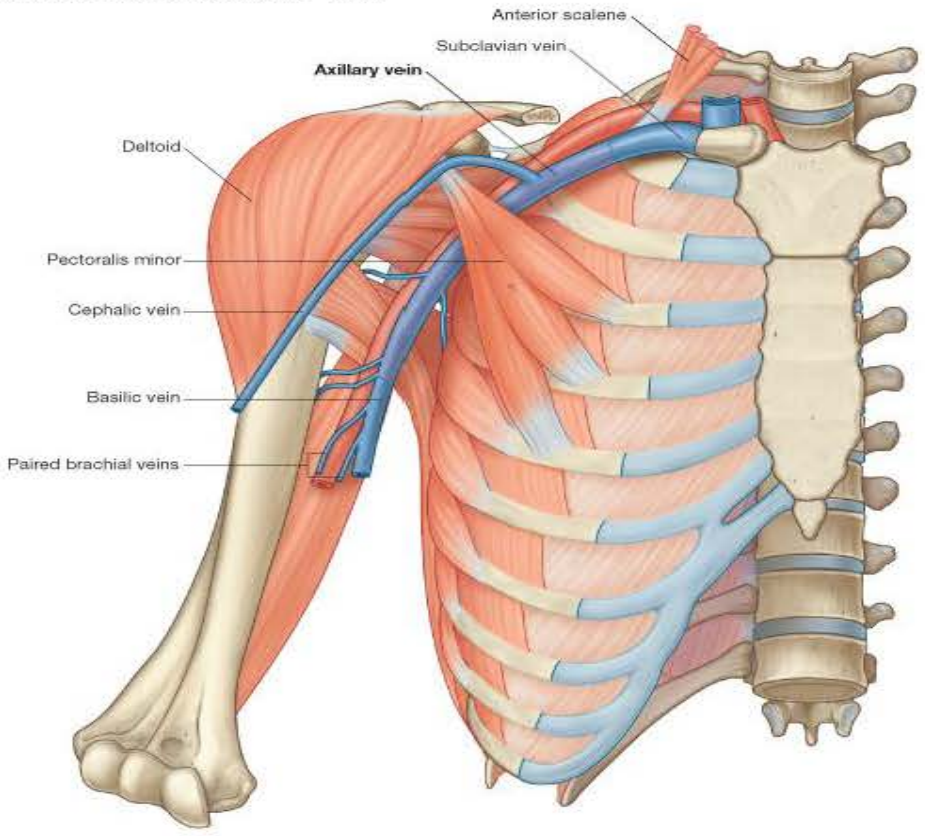


Fig. 9: Axillary vein

AXILLARY LYMPH NODES (Fig. 10)

- About 20-30 lymph nodes
- Arranged in 5 groups
- Lie in relation to walls and apex of axilla
- Usually along blood vessels

Lateral group:

- Lies In lateral wall of axilla
- Along: Axillary vein.
- Receives lymph from: Almost upper limb EXCEPT area drained by lymphatic which accompany cephalic vein
- Sends efferents to: Central, apical and lower deep cervical nodes

Anterior (Pectoral) group:

- Lies: In relation to anterior wall of axilla
- Along: Lower border of pectoralis minor, axillary tail and lateral thoracic vessels
- Receives lymph from:
  - Lateral quadrants of breast
  - Anterolateral wall of trunk above level of umbilicus
- Sends efferents to: Central and apical nodes

Posterior (Subscapular) group:

- Lies: In relation to posterior wall of axilla
- Along: Subscapular vessels
- Receives lymph from: Posterior wall of trunk above level of iliac crest and back of shoulder region
- Sends efferents to: Central and apical nodes

Central group:

- Embedded: In fat of axilla near its base
- Receives lymph from: Anterior, posterior and lateral groups
- Sends efferent vessels to: Apical nodes

Apical group:

- Placed at apex of axilla along medial side of upper part of axillary vein

- Lies just below clavicle
- Deep to clavipectoral fascia
- Receives afferent vessels from:
  - Anterior, posterior, lateral and central nodes
  - Upper quadrant of mammary gland
  - Lymph vessels which accompany cephalic V

- Sends efferents to:
  - Lower deep cervical nodes
  - Subclavian lymph trunk (right joins jugular lymph trunk to form right lymphatic trunk and left ends in thoracic duct)

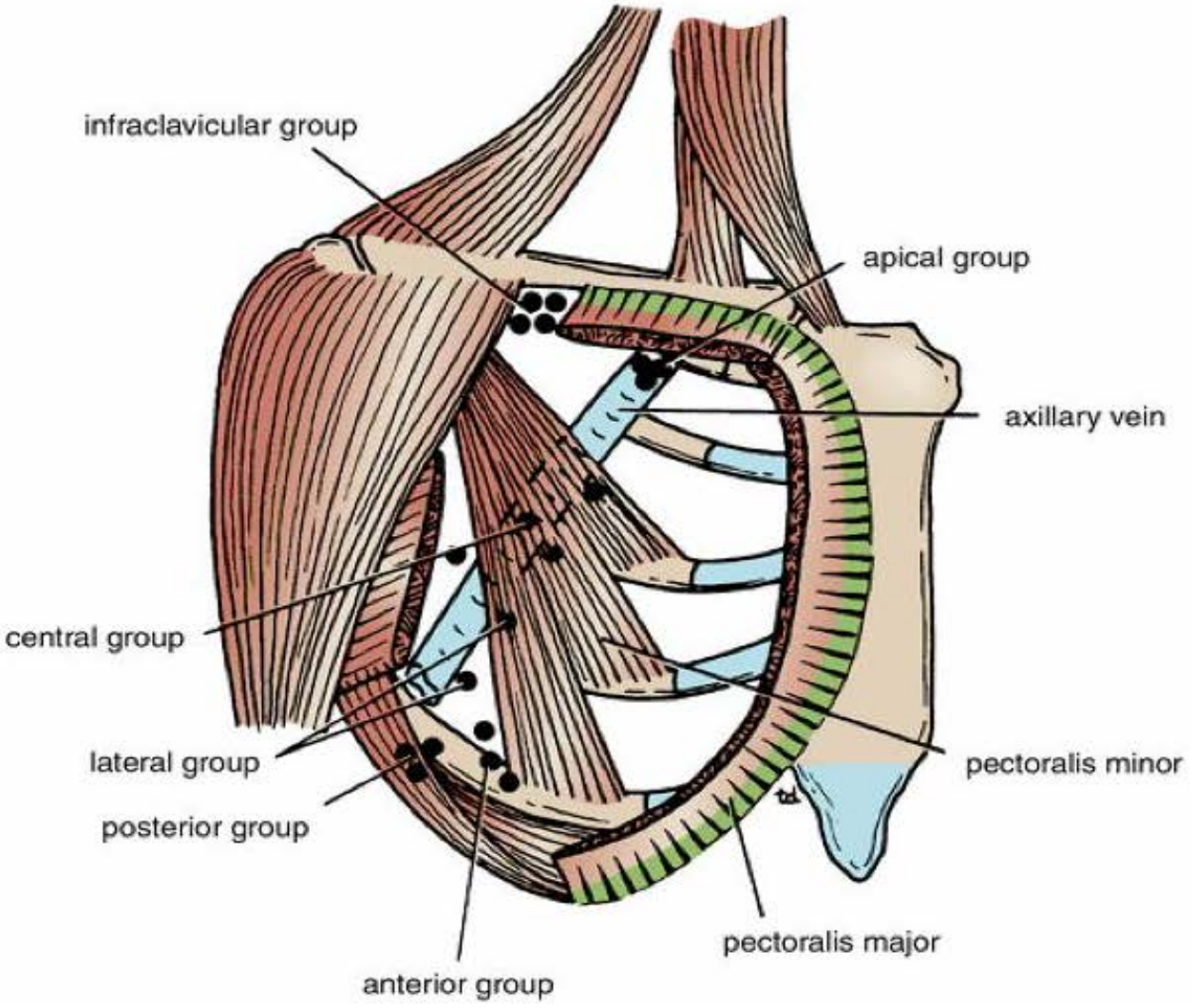


Fig. 10: Different groups of lymph nodes in the axilla.

BRACHIAL PLEXUS

Formation of brachial plexus (Fig. 11):

A collection of nerves which lies partly in the neck and partly in the axilla

Roots of brachial plexus:

Ventral primary rami of the 5th, 6th, 7th, 8th cervical and 1st thoracic nerves
Prefixed brachial plexus: Contribution from C4
Postfixed brachial plexus: Contribution from T2

Trunks of brachial plexus:

- **Upper trunk:** Union of C 5 and 6 roots
- **Middle trunk:** C 7 root only
- **Lower trunk**: union of C 8 and T 1 roots

The trunks lie in posterior triangle of the neck

Divions of brachial plexus:

Each trunk divides behind clavicle into anterior and posterior divisions

Cords of brachial plexus(fig.12):

The cords lie in the axilla

1. lateral cord: union of anterior divisions of upper and middle trunks (C5, 6, 7)
2. Medial cord: anterior division of lower trunk only (C8, T1)
3. Posterior cord: union of posterior divisions of the 3 trunks (C 5, 6, 7, 8, T1)

Branches of Brachial Plexus:

Branches from roots (C 5, 6, 7, 8, T 1):

1. Dorsal scapular nerve (C 5)
2. Long thoracic nerve (C5, 6, 7)
3. Branch to phrenic nerve from (C 5)
4. Twigs to scalene muscles
5. Twigs to longus coli muscles

Branches from upper trunk (C 5, 6):

1. Suprascapular nerve (C 5, 6)
2. Nerve to subclavius (C 5, 6)

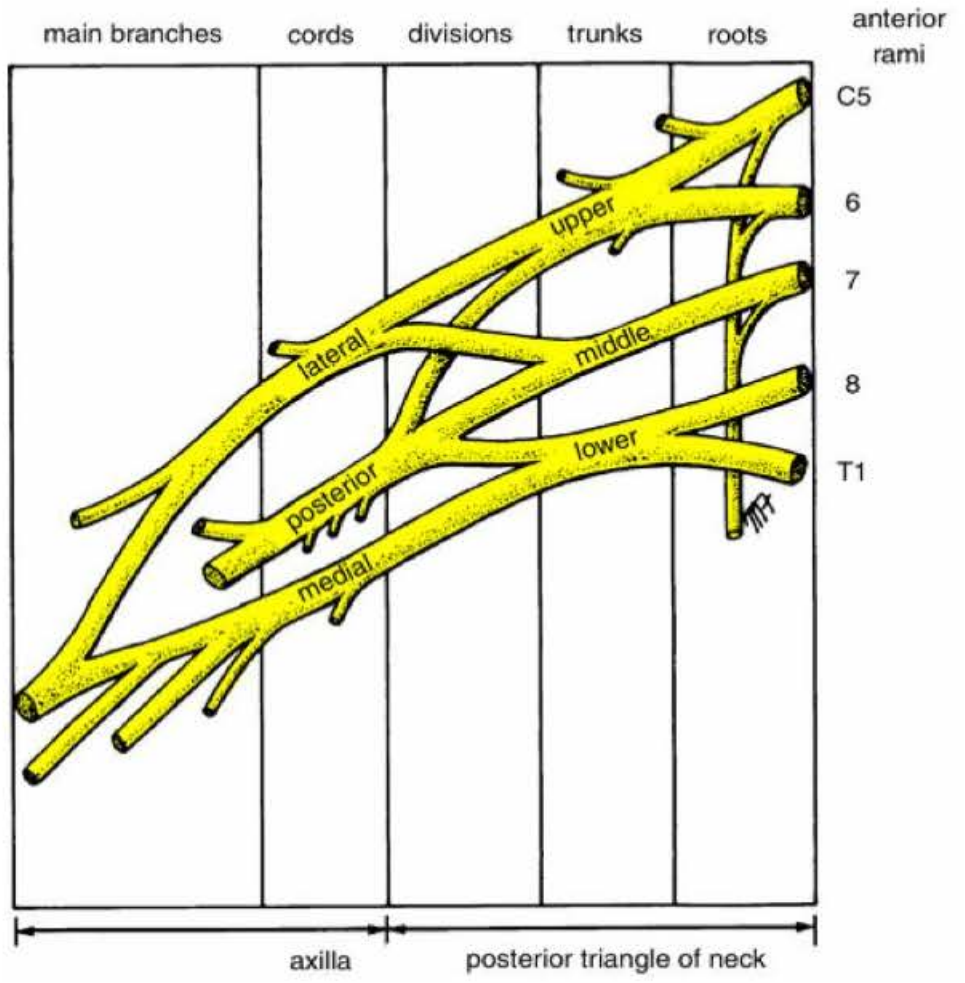


Fig. 11: The formation of the main parts of the brachial plexus. Note the locations of the different parts.

Branches from lateral cord (C 5, 6, 7):

1. Lateral pectoral nerve (C5, 6, 7)
2. Musculocutaneous nerve (C 5, 6, 7)
3. Lateral root of median nerve (C 5, 6, 7)

Branches from medial cord (C 8, T 1):

1. Medial pectoral nerve (C 8, T 1)
2. Medial cutaneous nerve of arm (C 8, T 1)
3. Medial cutaneous nerve of forearm (C 8, T 1)
4. Ulnar nerve (C 7, 8, T 1)
5. Medial root of median nerve (C 8, T 1)

Branches from posterior cord (C5, 6, 7, 8, T 1):

1. Upper subscapular nerve (C5, 6)
2. Lower subscapular nerve (C 5, 6)
3. Thoracodorsal nerve (C6, 7, 8)
4. Axillary nerve (C 5, 6)
5. Radial nerve (C 5, 6, 7, 8, T 1)

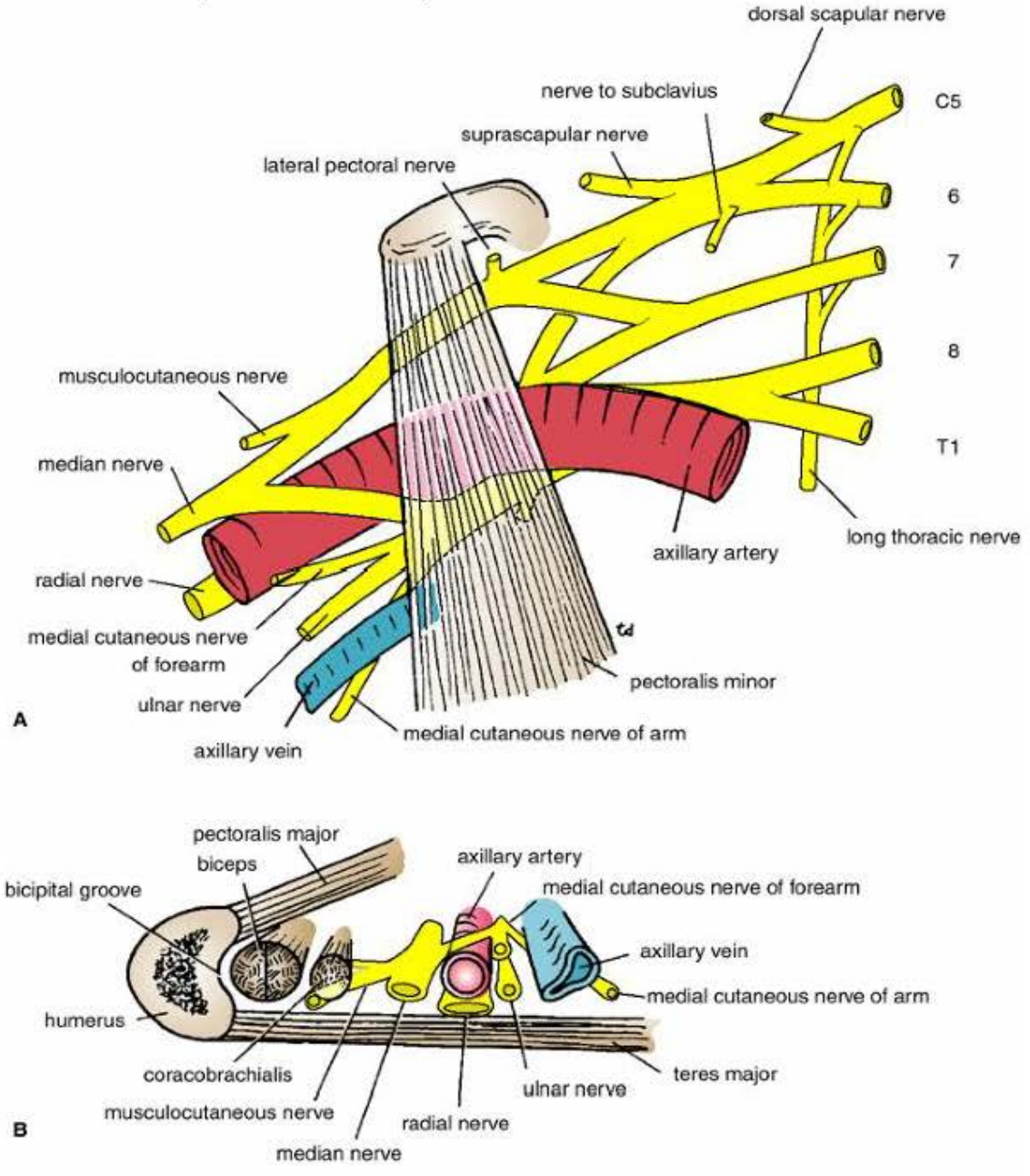


Fig. 12: A. Relations of the brachial plexus and its branches to the axillary artery and vein. B. Section through the axilla at the level of the teres major muscle

APPLIED ANATOMY:

Erb's paralysis:

- Due to injury to upper trunk of brachial plexus (C 5, 6)
- Muscles supplied by C5, 6 are paralysed; deltoid, biceps , brachialis, brachioradialis, supraspinatus, infraspinatus, teres minor, teres major, subscapularis and supinator.
- They are abductors and lateral rotators of shoulder, flexors of elbow and supinators of forearm.
- Upper limb acquires porter's tip deformity:
  - Arm hangs by the side and can not be abducted (paralysis of abductors of shoulder)
  - Forearm is extended at elbow joint and pronated (paralysis of flexors of elbow and supinators of forearm).

Klumpke's paralysis:

- Due to injury of lower trunk of brachial plexus (C 8, T 1)
- Muscles paralysed are mainly intrinsic muscles of the hand with partial affection of flexor digitorum profundus.
- Hand acquires claw-hand deformity:
  - Extension at metacarpophalangeal joints
  - Flexion at interphalangeal joints especially medial 2 fingers. Wrist is not severely affected (flex. carpi ulanris is supplied by C7)

MUSCLES OF THE BACK

Muscles of upper limb in back are arranged in:

I. Superficial layer:

1. Trapezius 2. Latissimus dorsi

II. Deep layer:

1. Levator scapulae 2. Rhomboideus minor
3. Rhomboideus major

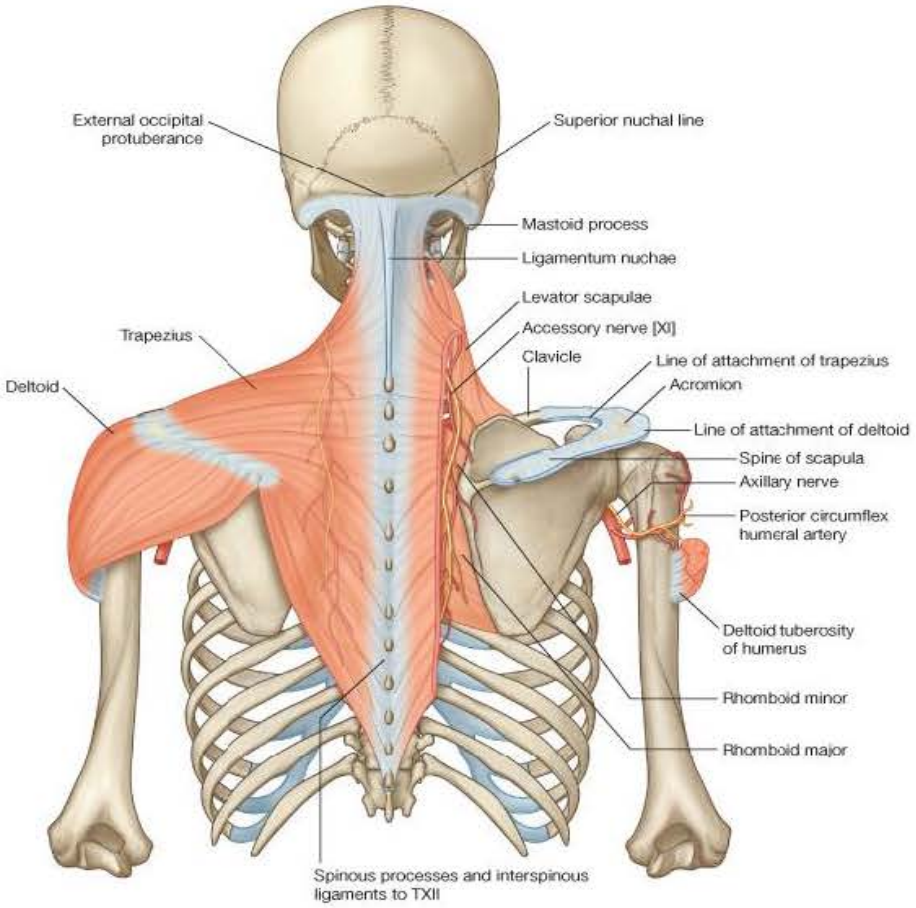


Fig. 13: Attachment and neurovascular supply of the trapezius, rhomboids and levator scapulae muscles

Trapezius: (Fig. 13)

- Large triangular flat muscle
- Covers upper ½ of the back including back of neck
- 2 muscles of both sides form together outline of a trapezius (4-sided figure).

Origin:

1. Medial 1/3 of superior nuchal line
2. External occipital protuberance
3. Ligamentum nuchae
4. Spines of 7th cervical and all thoracic vertebrae and their supraspinous ligaments.

Insertion:

1. Upper fibers: Posterior border of lateral 1/3 of clavicle
2. Middle fibers: Medial margin of the acromion and superior lip of the crest of spine of scapula

3. Lower fibers: Tubercle of the crest of spine of scapula (close to root of spine).

Nerve supply of trapezius:

- Spinal root of accessory nerve (motor)
- 3rd and 4th cervical nerves (sensory)

Action of trapezius:

1. Upper fibers: Elevation of shoulder girdle. Acting with lower fibers of trapezius and lower digitations of serratus anterior rotate the scapula to raise the arm above the head
2. Middle fibers: Retraction of the scapula
3. Lower fibers: Depression of the scapula. Rotate scapula so glenoid cavity faces upward

Applied Anatomy:

- Paralysis of trapezius due to injury of spinal accessory nerve leads to drooping of shoulder.

Latissimus Dorsi: (Fig. 14)

- Large triangular flat muscle
- Covers lower ½ of back down to iliac crest
- Has wide origin (latissimus means wide)

Origin:

1. Spines of lower 6 thoracic vertebrae and supraspinous ligaments
2. Posterior layer of thoracolumbar fascia
3. Posterior part of outer lip of iliac crest
4. Lower 4 ribs
5. Back of inferior angle of scapula

Insertion:

Floor of intertubercular groove of the humerus

Nerve supply:

- Thoracodorsal nerve (C6, 7, 8)

Action:

- Powerful adductor, extensor and medial rotator of the arm at shoulder joint.

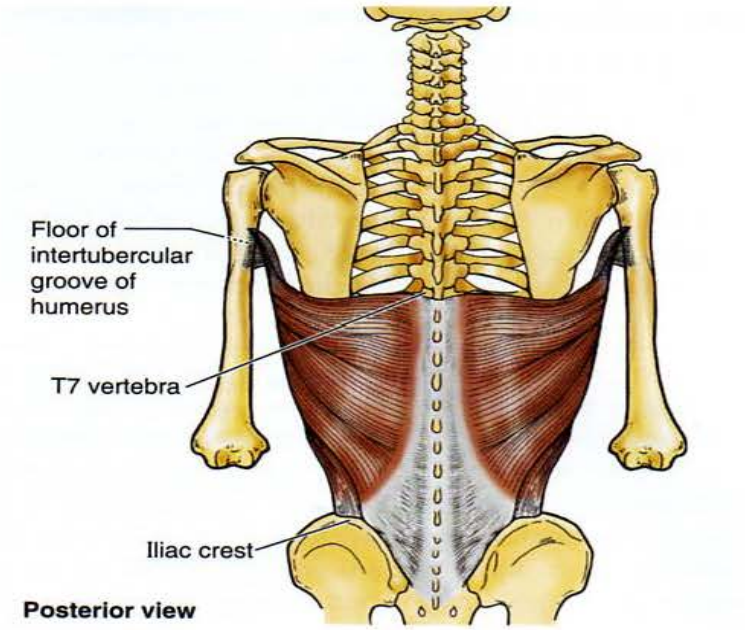


Fig. 14: Latissmus dorsi

Triangle of Auscultation:

- Situated medial to lower part of scapula
- Above and medial: lower part of lateral border of trapezius.
- Lateral: Lower part of medial border of scapula.
- Below: Upper border of latissimus dorsi
- Floor:
  - Rhomoideus major
  - 6th and 7th ribs and the space in between

Lumbar Triangle

- Situated just above middle part of iliac crest
- Below: Iliac crest
- Medial: Lateral border of latissimus dorsi
- Lateral: Posterior border of external oblique
- Floor:
  - Internal oblique muscle of abdomen
  - Transversus abdominis muscle of abdomen

Rhomboideus Major: (Fig. 15)

Origin:

- Spines of the 2nd, 3rd, 4th, and 5th thoracic vertebrae and related supraspinous ligaments

Insertion:

- Back of medial border of scapula from root of spine to inferior angle of scapula

Nerve supply:

- Dorsal scapular nerve (C 5)

Action:

- Retraction of the shoulder

Rhomboideus Minor: (Fig. 15)

Origin:

- Lower part of ligamentum nuchae
- Spines of 7th cervical and 1st thoracic vertebrae

Insertion:

Back of medial border of scapula opposite root of the spine

Nerve supply:

Dorsal scapular nerve (C 5)

Action:

Retraction of the shoulder

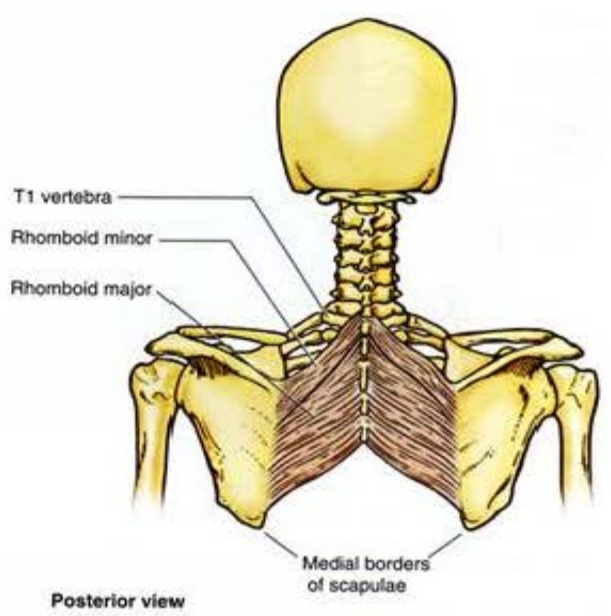


Fig.15: Rhomboid muscles

Levator Scapula: (Fig. 16)

Origin:

Transverse processes of upper 4 cervical vertebrae

Insertion:

Back of medial border of the scapula, from superior angle to root of its spine

Nerve supply:

- Dorsal scapular nerve (C 5)
- 3rd and 4th cervical nerves (cervical plexus)

Action:

- Elevation of the scapula
- Retraction of the scapula

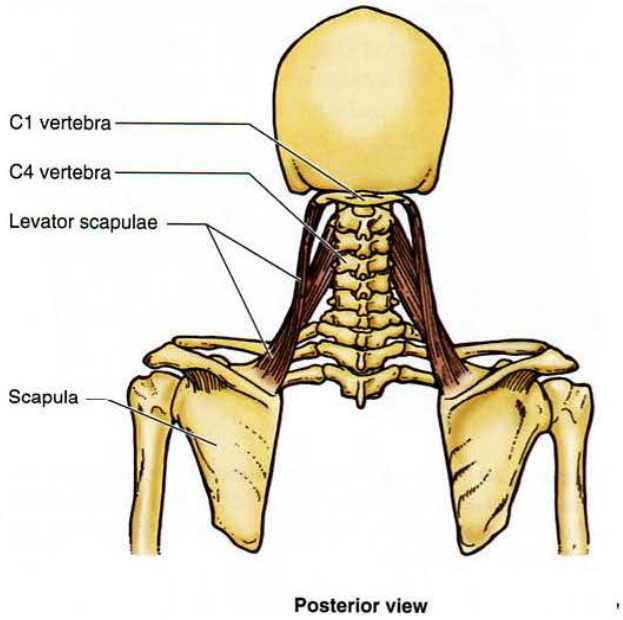


Fig. 16: Levator scapulae

Dorsal Scapular Nerve

- Arises in the neck from the uppermost root of the brachial plexus (C 5)
- Descends deep to levator scapulae and 2 rhomboids close to medial border of the scapula.
- Accompanied by dorsal scapular artery (deep branch of transverse cervical artery)
- Supplies:
  1. Levator scapula
  2. Rhomboideus minor
  3. Rhomboideus major

Muscles Of Shoulder Region (Scapular Muscles)

1. Deltoid
2. Subscapularis
3. Spraspinatus
4. Infraspinatus
5. Teres minor
6. Teres major
7. Serratus anterior
8. Inferior belly of omohyoid

Deltoid Muscle: (Fig.17)

- Thick, strong, triangular muscle
- Forms rounded contour of the shoulder

Origin:

1. Anterior border of lateral 1/3 of clavicle (ant.)
2. Lateral margin of the acromion (middle part)
3. Lower lip of crest of spine of scapula (post. p.)

Insertion:

Deltoid tuberosity of the humerus

Nerve supply:

Axillary nerve (C 5, 6)

Action:

Anterior part: Flexion and medial rotation of the arm at the shoulder joint

Middle part: abduction of arm from 15 to 90

Posterior part: Extension and lateral rotation of the arm at the shoulder joint

Applied Anatomy Of The Deltoid:

Lesion of axillary nerve leads to paralysis of deltoid which results in:

1. Flat shoulder
2. Prominent acromion due to loss of rounded contour of the muscle and its wasting
3. Loss of abduction from 15 to 90

Deep Relations of The Deltoid:

Bones: Coracoid process, head, greater and lesser tuberosities and surgical neck of humerus

Joint and Ligaments: shoulder joint, coracoacromial ligament, subacromial bursa

Muscles: Tendons of insertion of pectoralis major, pectoralis minor, subscapularis, supraspinatus, infraspinatus and teres minor

Axillary nerve

Vessels: Anterior and posterior circumflex humeral vessels

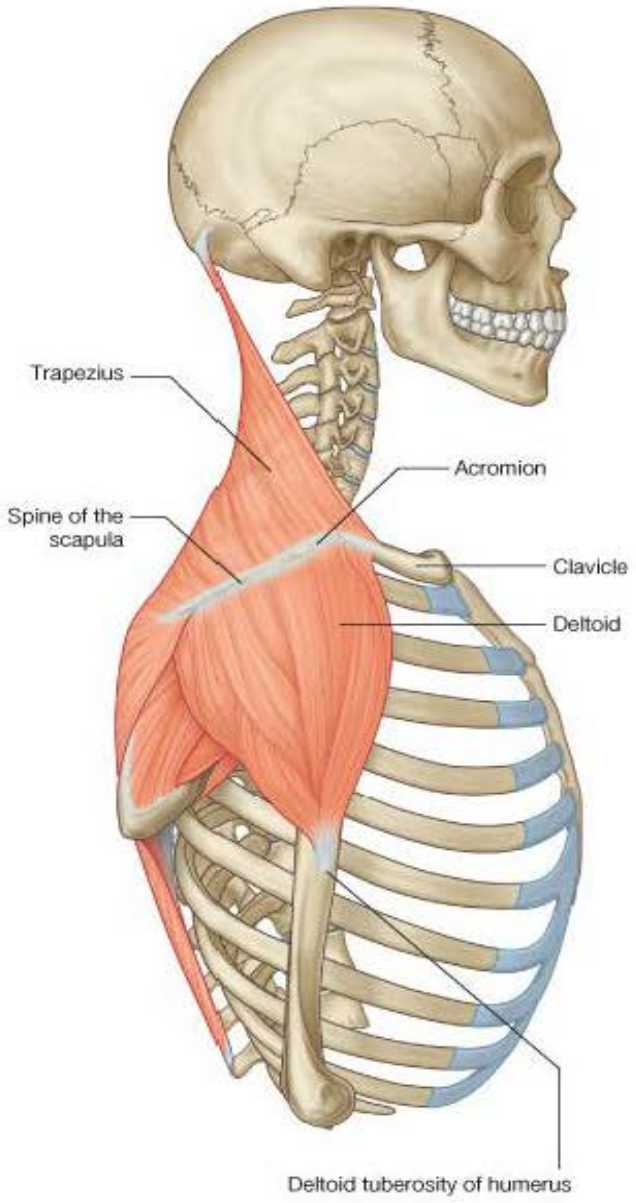


Fig. 17: Lateral view of trapezius and deltoid muscles.

Subscapularis Muscle (one of rotator cuff muscles): (Fig. 5)

Origin:

Medial 2/3 of subscapular fossa

Insertion:

Lesser tuberosity of the humerus

Nerve supply:

Upper and lower subscapular nerves (C5, 6)

Action:

Adduction and medial rotation of the arm

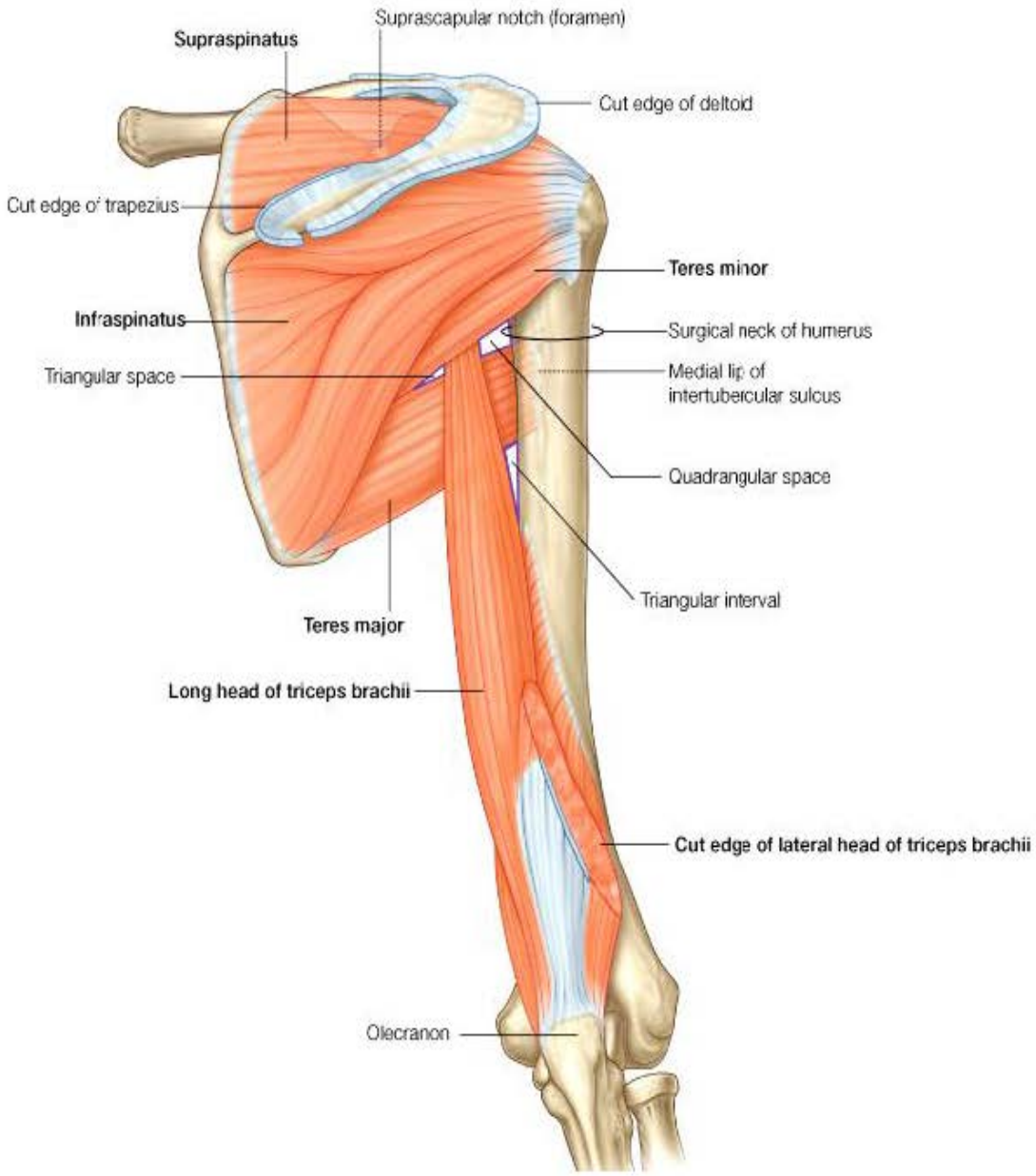


Fig. 18: Right posterior scapular region

Supraspinatus Muscle (one of rotator cuff muscles): (Fig. 18)

Origin:

- Medial 2/3 of supraspinous fossa.
- Overlying strong deep fascia.

Insertion:

Uppermost impression of greater tuberosity of the humerus

Nerve supply:

Suprascapular nerve (C5, 6)

Action:

- Abduction of the arm from 0 to 15.
- Assists in stabilizing the head of the humerus in the glenoid cavity.

Infraspinatus Muscle (one of rotator cuff muscles): (Fig. 18)

Origin:

- Medial 2/3 of infraspinous fossa
- Overlying strong deep fascia

Insertion:

Middle impression on greater tuberosity of the humerus

Nerve supply:

Suprascapular nerve (C5, 6)

Action:

- Adduction and lateral rotation of arm.
- Stabilization of shoulder joint

Teres Minor Muscle (one of rotator cuff muscles): (Fig. 18)

Origin:

Upper 2/3 of back of lateral border of scapula

Insertion:

Lowest impression on greater tuberosity of the humerus.

Nerve supply:

Axillary nerve (C5, 6)

Action:

1. Adduction and lateral rotation of arm
2. Stabilization of shoulder joint

Teres Major Muscle:

Origin:

Lower 1/3 of back of lateral border of scapula

Insertion:

Medial lip of bicipital groove of the humerus.

Nerve supply:

Lower subscapular nerve (C5, 6).

Action:

Adduction and medial rotation of the arm

ROTATOR CUFF MUSCLES:

1. Subscapularis 2. Supraspinatus
3. Infraspinatus 4. Teres minor

- Lie on anterior, superior and posterior aspects of the shoulder joint.
- Their tone assists in holding head of the humerus in glenoid cavity of the scapula during movements of the shoulder.
- Therefore, they stabilize the shoulder joint.
- The cuff is deficient inferiorly; this is a site of potential weakness.

Quadrangular Space: (Fig.18)

- Intermuscular space, below shoulder joint
- Lateral to long head of triceps brachii

Boundaries:

Above: Subscapularis, teres minor and capsule of shoulder joint
Below: Teres major
Lateral: Surgical neck of the humerus
Medial: Long head of triceps brachii

Contents:

1. Axillary nerve (C5, 6)
2. Posterior circumflex humeral vessels

Triangular Space:

- Intermuscular space
- Medial to long head of triceps brachii

Boundaries:

Above: Subscapularis and teres minor
Below: Teres major
Lateral: Long head of triceps brachii
Contents: Circumflex scapular vessels

Suprascapular Nerve (C 5, 6):

Course and Relations:

- Arises in the neck from upper trunk of brachial plexus
- Descends behind clavicle to reach upper border of scapula
- Passes through suprascapular notch below suprascapular ligament to enter supra-spinous fossa deep to supraspinatus
- Continues through spinoglenoid notch to infraspinous fossa

Branches of suprascapular nerve:

- Muscular branches to:
  1. Supraspinatus 2. Infraspinatus
- Articular branches to:
  1. Acromioclavicular joint 2. Shoulder joint

Suprascapular Artery:

Course and Relations:

- Arises in root of neck from thyrocervical trunk from 1st part of subclavian artery
- Passes behind clavicle and in front trunks of brachial plexus
- Accompanied by suprascapular nerve
- At upper border of scapula, it runs above suprascapular ligament to enter supra-spinous fossa deep to supraspinatus
- Continues with suprascapular nerve through spinoglenoid notch to infraspinous fossa to join anastomosis around scapula

Branches:

- Articular branches to:
  1. Acromioclavicular joint 2. Shoulder joint
- Nutrient branches to:
  1. Scapula 2.Clavicle

Axillary (Circumflex) Nerve (C5, 6): (Fig. 19)

Course and Relations:

- Arises from posterior cord of brachial plexus, behind 3rd part of axillary artery and front subscapularis
- At lower border of subscapularis, it winds backwards round surgical neck of humerus through quadrangular space
- Accompanied by posterior circumflex humeral vessels and in close relation with capsule of shoulder joint.
- Ends under cover of deltoid by dividing into
  - Anterior division: passes in the front of surgical neck of humerus to anterior border of deltoid.
  - Posterior division: pierces deep fascia at posterior border of deltoid and continues as *upper lateral cutaneous nerve of the arm.*

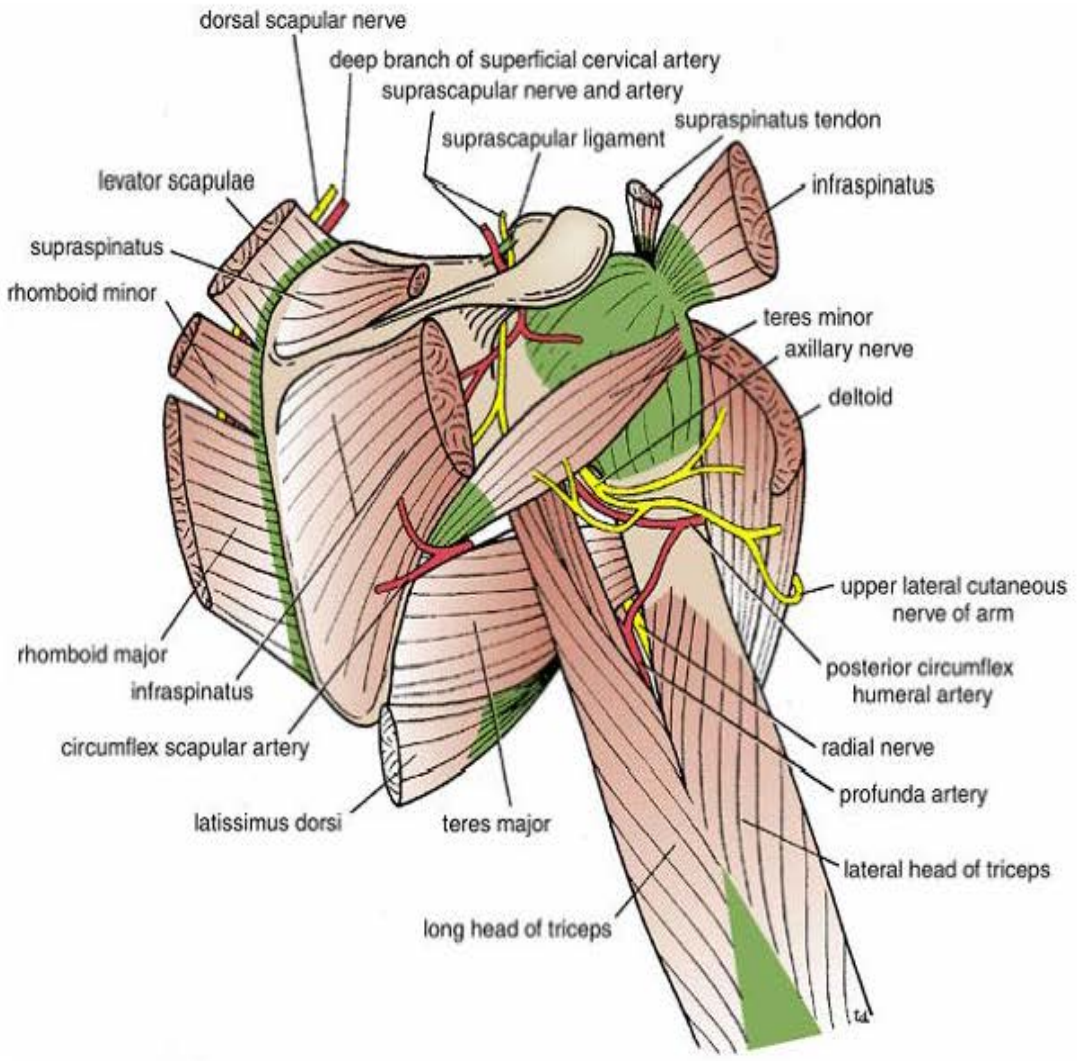


Fig. 19: Muscles, nerves, and blood vessels of the scapular region. Note the close relation of the axillary nerve to the shoulder joint.

Branches of axillary nerve:

1. From the trunk:
   Articular branch to: Shoulder joint
2. From the anterior division:
   a. Muscular branches to: deltoid
   b. Cutaneous branches to: skin over lower part of deltoid
3. From the posterior division:
   a. Muscular branches to:
      - Teres minor
      - Posterior part of deltoid
   b. Upper lateral cutaneous nerve of the arm: Supplies skin over lower part of deltoid and skin of upper part of lateral side of arm

Applied anatomy of axillary nerve:

It is exposed to injury in following conditions:

1. Fracture of surgical neck of the humerus
2. Downward dislocation of head of humerus
3. Compression against surgical neck by crutch

The effects of injury are:

1. Paralysis of deltoid and teres minor
2. Loss of abduction of arm from 15 to 90
3. Loss of rounded contour of shoulder (flat shoulder) and prominent acromion.
4. Sensory loss in skin over lower part of deltoid

Serratus Anterior: (Fig. 5)

- Large flat muscle
- Covers upper part of side of the chest
- Forms part of medial wall of the axilla

Origin:

By 8 digitations from outer surfaces of upper 8 ribs.

The lowermost 4 digitations interdigitate with upper digitations of external oblique muscle.

Insertion:

Ventral surface of medial border of scapula:

- 1st digitation into superior angle of scapula
- 2nd and 3rd digitations into medial border
- Lowermost 5 digitations into inferior angle

Nerve supply: Long thoracic nerve (C 5, 6, 7)

Action: Protraction of scapula.

Acting with trapezius to raise arm above head

Applied Anatomy: Winged scapula

Long Thoracic Nerve (C5, 6, 7): (Nerve to serratus anterior)

Course and Relations:

- Arises in the neck from roots of the brachial plexus
- Descends behind trunks of brachial plexus
- Enters axilla behind 1st part of axillary artery between the artery and serratus anterior.
- Descends vertically on surface of serratus anterior in the midaxillary line

Branches: Supplies serratus anterior muscle

Applied Anatomy:

- The nerve is exposed to injury because it is superficial leading to 'winged scapula'.
- The inferior angle of the scapula is retracted by the 2 rhomboid muscles.
- Thus, the scapula projects backwards like a wing.
- There is failure of protraction of the upper limb.

Inferior Belly of Omohyoid:

Origin: Upper border of scapula close to suprascapular notch
Insertion: intermediate tendon, situated in the neck deep to sternomastoid muscle
Nerve supply: Ansa cervicalis (C1, 2, 3)
Action: Depression of the hyoid bone during swallowing

ARM

Deep Fascia Of The Arm (Brachial fascia)

- Thin on the front but thick on the back
- Sends 2 intermuscular septa deeply among the muscles of the arm
- The 2 septa with humerus divide the arm into 2 compartments; anterior and posterior

I. Lateral intermuscular septum:

- Attached to lateral aspect of the humerus; lateral epicondyle, lateral supracondylar ridge and lower part of lateral lip of bicipital groove
- Separates triceps (behind) from brachialis, brachioradialis and extensor carpi radialis longus (front) and gives partial attachments to these muscles
- Perforated by radial nerve and descending branch of profunda brachii artery

II. Medial intermuscular septum:

- Attached to medial aspect of humerus, medial epicondyle, medial supracondylar ridge and lower part of bicipital groove
- Separates triceps (behind) from brachialis and coracobrachialis (front)
- Perforated by ulnar nerve, superior ulnar collateral artery and posterior branch of inferior ulnar collateral artery

MUSCLES OF THE ARM
(Fig. 20)

1. Coracobrachialis 2. Biceps brachii
3. Brachialis 4. Triceps brachii

Coracobrachialis:

- Lies in upper ½ of medial side of arm
- Extends from coracoid process to brachium (arm) so its name (coracobrachialis)

Origin: Tip of coracoid process with short head of biceps

Insertion: Middle of medial border of shaft of the humerus (opposite insertion of deltoid)

Nerve supply: Musculocutaneous nerve (C 5, 6, 7)

Action: Assists in flexion and adduction of the arm

Relations at its insertion:

1. Basilic vein pierces deep fascia
2. Ulnar nerve and superior ulnar collateral artery pierce medial intermuscular septum
3. Radial nerve and descending branch of profunda brachii artery pierce lateral intermuscular septum
4. Nutrient artery enters the humerus
5. Median nerve crosses over brachial artery from lateral to medial

Biceps Brachii:

Origin:

1. Long head: Supraglenoid tubercle of scapula and upper part of labrum glenoidale (intracapsular, extrasynovial).
2. Short head: Tip of coracoid process

Insertion: by

1. Tendon: Into rough posterior part of radial tuberosity, separated from it by a bursa.
2. Bicipital aponeurosis: Into deep fascia of upper part of medial side of forearm, intervenes between median cubital vein (superficial) and brachial artery and median nerve (deep).

Nerve supply:

Musculocutaneous nerve (C 5, 6, 7)

Action:

1. Powerful supinator of forearm
2. Strong flexor of supinated forearm
3. Long head: Assists in flexion of shoulder joint and helps to keep head of humerus in glenoid cavity during abduction of shoulder

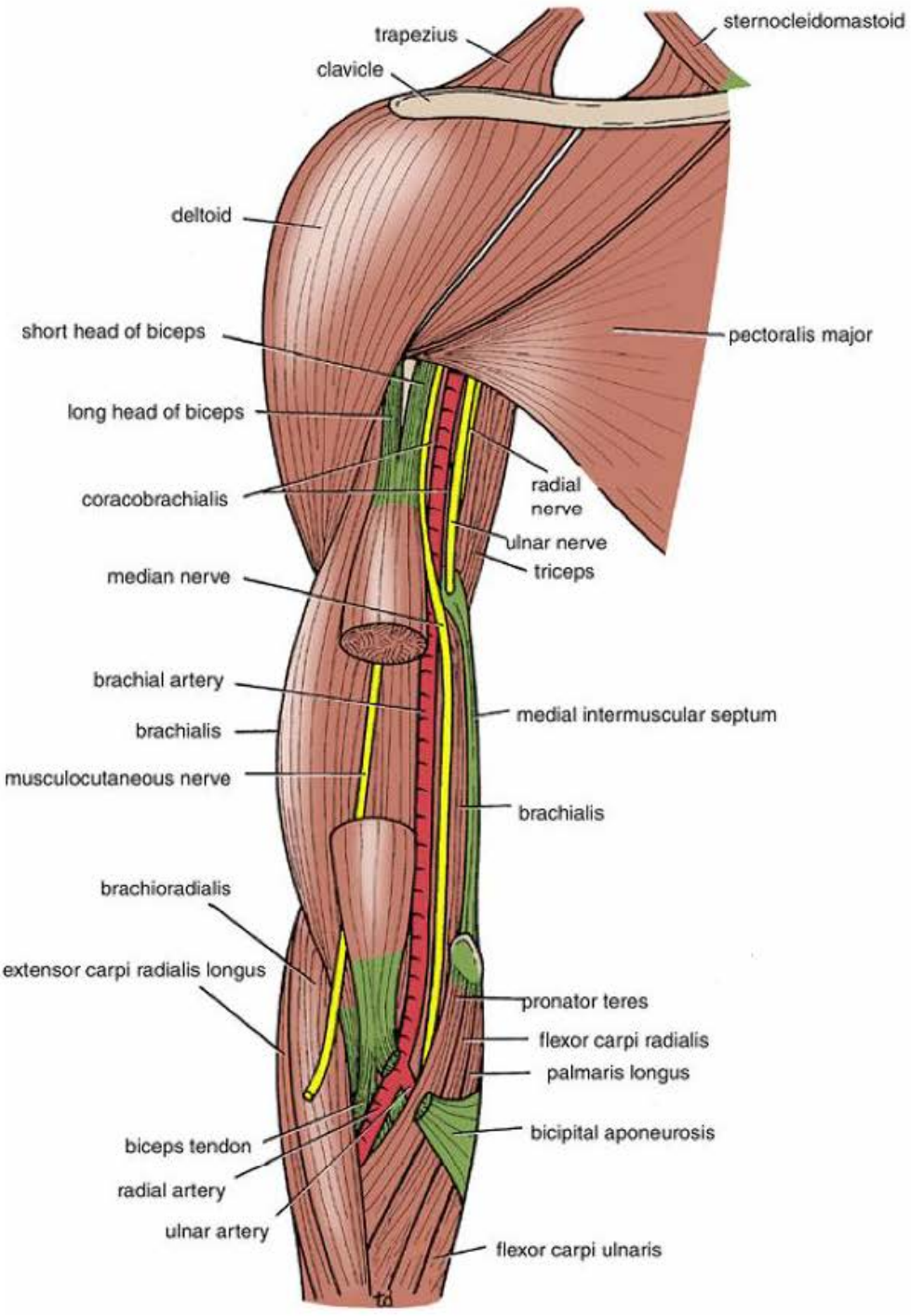


Fig. 20: Anterior view of the upper arm. The middle portion of the biceps brachii has been removed to show the musculocutaneous nerve lying in front of the brachialis.

Brachialis:

Origin:

1. Front of lower ½ of humerus
2. Medial and lateral intermuscular septa

Insertion: Ulnar tuberosity on anterior surface of coronoid process of the ulna

Nerve supply:

1. Musculocutaneous nerve
2. Radial nerve (lateral part)

Action: Main flexor of elbow joint

Triceps Brachii: (Fig. 21)

The only muscle on the back of the arm

Origin:

1. Long head: Infraglenoid tubercle of scapula
2. Lateral head: Upper lip of spiral groove (back of upper ½ of humerus)
3. Medial head: Back of lower ½ of humerus (below spiral groove)

Insertion:

1. Upper surface of olecranon process
2. Few deep fibers attached to posterior part of fibrous capsule of elbow joint forming articularis cubiti muscle (subanconeus)

Nerve supply: Radial nerve (C 5, 6, 7, 8, T 1)

1. Medial head: 2 branches; one in the axilla and one in the spiral groove
2. Long head: Branch in the axilla
3. Lateral head: Branch in the spiral groove

Action:

1. Main extensor of the elbow joint
2. Long head: Supports lower aspect of capsule of shoulder joint in raising arm above the head
3. Fibers of articularis cubiti draw up capsule of elbow joint in extension of forearm.

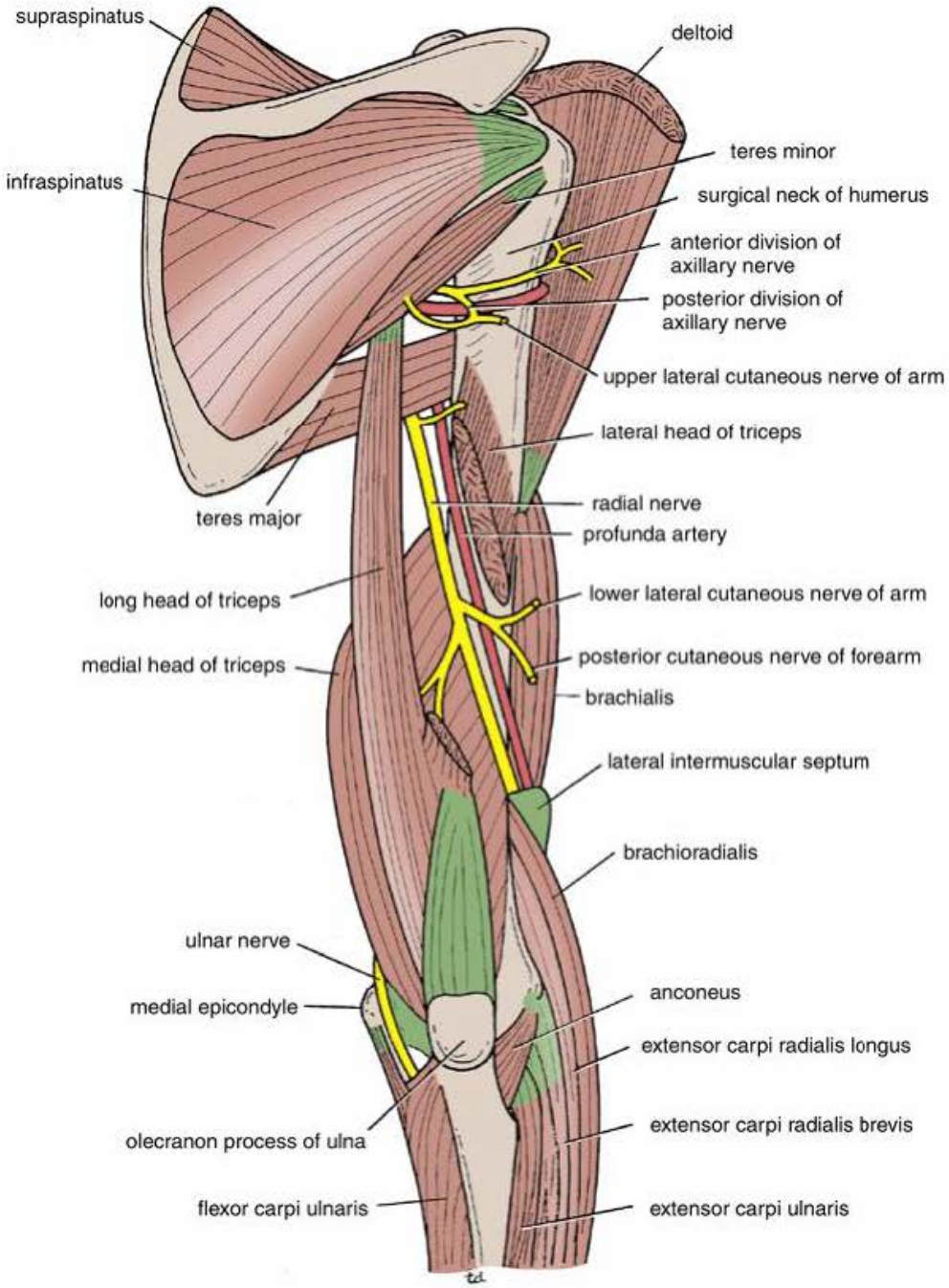


Fig. 21: Posterior view of the upper arm. The lateral head of the triceps has been divided to display the radial nerve and the profunda artery in the spiral groove of the humerus

BRACHIAL ARTERY
(Fig. 22)

Beginning:

- Continuation of axillary artery
- At lower border of teres major

End:

- Divides into: Ulnar and radial arteries.
- At level of neck of the radius; below elbow joint by 1 Cm.

Relations:

Superficial relations:

- Superficial throughout its whole course; only covered by skin and fascia.
- Its lowermost part is crossed superficially by bicipital aponeurosis which separates the artery from the median cubital vein.

Deep (posterior) relations (muscle bed):

- Long head of triceps (separated from it by radial nerve and profunda brachii artery)
- Medial head of triceps
- Brachialis

Lateral relations:

- Above: Coracobrachialis and median nerve
- Below: Biceps brachii

Medial relations of brachial artery:

- Above: Ulnar nerve and medial cutaneous nerve of the forearm
- Below: Median nerve

Relations to the median nerve:

The nerve is lateral to the artery (above), crosses it at insertion of coracobrachialis to come on its medial side below

Relations to veins:

- Accompanied by 2 venae comitantes
- Basilic vein lies on its medial side, separated from it below by deep fascia

Relations to the humerus:

- Above: The artery is medial to the humerus
- Below: The artery is in front of the humerus

Branches of Bachial Artery:

1. **Profunda brachii artery:**
   - The highest and deepest branch
- Arises from the posteromedial aspect
- Accompanies radial nerve in front of long head of triceps and in the spiral grove

- At lateral side of the arm, it divides into:
  - **Ascending branch**: ascends between long and lateral heads of triceps
  - **Descending branches (ant. and post.)**: They descend in front of and behind lateral intermuscular septum.

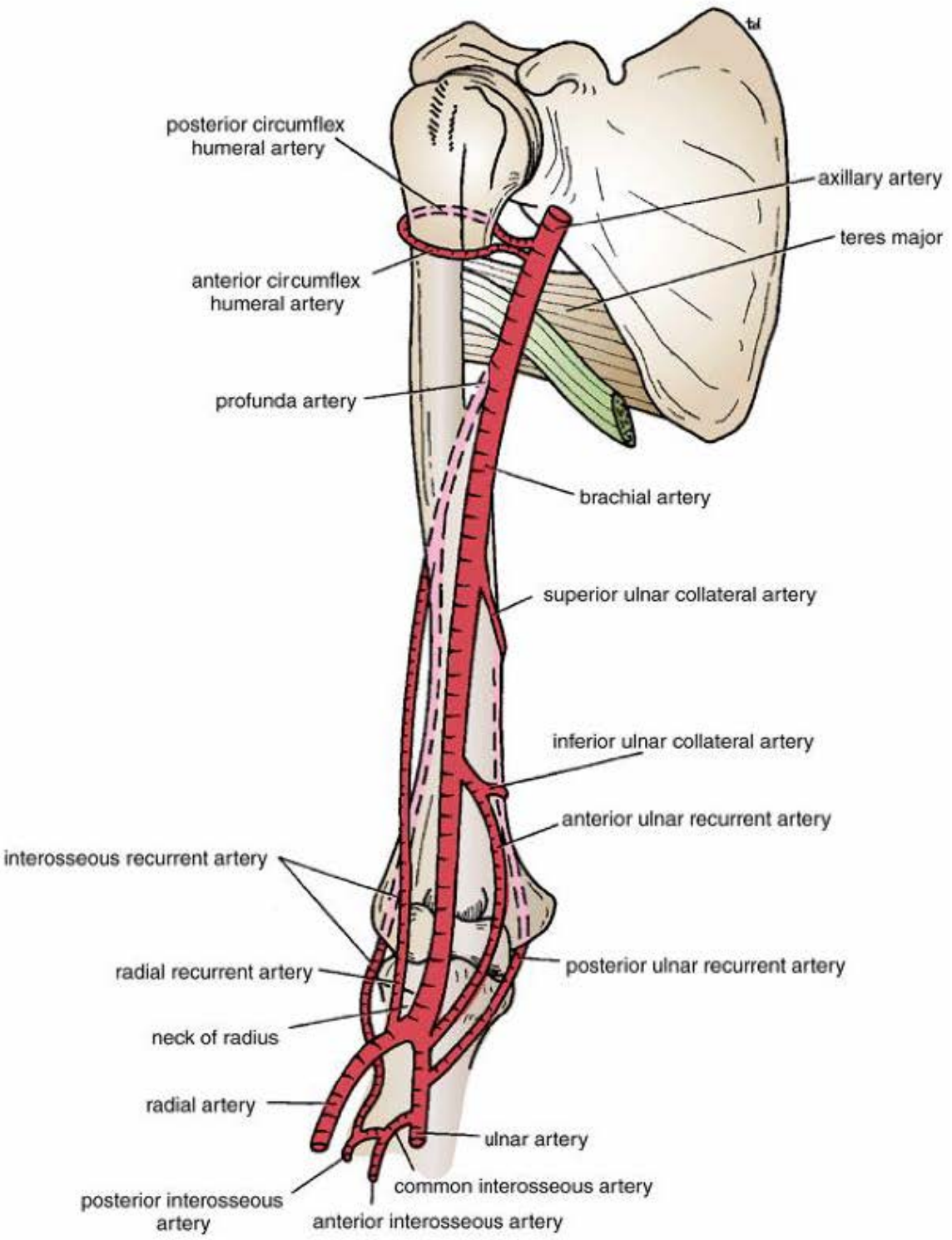


Fig. 22: Main arteries of the upper arm. Note the arterial anastomosis around the elbow joint.

a. Anterior descending branch: Accompanies radial nerve to front of lateral epicondyle.
b. Posterior descending branch: Descends to back of lateral epicondyle

2. **Nutrient artery to the humerus:**
   Enters nutrient foramen of humerus at insertion of coracobrachialis to shaft of the bone
3. **Superior ulnar collateral artery:**
   Accompanies ulnar nerve in posterior compartment of the arm to reach back of medial epicondyle
4. **Inferior ulnar collateral artery:**

- Arises 5 Cm. above elbow joint
- Enters posterior compartment of the arm
- Gives off 2 branches at medial epicondyle:
  1) Anterior branch: Descends in front the medial epicondyle
  2) Posterior branch: Descends behind the medial epicondyle

5. **Muscular branches of brachial artery:** To the muscles of the arm
6. **Ulnar artery (larger terminal branch)**
7. **Radial artery (smaller terminal branch)**

ANASTOMOSIS AROUND THE ELBOW

(Fig. 22)

Between brachial artery above elbow and ulnar and radial arteries below elbow:

Anastomosis around medial epicondyle:

1. Front of medial epicondyle:
   Between anterior branch of inferior ulnar collateral artery (brachial artery) and anterior ulnar recurrent artery (ulnar artery).
2. Behind of medial epicondyle:
   Between superior ulnar collateral artery and posterior branch of inferior ulnar collateral artery (brachial artery) and posterior ulnar recurrent artery (ulnar artery)

Anastomosis around lateral epicondyle:

1. Front of lateral epicondyle:
   Between anterior descending branch of profunda brachii (brachial artery) and radial recurrent artery (radial artery)
2. Back of lateral epicondyle:

Between posterior descending branch of profunda brachii (brachial artery) and interosseous recurrent artery (ulnar artery)

MUSCULOCUTANEOUS NERVE
(Fig. 23)

Course and relations:

- Arises from lateral cord of brachial plexus (C 5, 6, 7)
- Runs downwards lateral to the 3rd part of axillary artery
- Pierces coracobrachialis muscle
- Descends between biceps and brachialis
- Pierces deep fascia lateral to tendon of biceps to continue as *lateral cutaneous nerve of forearm* which runs in superficial fascia along lateral border of forearm as far as base of thenar eminence

Branches of musculocutaneous nerve:

1. **Muscular branches (B B C):**
- Biceps brachii
- Brachialis
- Coracobrachialis
2. **Articular branches:**
- To elbow joint through nerve to brachialis
3. **Cutaneous branch:**
- Lateral cutaneous nerve of the forearm which supplies the skin over lateral border of forearm (fig.23).

MEDIAN NERVE (C 5, 6, 7, 8, T 1)
(Figs. 20 and 23)

Course and relations:

Relations in the arm:

- Arises in the axilla by roots: a lateral root from lateral cord and a medial root from the medial cord of the brachial plexus.
- The 2 roots pass one on each side of the 3rd part of the axillary artery, then they unite on lateral side of the axillary artery to form trunk of the median nerve.

- Descends lateral to upper part of brachial artery as far as insertion of coraco-brachialis, where it crosses in front it to come medially and descend to cubital fossa.

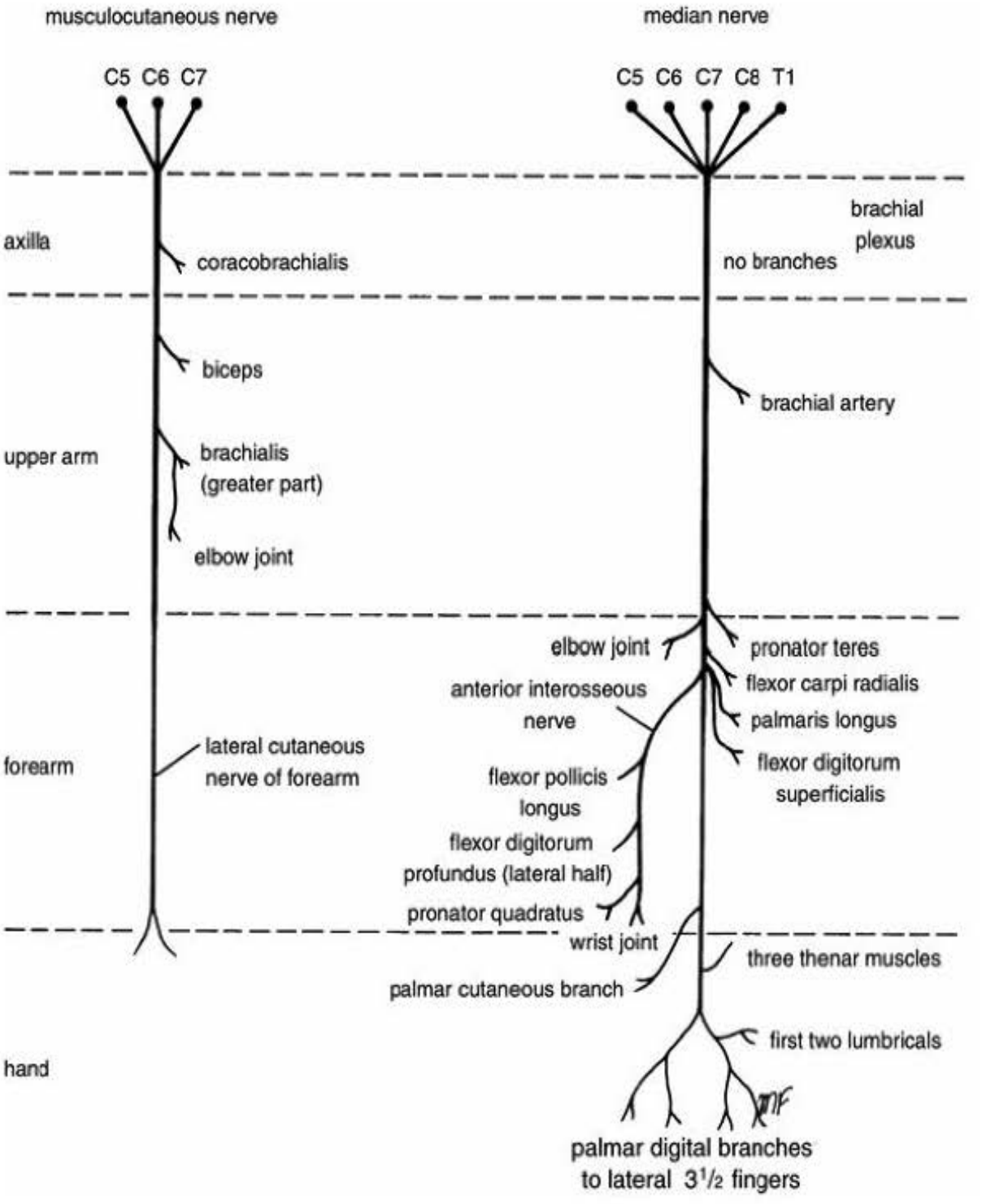


Fig. 23: Summary of the main branches of the musculocutaneous and median nerves.

Relations at the elbow (cubital fossa):

- Lies medial to brachial artery which separates it from tendon of biceps brachii.
- Lies in front of brachialis which separates it from elbow.
- Lies behind bicipital aponeurosis which separates it from median cubital vein.

Relations in the forearm:

- Leaves cubital fossa by passing between 2 heads of pronator teres where it is separated from ulnar artery by deep head of pronator teres.
- Passes undercover of flexor digitorum superficialis (FDS).
- Descends between FDS and FDP (flexor digitorum profundus), accompanied by median artery.
- About 5 Cm above wrist, it emerges from undercover of lateral border of FDS to lie between tendons of flexor carpi radialis and palmaris longus.
- Leaves forearm by passing through carpal tunnel, deep to flexor retinaculum and superficial to tendons of FDS.

Relations of median nerve in the hand:

- Leaves the carpal tunnel and ends at distal border of flexor retinaculum by dividing into lateral division and medial divisions which divide into palmar digital branches.

Branches of Median Nerve:

I. **Branches in the arm:**
   - No branches EXCEPT a small vasomotor nerve to the brachial artery.

II. **Branches in the forearm:**
   1. **Muscular branches to:**
      a. Pronator teres
      b. Flexor carpi radialis
      c. Palmaris longus
      d. Flexor digitorum superficialis
   2. **Articular branches to:**
      a. Elbow joint
      b. Superior radio-ulnar joint
   3. **Anterior interosseous nerve:**
      - Descends on front of interosseous membrane, in company with anterior interosseous artery to give:
        a. Muscular branches to:

- Flexor pollicis longus
- Lateral ½ of flexor digitorum profundus
- Pronator quadratus

b. Articular to:

- wrist
- Inferior radio-ulnar joint

4. **Palmar cutaneous branch:**
   - Crosses over flexor retinaculum to supply skin of central part of palm and skin over thenar eminence (skin of lateral 2/3 of palm).
5. **Communicating branch with ulnar nerve:**
   - Consists of fibers of C 7 which pass though ulnar nerve to supply flexor pollicis brevis

III. **Branches in the hand:**

1. **Muscular (recurrent) branch:**
   - Arises at distal border of flexor retinaculum and return to supply:

a. Flexor pollicis brevis
b. Abductor pollicis brevis
c. Opponens pollicis

2. **Palmar digital branches (5 branches):**
   - Lateral division: Gives 3 palmar digital nerves to 2 sides of thumb and lateral side of index finger. The nerve to index finger gives a branch to 1st lumbrical muscle.
   - Medial division: Gives 2 palmar digital branches to adjacent sides of index, middle and ring fingers. The lateral one of these 2 nerves gives a branch to the 2nd lumbrical muscle and the medial one communicates with palmar digital branch of ulnar nerve.

Palmar digital nerves: *Supply the skin on front and sides of the fingers, and dorsum of distal phalanx of the thumb and dorsum of middle and distal phalanges of the other digits*

- The muscular branch may arise from lateral division of the median nerve

Effect of Injury of Median Nerve:

Injury in axilla or arm:

1. **Loss of pronation of forearm:** Paralysis of pronator teres and pronator quadratus

2. **Loss of flexion of proximal and middle phalanges of medial 4 fingers:** Paralysis of flexor digitorum superficialis
3. **Loss of flexion of distal phalanges of index and middle fingers:** Paralysis of lateral ½ of flexor digitorum profundus
4. **Paralysis of thumb (Ape-like deformity):**
    - Loss of flexion: paralysis of flexors
    - Loss of opposition: paralysis of opponens policis
    - Wasting of muscles of thenar eminence
    - Adduction of thumb is intact
5. **Weak flexion of the wrist:** Paralysis of flexor carpi radialis and palmaris longus
6. **Loss of sensation in the skin of lateral 2/3 of the palm and lateral 3.5 fingers:** Lesion to palmar and digital cutaneous nerves

Injury just above wrist:

Only confined to the hand especially the thumb:

1. Ape-like deformity
2. Loss of opposition of the thumb
3. Sensory loss in the skin of lateral 3.5 fingers

Carpal tunnel syndrome:

Median nerve is compressed in the carpal tunnel by oedematous fluid or by dislocations of one of the carpal bones.

The same effects of injury just above wrist:

1. Ape-like deformity:
2. Loss of opposition of the thumb:
3. Sensory loss in the skin of lateral 3.5 fingers(fig.23)

ULNAR NERVE (C 7, 8, T 1)
(Figs. 20 and 24)

Course and relations in the arm:

- Arises in the axilla from medial cord of brachial plexus (C8, T1), C7 added to ulnar nerve from lateral root of median nerve or through connection between lateral and medial cords of brachial plexus.
- Runs along medial side of the 3rd part of axillary artery, between it and axillary vein.

- Continues on medial side of brachial artery as far as middle of the arm.
- Pierces medial intermuscular septum to enter posterior compartment of the arm
- Descends in front of medial head of triceps to reach back of medial epicondyle accompanied by superior ulnar collateral artery, ulnar collateral nerve (branch from radial nerve to medial head of triceps) and post. branch of inf. ulnar collateral artery.
- Enters forearm by passing behind medial epicondyle between 2 heads of flexor carpi ulnaris (FCU).

Relations in the forearm:

- Lies on ulnar collateral ligament of elbow related to posterior ulnar recurrent artery.
- Descends on medial side of forearm down to wrist, related to muscles and ulnar artery.
- Lies between FCU (superficial) and FDP (deep), in upper 2/3 of forearm.
- Comes out from undercover of lateral border of FCU to become under the skin and fascia, in lower 1/3 of forearm.
- At the wrist crosses over flexor retinaculum just lateral to pisiform bone, where it divides into superficial and deep divisions.

Relations of ulnar nerve in the hand:

Superficial division:

- Passes medial to hook of hamate
- Gives its palmar digital branches to medial 1.5 fingers

Deep division:

- Passes between flexor digiti minimi brevis and abductor digiti minimi in company with deep division of ulnar artery.
- Pierces opponens digiti minimi
- Curves round hook of hamate
- Continues laterally in concavity of deep palmar arch
- Ends in adductor pollicis muscle

Branches of Ulnar Nerve:

I. **Branches in the arm:**

NO branches in front of the arm, but gives an articular branch to the elbow (back of arm)

II. **Branches in the forearm:**

1. **Muscular branches to:**
   a. Flexor carpi ulnaris
   b. Medial ½ of flexor digitorum profundus
2. **Cutaneous branches:**
   a. Palmar cutaneous branch:
   Crosses over flexor retinaculum to supply skin of medial 1/3 of the palm.
   b. Dorsal cutaneous branch:
   Runs along medial side of wrist to reach dorsum of hand to supply medial 1/3 of skin of dorsum of hand and skin of dorsum of medial 1.5 fingers.

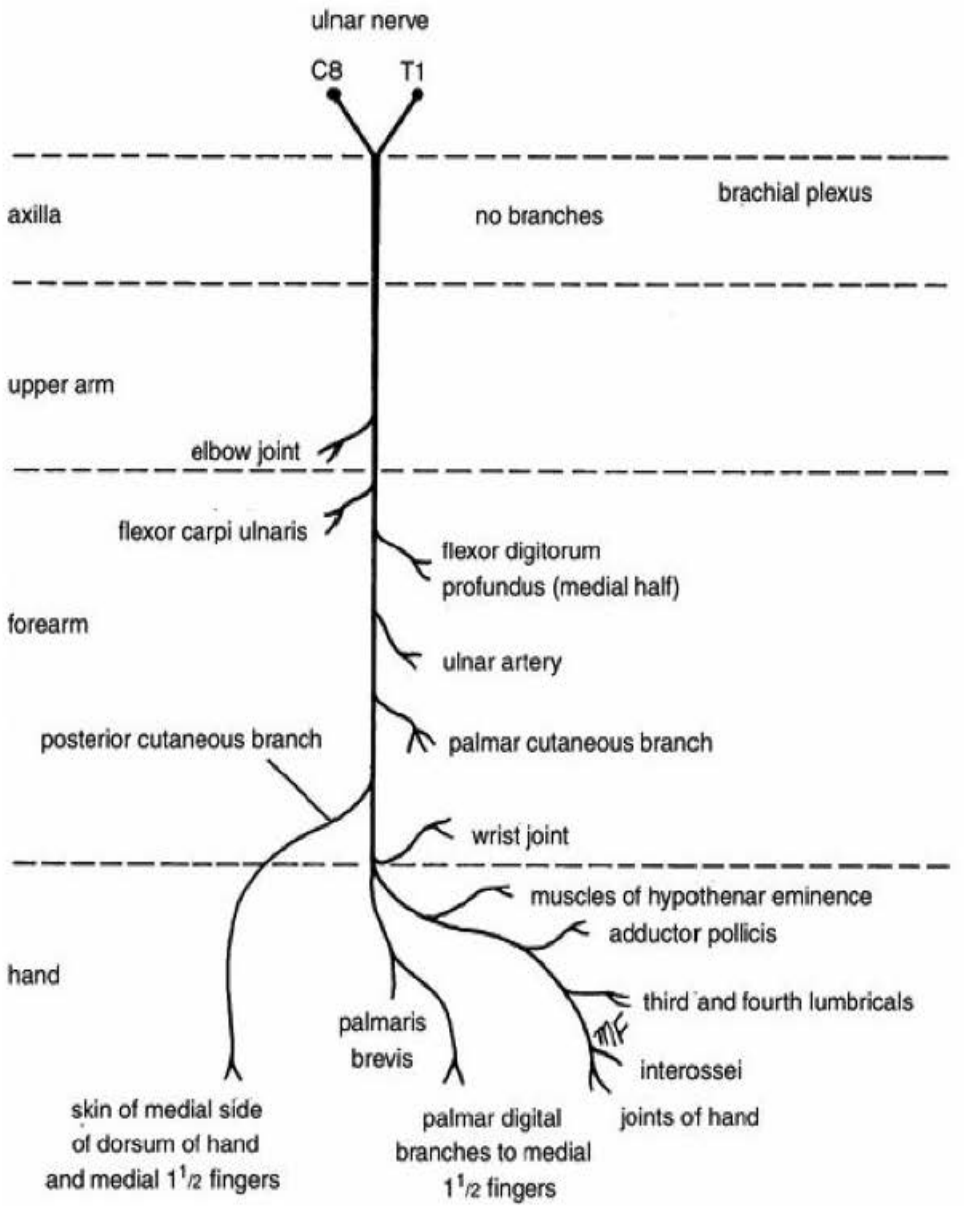


Fig. 24: Ulnar nerve

Branches in the hand:

1. **Superficial terminal division:**
   a. Muscular branch to: Palmaris brevis
   b. Palmar digital nerves (lateral and medial):
      - Lateral nerve: Supplies adjacent sides of ring and little fingers and communicates with medial palmar digital branch of median nerve.
      - Medial nerve: Supplies medial side of little finger
2. **Deep terminal division:**

I. Muscular branches to:
- Flexor digiti minimi brevis
- Abductor digiti minimi
- Opponens digiti minimi
- The 8 interosseous muscles
- Medial 2 lumbricals
- Adductor pollicis
- Flexor pollicis brevis

II. Articular branches to:
- Wrist joint
- Metacarpo-phalangeal joints

III. Vasomotor branches to:
- Palmar digital arteries in the hand

Effect of injury of the ulnar nerve:

I. **Injury just above the wrist:**

Claw-hand: extension of metacarpo-phalangeal joints and flexion of interphalangeal joints. The index and middle fingers are little affected as the lateral 2 lumbricals are intact.

Sensory loss: limited to skin of palmar surface of medial 1.5 fingers.

II. **Injury above the elbow:**
- Paralysis of flexor carpi ulnaris, medial half of flexor digitorum profundus and the 2 cutaneous nerves (palmar and dorsal) and paralysis of muscles in the hand
- Paralysis of long tendons for little and ring fingers weakens their flexion movements leads to **partial claw hand.**
- **Lateral deviation of the hand**: Paralysis of flexor carpi ulnaris.

Sensory loss: Skin of medial 1/3 of hand (both palmar and dorsal surfaces) and skin of medial 1.5 fingers (both palmar and dorsal surfaces) (fig.24).

RADIAL NERVE (C 5, 6, 7, 8, T 1)
(Figs. 21 and 25)

The largest branch of the brachial plexus

Beginning of Radial Nerve:

- Arises in the axilla from posterior cord of brachial plexus (C 5, 6, 7, 8, T 1)

Has the following relations:

- Anteriorly: 3rd part of axillary artery
- Laterally: axillary nerve
- Posteriorly: subscapularis and tendon of latissimus dorsi

Course and Relations:

- Enters spiral groove on back of humerus.
- Accompanied by profunda brachii artery.
- Reaches lateral side of arm a little below insertion of deltoid.
- Pierces lateral intermuscular septum to enter anterior compartment with anterior descending branch of profunda brachii A.
- Lies between brachioradialis and extensor carpi radialis longus (laterally) and brachialis (medially).

End of Radial Nerve:

- Gives deep terminal branch (posterior interosseous nerve) and continues as superficial terminal branch.
- Front lateral epicondyle of the humerus.

Braches of Radial Nerve (Fig. 25):

I. Branches in the axilla (2 muscles, 1 skin):

1. Long head of triceps
2. Medial head of triceps
3. Posterior cutaneous nerve of the arm

II. Branches in spiral groove (3 muscles, 2 skin):

1. Lateral head of triceps

2. Medial head of triceps
3. Anconeus (gives also medial head of triceps)
4. Lower lateral cutaneous nerve of the arm
5. Posterior cutaneous nerve of the forearm

III. Braches on lateral side of the arm (3 muscles, 1 joint):

1. Lateral part of brachialis
2. Brachioradialis
3. Extensor carpi radialis longus
4. Articular to elbow joint

IV. Braches on lateral side of the arm

1. Superficial terminal (radial) branch
2. Deep (posterior interosseous) branch

Injury To Radial Nerve (Wrist Drop, Finger Drop):

In The Spiral Groove: Triceps is not completely paralysed (elbow can be extended) but the muscles on back of forearm are paralysed leading to wrist drop and finger drop.

Superficial Radial Nerve (Cutaneous):

- Descends along lateral side of forearm
- Lateral to radial artery (middle 1/3 of forearm)
- Undercover of brachioradialis
- **Crosses 4 muscles attached to the radius:**
  1. Supinator
  2. Insertion of pronator teres
  3. Radial head of flexor digitorum superficialis
  4. Flexor pollicis longus
- About 5 Cm above the wrist, it winds round lateral side of radius to reach back of hand.
- Ends by dividing into 5 dorsal digital branches which cross over anatomical snuff-box
- Supply skin of lateral 2/3 of dorsum of hand and dorsum of proximal phalanges of lateral 3.5 fingers

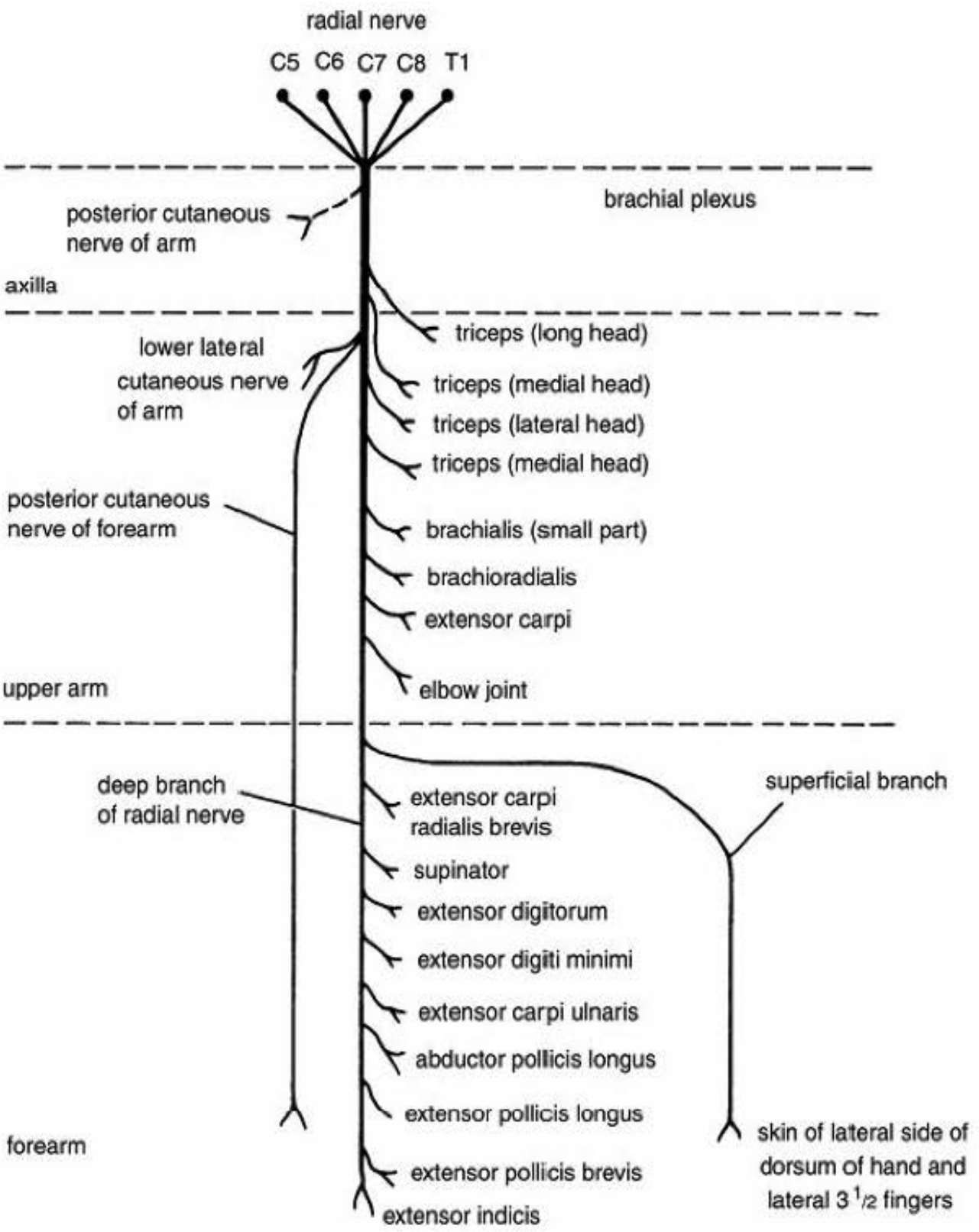


Fig. 25: Radial nerve

Posterior Interosseous Nerve:

- Descends undercover of brachioradialis.
- Pierces supinator.
- Winds round lateral side of neck of radius to back of forearm.
- Descends between superficial and deep layers of extensor muscles of forearm.
- Accompanied by posterior interosseous artery to dorsum of the wrist.

Branches of Posterior Interosseous Nerve:

Branches before piercing supinator:

1. Extensor carpi radialis brevis
2. Supinator

Branches on back of forearm:

1. Extensor digitorum
2. Extensor digiti minimi
3. Extensor carpi ulnaris
4. Abductor pollicis longus
5. Extensor pollicis brevis
6. Extensor pollicis longus
7. Extensor indicis

Articular branches:

1. Wrist joint
2. Carpal joints

Injury to superficial terminal branch:

- Sensory loss on lateral 2/3 of dorsum of hand and dorsum of proximal phalanges of lateral 3.5 fingers.

Injury to deep terminal branch:

- Paralysis of most of extensors of wrist (wrist drop) and extensors of fingers (finger drop)
- Paralysis of supinator if injury takes place at lateral epicondyle (failure of supination of extended forearm)
- *Supination of flexed forearm is done by bicep*

CUBITAL FOSSA

Triangular depression that lies in front of elbow

Boundaries Of Cubital Fossa:

Laterally: Brachioradialis (medial margin)
Medially: Pronator teres (lateral margin)
Base: Imaginary line between two epicondyles of the humerus
Apex: Meeting of lateral and medial boundaries
Floor: Supinator and brachialis
Roof: Skin, fascia and bicipital aponeurosis

Contents of Cubital Fossa (Fig.26):

1. Median nerve
2. Brachial artery
3. Ulnar artery
4. Radial artery
5. Tendon of biceps brachii
6. Radial nerve
7. Deep branch of radial nerve

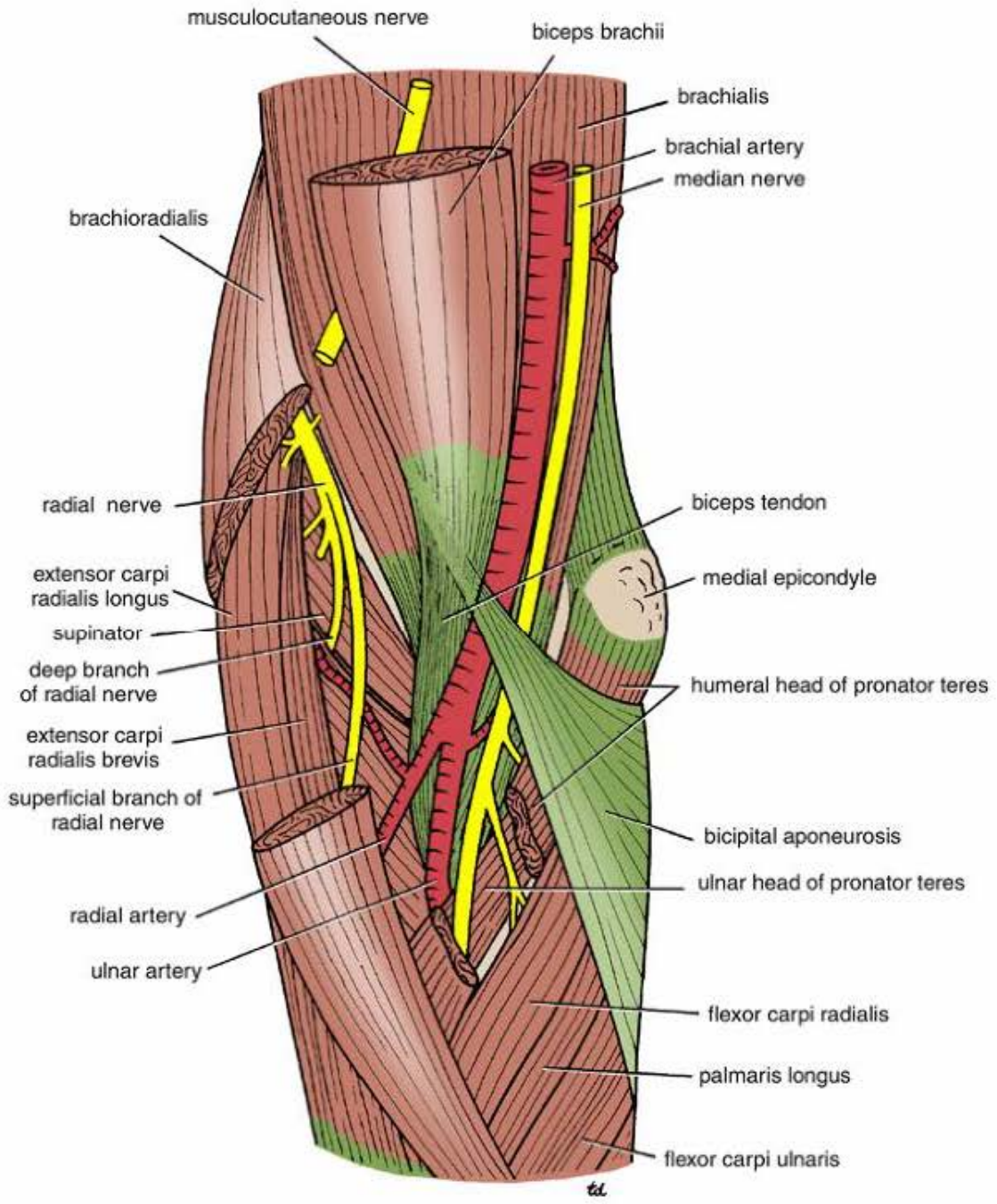


Fig. 26: Cubital fossa

STERNOCLAVICULAR JOINT (Fig. 27)

Articulation: Between sternal end of clavicle, manubrium sterni and first costal cartilage

Type: Synovial joint double-plane type

Capsule: Surrounds the joint and attached to margins of articular surfaces

Ligaments:

1. Anterior sternoclavicular ligament
2. Posterior sternoclavicular ligament

Accessory ligaments: Costoclavicular ligament

Fibrocartilagenous disc: Divide the joint into medial and lateral compartments

Synovial membrane: Lines the capsule and margins of cartilage covering articular surfaces

Nerve supply: Suprascapular nerve and nerve to subclavius

Movements of clavicle and muscles doing:

Forward: Serratus anterior

Backward: Trapezius and rhomboids

Elevation: Trapezius, sternomastoid, levator scapula, rhomboids

Depression: Pectoralis minor, subclavius

Relations of sternoclavicular joint:

Front: Skin, sternomastoid, pectoralis major

Back: Sternohyoid, right: brachiocephalic artery, left: left brachiocephalic vein and left common carotid artery

ACROMIOCLAVICULAR JOINT (Fig. 27)

Articulation: Between acromion of scapula and lateral end of clavicle

Type: Synovial joint plane type

Capsule:

Surrounds the joint and attached to margins of articular surfaces

Ligaments (and fibrocartilagenous disc):

1. Superior acromioclavicular ligament
2. Inferior acromioclavicular ligament

Accessory ligaments: Coracoclavicular ligament

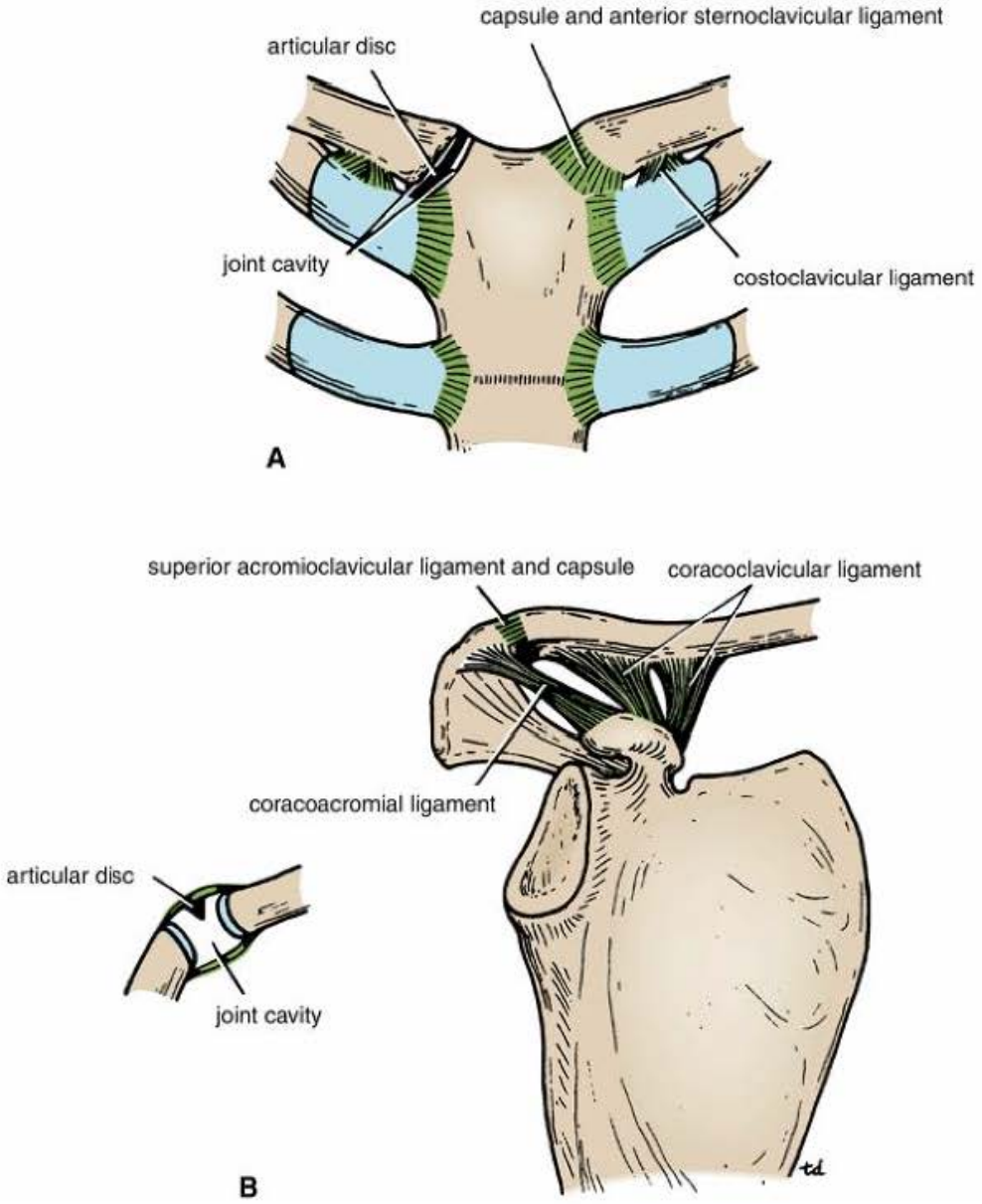


Fig. 27: A. Sternoclavicular joint. B. Acromioclavicular joint

Synovial membrane:

Lines the capsule and margins of cartilage covering articular surfaces

Nerve supply: Suprascapular nerve

Movements:

A gliding movement when scapula rotates or when clavicle is elevated or depressed

Relations:

Anteriorly: Deltoid

Posteriorly: Trapezius

Superiorly: Skin

SHOULDER (PECTORAL) GIRDLE

Consists of both the scapula and the clavicle

Movements of Shoulder Girdle & Muscles Doing:

Occur at sternoclavicular and acromioclavicular joints at the same time

1. **Elevation of scapula:**
   - Upper part of trapezius
   - Levator scapula
2. **Depression of scapula:**
   - Pectoralis minor
   - Lower part of trapezius
3. **Protraction of scapula (forward movement):**
   - Serratus anterior
   - Pectoralis minor
4. **Retraction of scapula(Backward movement):**
   - Middle part of trapezius
   - Rhomoideus major
   - Rhomboideus minor
5. **Upward rotation of scapula:**
   - Upper fibers of trapezius
   - Lower fibers of trapezius
   - Lower 5 digitations of serratus anterior
6. **Downward rotation of scapula:**
   - Levator scapula
   - Rhomboideus major
   - Rhomboideus minor
   - Pectoralis minor

SHOULDER JOINT
(Fig. 28)

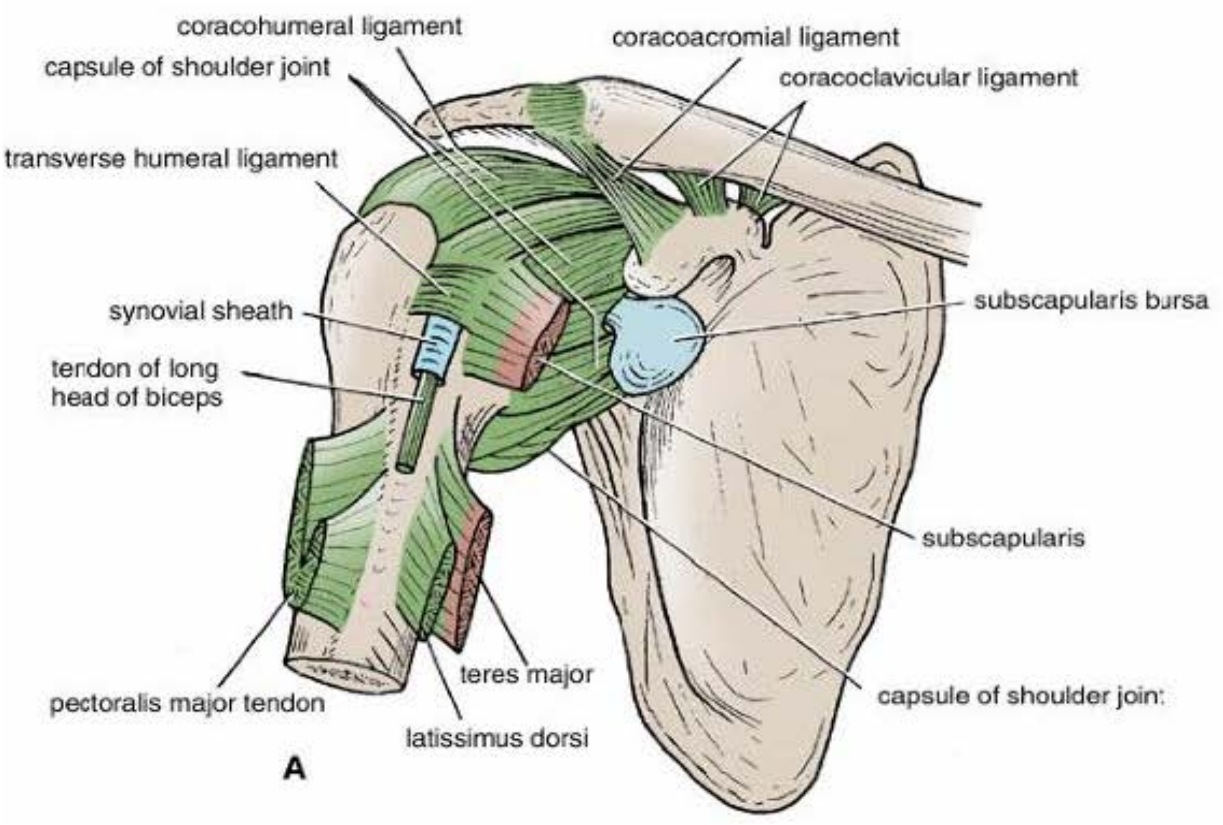
Articulation:

- Between head of humerus and glenoid cavity of scapula, deepened by glenoid labrum

Type: Synovial joint, ball and socket

Capsule:

- Surrounds the joint, attached medially to margin of glenoid cavity outside labrum, laterally attached to anatomical neck of humerus, strengthened by rotator cuff muscles



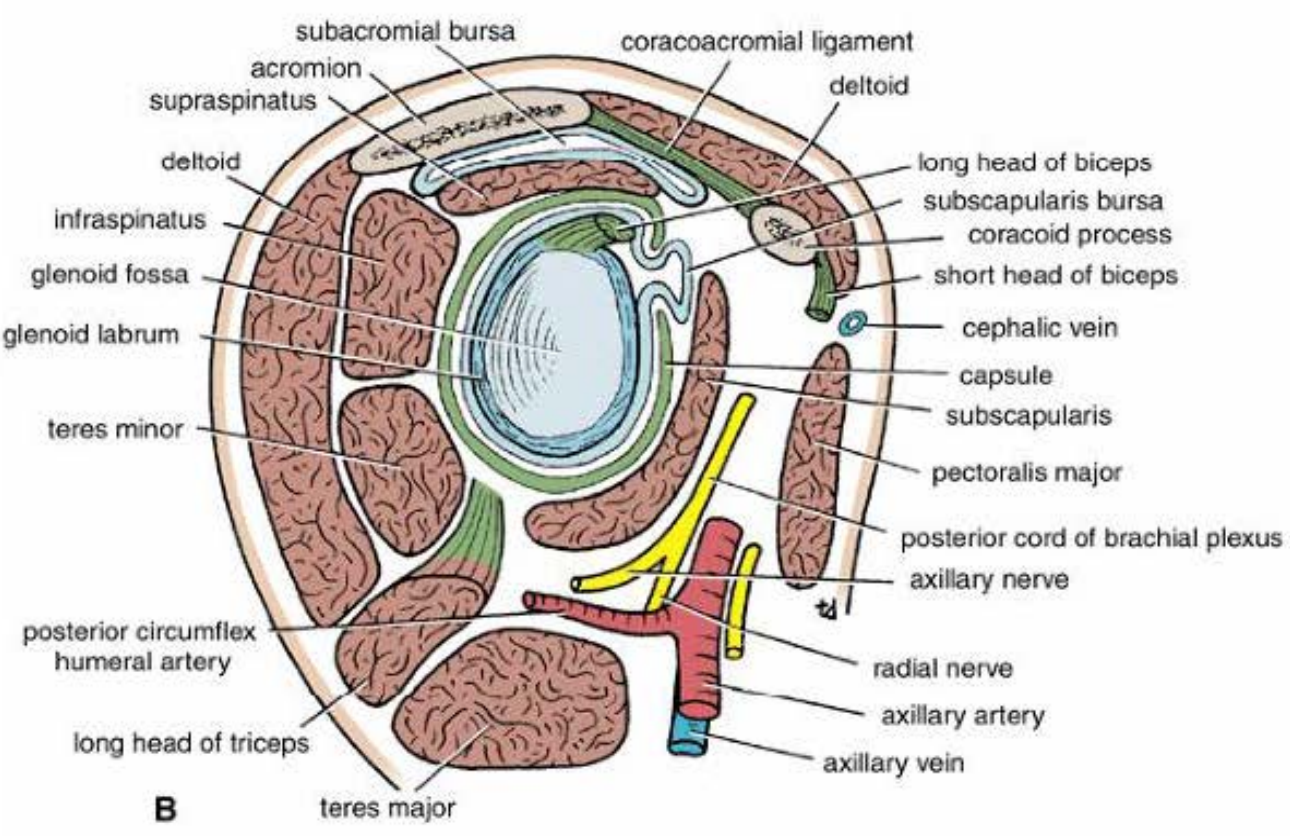


Fig. 28: Shoulder joint and its relations. A. Anterior view. B. Sagittal section.

Ligaments:

1. Glenohumeral ligaments (3)
2. Transverse humeral ligament
3. Coracohumeral ligament

Accessory ligaments: Coracoacromial ligament

Synovial membrane (Fig. 29):

- Lines the capsule and attached to margins of cartilage covering articular surfaces, forms a tubular sheath around tendon of long head of biceps, extends through anterior wall of capsule to form subscapularis bursa (deep to subscapularis)

Nerve supply: Axillary and suprascapular nerves

Movements of shoulder joint and muscles doing:

Flexion:

1. Anterior fibers of deltoid
2. Pectoralis major
3. Biceps brachii
4. Coracobrachialis

Extension:

1. Posterior fibers of deltoid
2. Latissimus dorsi
3. Teres major

Abduction:

1. Supraspinatus
2. Middle fibers of deltoid

Adduction:

1. Pectoralis major
2. Latissimus dorsi
3. Teres major
4. Teres minor

Lateral rotation:

1. Infraspinatus
2. Teres minor
3. Posterior fibers of deltoid

Medial rotation:

1. Subscapularis
2. Latissimus dorsi
3. Teres major
4. Anterior fibers of deltoid

Circumduction:

- Combination of the above movements

Relations of Shoulder Joint:

Anteriorly:

1. Subscapularis
2. Axillary vessels
3. Brachial plexus

Posteriorly:

1. Infraspinatus
2. Teres minor

Superiorly:

1. Supraspinatus
2. Subacromial bursa
3. Coracoacromial ligament
4. Deltoid muscle

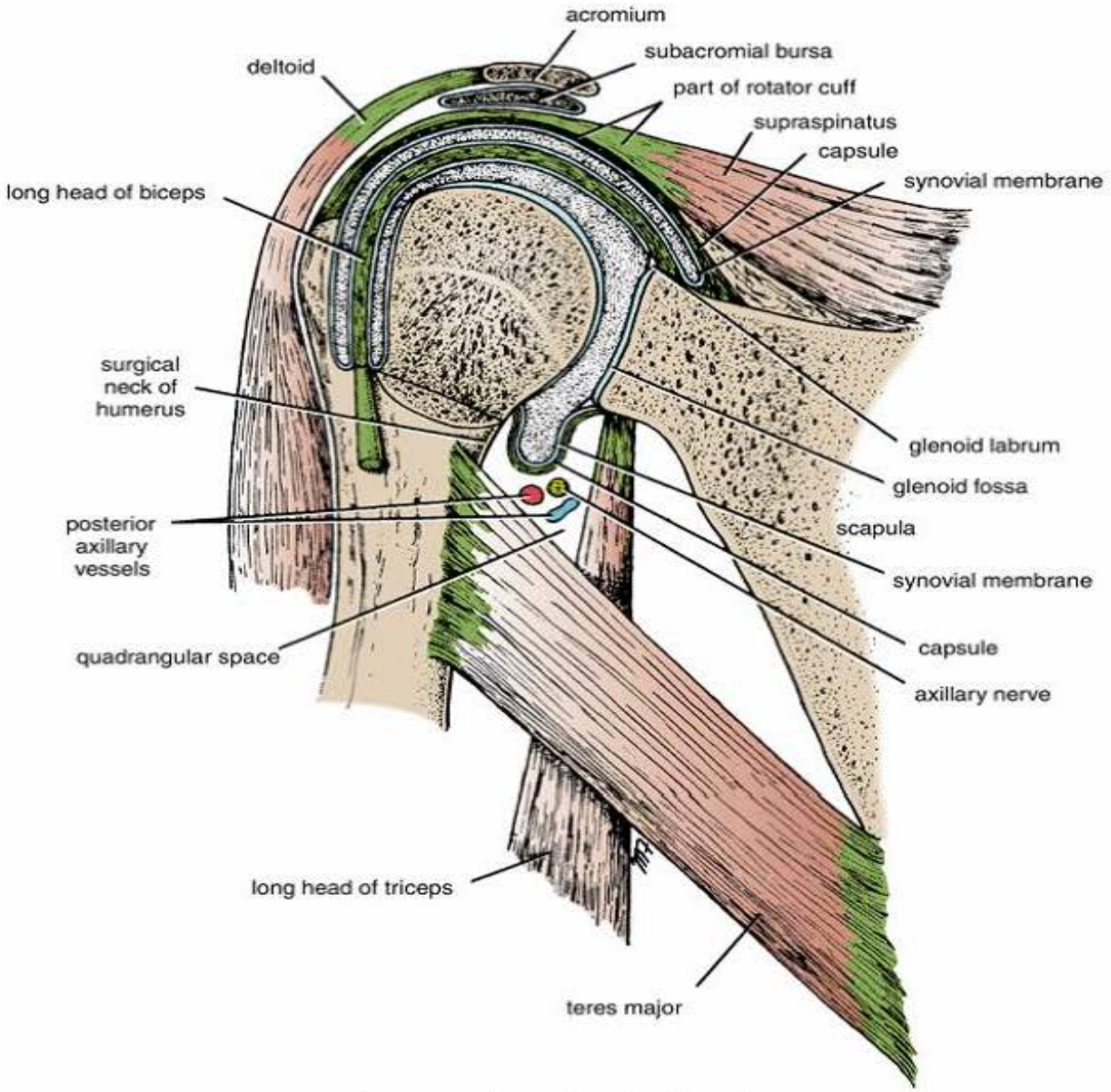


Fig. 29: Interior of the shoulder joint.

Inferiorly:

1. Long head of triceps
2. Axillary nerve
3. Posterior circumflex humeral vessels
   - Tendon of long head of biceps brachii passes through the joint and emerges beneath the transverse ligament.

Bursae Related To Shoulder Joint:

1. Subscapular bursa
2. Deep to infraspinatus
3. Subacromial bursa
4. Deep to supraspinatus

ELBOW JOINT

Articulation:

- Between trochlea and capitulum of humerus and trochlear notch of ulna and head of radius

Type: Synovial joint, hinge type (Fig. 30)

Capsule:

Anteriorly:

- Attached above to humerus along upper margins of coronoid and radial fossae and to front of medial and lateral epicondyles and below to margin of coronoid process of ulna and to annular ligament (surrounds head of radius)

Posteriorly:

- Attached above to margins of olecranon fossa of humerus and below to upper margin and sides of olecranon process of ulna and to annular ligament

Ligaments:

- Lateral collateral ligament: Attached to lateral epicondyle of humerus and upper margin of annular ligament
- Medial collateral ligament (3 bands): Anterior band: Passes from medial epicondyle to medial margin of coronoid process, posterior band: Passes from medial epicondyle to medial side of olecanon, transverse band: Passes between coronoid and olecranon processes of ulna

Synovial membrane of elbow:

Lines the capsule and the fatty pads in coronoid, olecranon and radial fossae
Contiues below with synovial membrane of superior radioulnar joint

Nerve supply:

1. Median nerve
2. Ulnar nerve
3. Musculocutaneous nerve
4. Radial nerve

Movements of Elbow, Muscles Doing:

Flexion:

1. Brachialis
2. Biceps brachii
3. Brachioradialis
4. Pronator teres

Extension:

1. Triceps brachii
2. Anconeus

Relations of Elbow Joint:

Anteriorly: Brachialis, tendon of biceps, median nerve, brachial artery

Posteriorly: Triceps, small bursa intervening

Medially: Ulnar nerve,

Laterally: Common extensor tendon, supinator

Bursae Related To Elbow Joint:

1. **Intratendinous olecranon bursa:** Sometimes preset in tendon of triceps
2. **Subtendinous bursa:** Between tendon of triceps and olecranon process
3. **Subcutaneous olecranon bursa:** Lies in subcutaneous connective tissue over olecranon.
4. **Bicipitoradial (Biceps) bursa:** Separates and reduces friction against anterior part of the radial tuberosity.
5. **Subcutaneous bursa of medial epicondyle**
6. **Subcutaneous bursa of lateral epicondyle**
7. **Bursa of anconeus**
8. **Bursa at origin of extensor carpi radialis brevis**

Subcutaneous olecranon bursa:

- *Exposed to injury during falls on elbow and to infection from abrasions of skin covering the olecranon.*
- *Repeated excessive pressure and friction as occurs in wrestling may cause subcutaneous olecranon bursitis (Student's elbow), dart thrower's elbow or miner's elbow*

Carrying Angle:

- Angle between long axis of arm and long axis of extended and supinated forearm
- Opens laterally
- About 170 in the male and 167 in the female
- Disappears when the elbow is fully flexed
- Caused by downward projection of medial edge of trochlea more than its lateral edge
- Also, obliquety of superior articular surface of coronoid process of the ulna

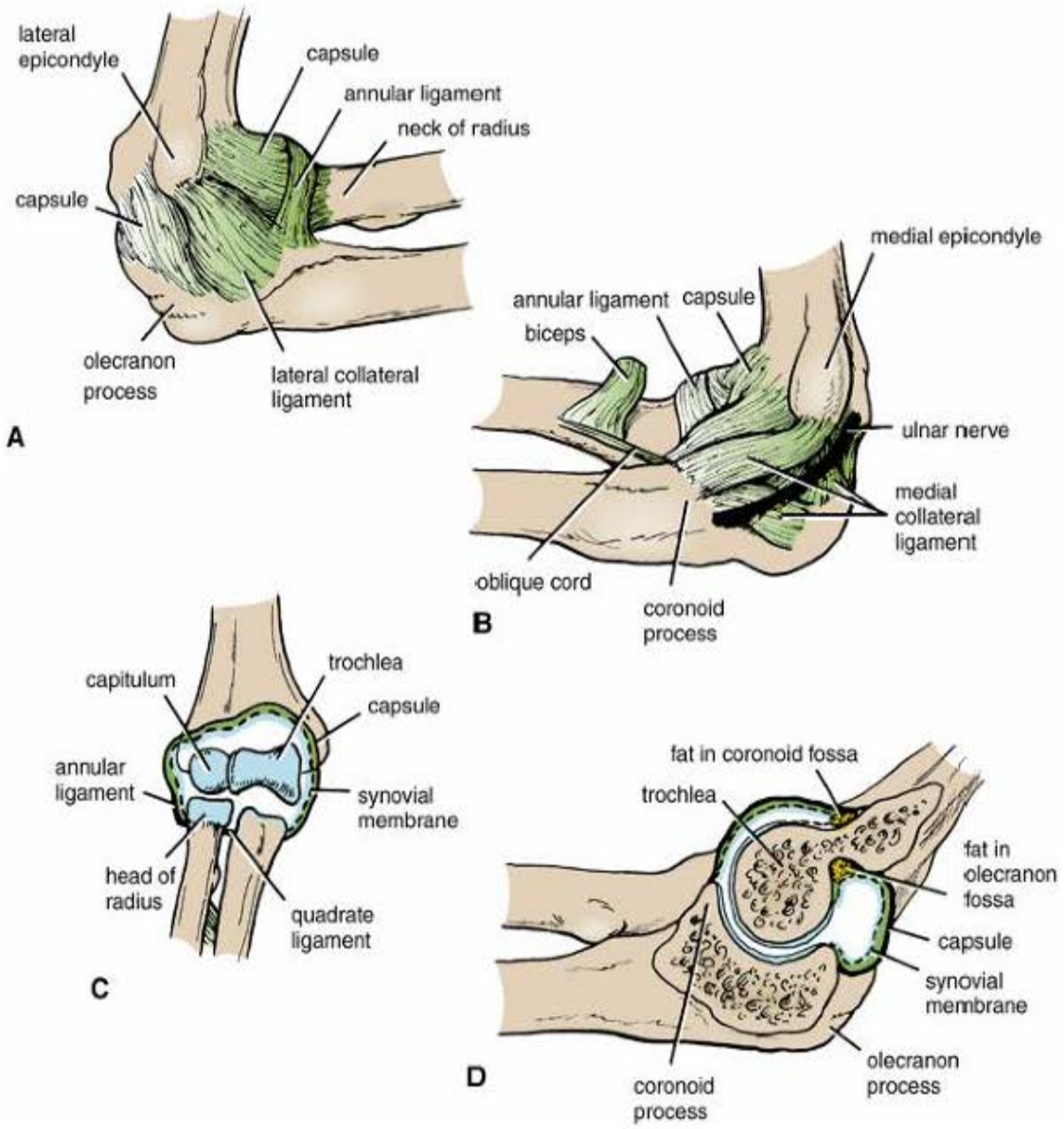


Fig. 30: Right elbow joint. A. Lateral view. B. Medial view. C. Anterior view of the interior of the joint. D. Sagittal section.

PROXIMAL RADIOULNAR JOINT

Articulation (Fig. 31):

- Between circumference of head of radius and annular ligament and radial notch on the ulna

Type: Synovial pivot joint

Capsule:

- Encloses the joint
- Continuous with elbow joint

Ligament (Annular Ligament):

- Attached to anterior and posterior margins of radial notch on the ulna
- Continuous with capsule of the elbow

Synovial Membrane:

- Continuous with elbow joint
- Attached to inferior margin of articular surface of radius and lower margin of radial notch of the ulna

Nerve Supply:

1. Median nerve 2. Ulnar nerve
3. Radial nerve 4. Musculocutaneous nerve

Movements of Superior and Inferior Radioulnar Joints:

- **Supination**: Biceps brachii, supinator
- **Pronation**: Pronator teres, pronator quadratus
- **Midprone**: Brachioradialis

Main Relations:

Anteriorly: Supinator, radial nerve

Posteriorly: Supinator, common extensor tendon

DISTAL RADIOULNAR JOINT

Articulation:

- Between head of ulna and ulnar notch on radius

Type: Synovial pivot type

Ligaments:

- Anterior and posterior ligaments (strengthen the capsule)

Articular Disc:

- Fibrocartilage and triangular
- Attached by its apex to lateral side of base of styloid process of ulna and by its base to lower border of ulnar notch of radius

Synovial Membrane: Lines the capsule

Nerve Supply:

1. Anterior interosseous nerve
2. Poserior interosseous nerve

Movements of Proximal and Distal Radioulnar Joints:

- **Supination:** Biceps brachii, supinator
- **Pronation:** Pronator teres, pronator quadratus
- **Midprone:** Brachioradialis

Main Relations:

- **Anteriorly**: Tendons of flexor digitorum profundus
- **Posteriorly**: Tendon of extensor digiti minimi

WRIST (RADIOCARPAL) JOINT

Articulation (Fig. 31):

- Between distal end of radius and articular disc (above)
- Scaphoid, lunate and triquetral bones (below)

Type: Synovial ellipsoid joint

Capsule: Encloses the joint

Ligaments:

1. **Anterior ligament:** Strengthen the capsule
2. **Posterior ligament:** Strengthen the capsule
3. **Medial ligament:** Attached to styloid process of ulna and triquetral bone
4. **Lateral ligament:** Attached to styloid process of radius and scaphoid bone

Synovial Membrane:

- Lines the capsule and attached to margins of articular surfaces

Nerve Supply:

1. Anterior interosseous nerve
2. Posterior interosseous nerve

Movements of The Wrist Joint:

1. **Flexion:** Flexor carpi radialis, flexor carpi ulnaris, palmaris longus, flexor digitorum superfacialis, flexor digitorum profundus and flexor pollicis longus.
2. **Extension:** Extensor carpi radialis longus, extensor carpi radialis brevis, extensor carpi ulnaris, helped by extensor digitorum, extensor indicis, extensor digiti mini and extensor pollicis longus.
3. **Abduction:** Flexor carpi radialis, extensor carpi radialis longus, extensor carpi radialis brevis, assisted by abductor pollicis longus, extensor pollicis longus and extensor pollicis brevis.
4. **Adduction:** Flexor carpi ulnaris and extensor carpi ulnaris

Main Relations:

- **Anteriorly:** Tendons of flexor digitorum profundus and superficialis, flexor pollicis longus, flexor carpi radialis, flexor carpi ulnaris, median nerve, ulnar nerve
- **Posteriorly**: Tendons of extensor carpi ulnaris, extensor digiti minimi, extensor digitorum, extensor indicis, extensor carpi radialis longus, extensor

carpi radialis brevis, extensor pollicis longus and brevis, abductor pollicis longus.

- **Medially**: Posterior cutaneous branch of ulnar nerve
- **Laterally**: Radial artery

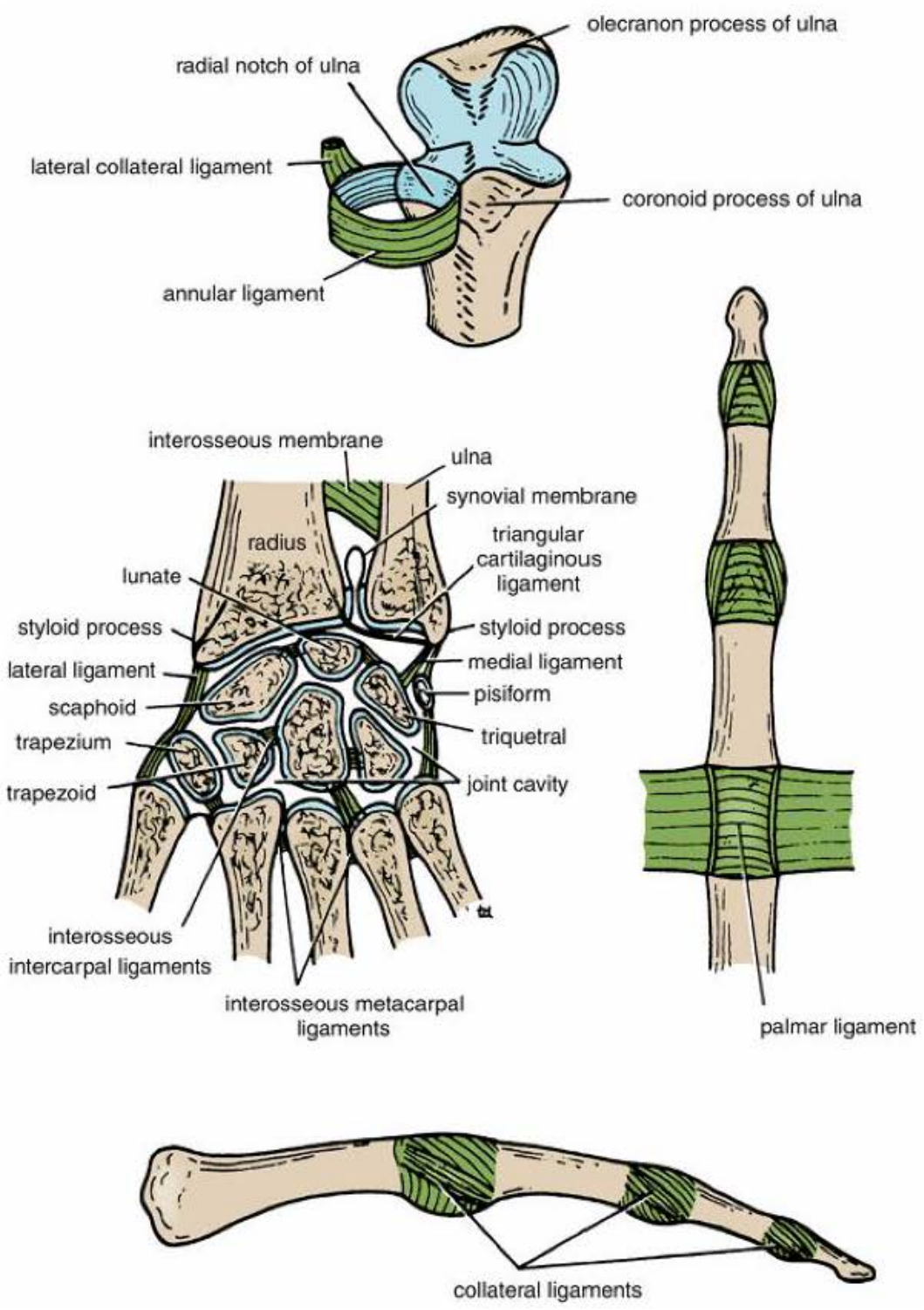


Fig. 31: Ligaments of the proximal and distal radioulnar, wrist, carpal and fingers joints.

THE FOREARM

Deep Fascia of Forearm:

Antebrachial fascia:

- Gives partial origin to superficial muscles of the forearm
- Thickened along posterior border of the ulna, where it forms a strong aponeurosis
- The aponeurosis gives partial origin to 3 muscles:
  1. Flexor carpi ulnaris
  2. Extensor carpi ulnaris
  3. Flexor digitorum profundus
- Thickened in region of wrist, where it forms 2 bands; flexor and extensor retinacula
- The retinacula retain the long tendons in position and thus increase efficiency of actions of these muscles by preventing *bow stringing*

MUSCLES OF FRONT OF THE FOREARM
(Figs. 32-33)

- Named as flexor and pronated group
- Arranged in 2 layers, superficial and deep

(I) Muscles of Superficial Layer (5 Muscles):

1. Pronator teres
2. Flexor carpi radialis
3. Palmaris longus
4. Flexor carpi ulnaris
5. Flexor digitorum superficialis

- They arise by a common tendon from front of the medial epicondyle (common flexor origin)
- Flexor digitorum superficialis: Situated deeper to flexor carpi radialis and palmaris longus

(II) Muscles of Deep Layer (3 Muscles):

1. Flexor pollicis longus (related to radius)
2. Flexor digitorum profundus (related to ulna)
3. Pronator quadratus (related to both radius and ulna)

MUSCLES OF BACK OF THE FOREARM
(Figs. 34-35)

- Arranged into superficial and deep layers.
- Constitute extensor and supinator group.
- Supplied by radial nerve and its posterior interosseous branch.

(I) Muscles of Superficial Layer (7 Muscles):

From lateral to medial:

1. Brachioradialis
2. Extensor carpi radialis longus
3. Extensor carpi radialis brevis
4. Extensor digitorum
5. Extensor digiti minimi
6. Extensor carpi ulnaris
7. Anconeus

(II) Muscles of Deep Layer (5 Muscles):

From above downwards:

1. Supinator
2. Abductor pollicis longus
3. Extensor pollicis longus
4. Extensor pollicis brevis
5. Extensor indicis

PRONATOR TERES

- The most lateral muscle of the group.

Origin:

***By 2 heads (superficial and deep)*:**

1. Superficial (*humeral*) head: Front of medial epicondyle and medial supracondylar ridge
2. Deep (*ulnar*) head: Medial side of coronoid process of the ulna

Insertion: Middle of lateral surface of the radius

Nerve Supply: Median nerve (in cubital fossa).

Action:

- Pronation of the forearm
- Flexion of forearm by superficial head

Main Relations of Pronator Teres:

1. Between its 2 heads the median nerve passes.
2. Ulnar head (deep head) separates the median nerve from the ulnar artery.
3. Its insertion is crossed by radial artery and superficial terminal branch of radial nerve.

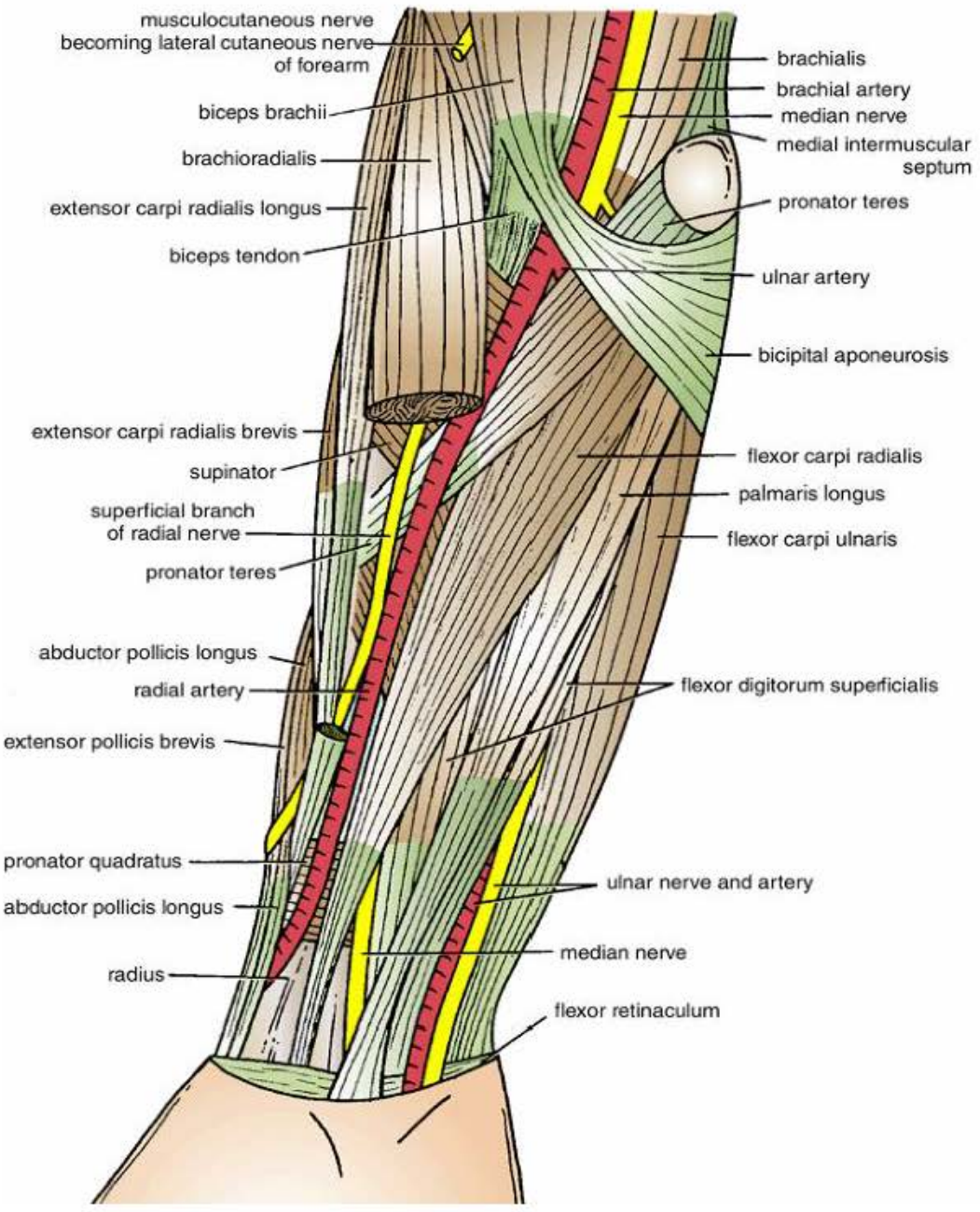


Fig. 32: Anterior view of the forearm. The middle portion of the brachioradialis muscle has been removed to display the superficial branch of the radial nerve and the radial artery.

FLEXOR CARPI RADIALIS

- Lies just medial to the pronator teres

Origin:

- Front of medial epicondyle

Insertion:

- Palmar surface of bases of the 2nd and 3rd metacarpal bones

Nerve Supply: Median nerve (in cubital fossa).

Action: Flexion and abduction of the wrist.

PALMARIS LONGUS

- Lies medial to the flexor carpi radialis
- May be absent.

Origin: Front of the medial epicondyle

Insertion: Apex of the palmer aponeurosis.

- Its tendon crosses superficial to flexor retinaculum

Nerve Supply: Median nerve (in cubital fossa).

Action: Assists in flexion of the wrist

FLEXOR DIGITORUM SUPERFICIALIS
(Fig. 33)

Origin:

1. **Humero-ulnar head:**
   - Front of the medial epicondyle *(common flexor origin)*.
   - Medial side of the coronoid process
2. **Radial head:**
   - Oblique upper 1/3 of anterior border of the radius (anterior oblique line)

Insertion (*4 tendons*): Middle phalanges of medial 4 fingers.

Nerve Supply: Median nerve (in cubital fossa).

Action:

1. Flexion of middle and proximal phalanges of the medial 4 fingers.
2. Assists in flexion of the wrist joint.

Main Relations:

1. Median nerve in the forearm runs on under surface of the muscle. In the carpal tunnel the nerve lies on its lateral side

2. Radial artery and superficial terminal branch of radial nerve run superficial to the origin of radial head of the muscle.
3. Superficial palmar arch and palmar aponeurosis; superficial to it in the hand

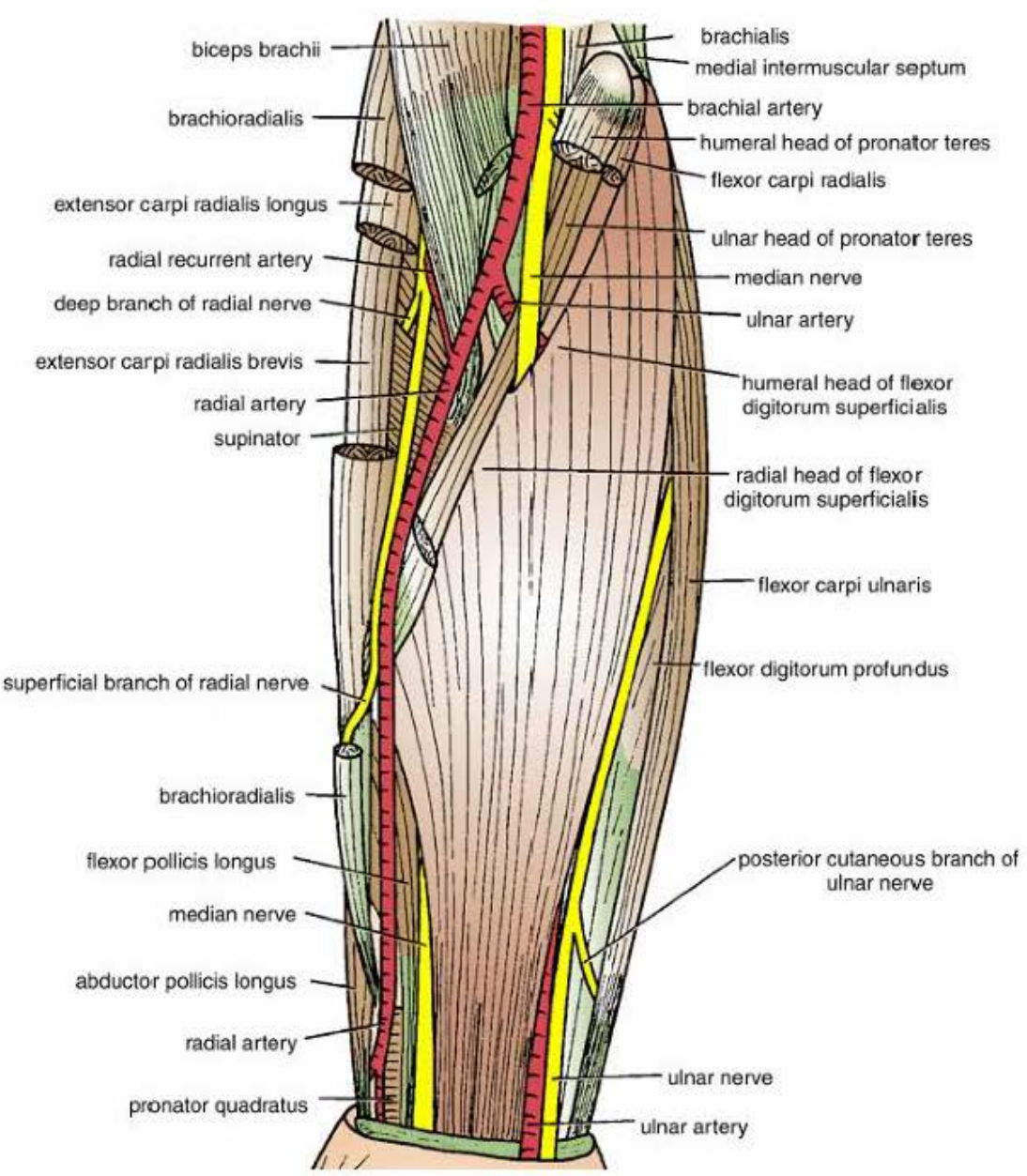


Fig. 33: Anterior view of the forearm. Most of the superficial muscles have been removed to display the flexor digitorum superficialis, median nerve, superficial branch of the radial nerve, and radial artery. Note that the ulnar head of the pronator teres separates the median nerve from the ulnar artery.

FLEXOR CARPI ULNARIS

- Lies along ulnar side of forearm.

Origin: By 2 heads (humeral and ulnar)

1. **Humeral head**: Medial epicondyle
2. **Ulnar head:** Medial margin of olecranon and by aponeurosis from posterior border of ulna

Insertion: Pisiform bone from which insertion extends to

- Base of 5th metacarpal bone: through piso-metacarpal ligament.
- Hamate: through piso-hamate ligament

Nerve Supply: Ulnar nerve

Action:

1. Acting alone: Flexes and adducts the wrist
2. Acting with flexor carpi radialis: Produces only flexion of the wrist
3. Acting with extensor carpi ulnaris: Produces only adduction of the wrist

Main Relations:

1. In the upper 2/3 of forearm: Ulnar nerve lies deep to the muscle
2. In the lower 1/3 of forearm: Ulnar nerve and artery lie on lateral side of the tendon of the muscle, where they come superficial.

FLEXOR POLLICIS LONGUS

Origin: Upper 2/3 of anterior surface of radius and interosseous membrane.
Insertion: Base of distal phalanx of the thumb.
Nerve Supply: Anterior interosseous nerve
Action: Flexion of all joints of the thumb

FLEXOR DIGITORUM PROFUNDUS

Origin:

1. Upper 2/3 of ant. and medial surfaces of ulna
2. Aponeurosis attached to post. border of ulna
3. Interosseous membrane

Insertion (*4 tendons*): Bases of terminal phalanges of medial 4 fingers
Nerve Supply:

Medial part: Ulnar nerve
Lateral part: Anterior interosseous nerve

Action:

1. Flexion of proximal, middle, distal phalanges of medial 4 fingers
2. Helps in flexion of the wrist

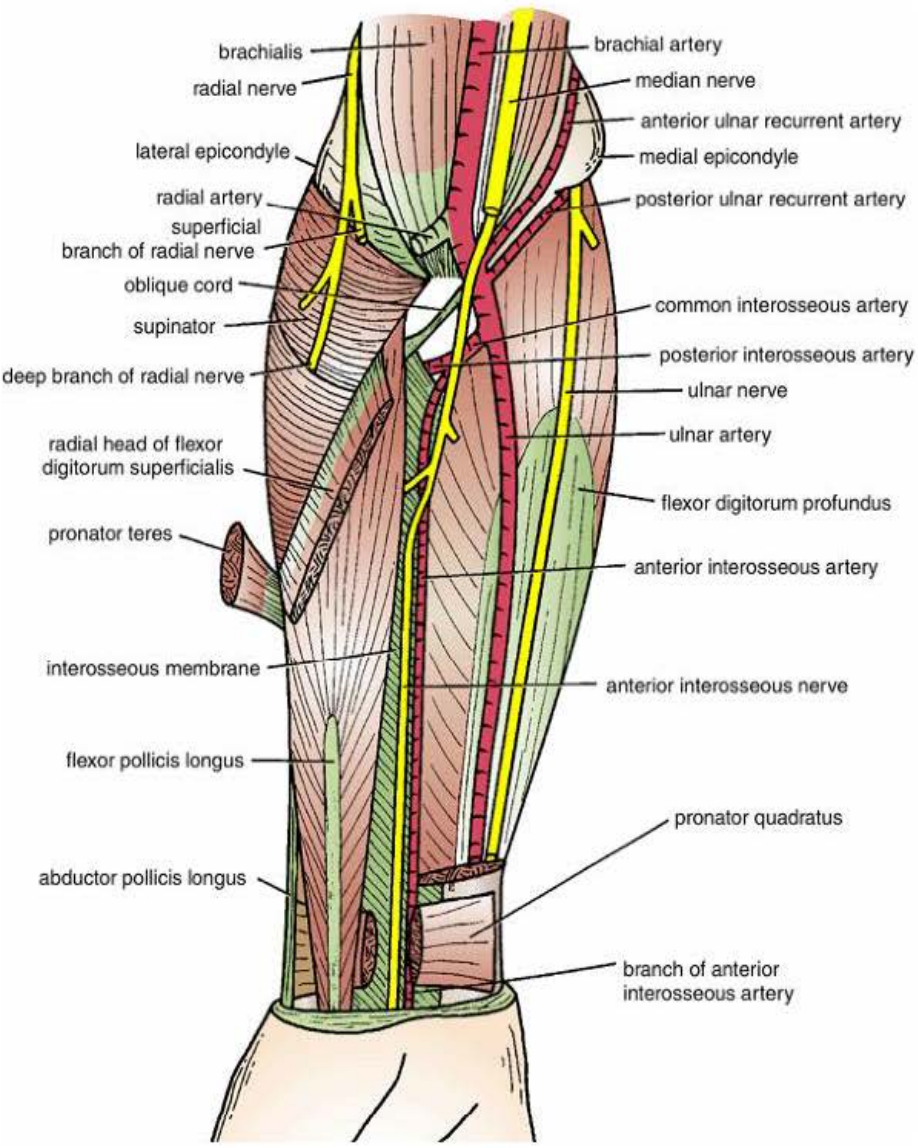


Fig. 34: Anterior view of the forearm showing the deep structure

PRONATOR QUADRATUS

Origin: Lower ¼ of anterior surface of the ulna.
Insertion: Lower ¼ of anterior surface of the radius.
Nerve supply: Anterior interosseous branch of median nerve.
Action: Pronation of the forearm

BRACHIORADIALIS

Origin: Upper 2/3 of lateral supracondylar ridge.
Insertion: Lateral surface of lower end of the radius (base of styloid process)
Nerve supply: Radial nerve.
Action:

1. Puts forearm in midprone position (midway between pronation and supination).
2. Assists in flexion of elbow.

EXTENSOR CARPI RADIALIS LONGUS

Origin: Lower 1/3 of lateral supracondylar ridge.
Insertion: Into the back of base of 2nd metacarpal bone.
Nerve Supply: Radial nerve
Action: Extension and abduction of the wrist.

EXTENSOR CARPI RADIALIS BREVIS

Origin: Common extensor origin *(front of lateral epicondyle).*
Insertion: Back of base of the 3rd metacarpal bone.
Nerve supply: Posterior interosseous nerve
Action: Extension and abduction of the wrist.

EXTENSOR DIGITORUM

Origin: Front of lateral epicondyle of humerus
Insertion:

- By **4 tendons** into the base of middle and distal phalanges of medial 4 fingers.
- Each tendon joins extensor expansion.
  - This expansion divides into 3 parts
  - Median part inserted into the base of middle phalanx
  - 2 collaterals inserted into the base of distal phalanx.

Nerve supply: Posterior interosseous nerve.
Action:

- Extends metacarpo-phalangeal (MCP) and interphalangeal (IP) joints.
- Helps in extension of wrist.

EXTENSOR DIGITI MINIMI

Origin: Common extensor origin.
Insertion: Extensor expansion of little finger.
Nerve supply: Posterior interosseous nerve.
Action: Extension of all joints of little finger.

EXTENSOR CARPI ULNARI

Origin:
- Common extensor origin
- Posterior border of ulna through aponeurosis

Insertion: Back of base of the 5th metacarpal bone
Nerve supply: Posterior interosseous nerve
Action:
- Extension and adduction of wrist
- Pure adduction of wrist when acts with FCU

ANCONEUS

- Triangular in shape
- Most medial and shortest muscle of the group

Origin: Back of lateral epicondyle.
Insertion:
- Lateral surface of olecranon
- Upper ¼ of back of the shaft of ulna

Nerve supply: Radial nerve
Action: Helps in extension of elbow

SUPINATOR

Origin:
1. **Superficial part:** Lateral epicondyle and radial collateral ligament of the elbow.
2. **Deep part:** Supinator crest and depression just in front.

Insertion: Upper 1/3 of lateral surface of radius
Nerve supply: Posterior interosseous nerve before piercing the muscle.
Action: Supinates forearm

ABDUCTOR POLLICIS LONGUS

Origin:

1. Upper part of back of ulna
2. Middle 1/3 of back of radius
3. Interosseous membrane

Insertion: Lateral side of base of the 1st metacarpal bone

Nerve Supply: Posterior interosseous nerve

Action:

- Abducts carpo-metacarpal joint of thumb
- Helps in abduction of the wrist

EXTENSOR POLLICIS LONGUS

Origin:

1. Middle 1/3 of back of ulna, below abductor pollicis longus
2. Interosseous membrane

Insertion: Back of base of distal phalanx of the thumb

Nerve supply: Posterior interosseous nerve

Action: Extension of all the joints of thumb

EXTENSOR POLLICIS BREVIS

Origin:

1. Lower 1/3 of back of radius, below abductor pollicis longus
2. Interosseous membrane

Insertion: Base of proximal phalanx of the thumb

Nerve supply: Posterior interosseous nerve

Action: Extends metacarpophalangeal joint of thumb

EXTENSOR INDICIS

Origin:

1. Lower part of back of ulna, below extensor pollicis longus
2. Interosseous membrane

Insertion: Extensor expansion of index finger

Nerve supply: Posterior interosseous nerve

Action: Extension of index finger

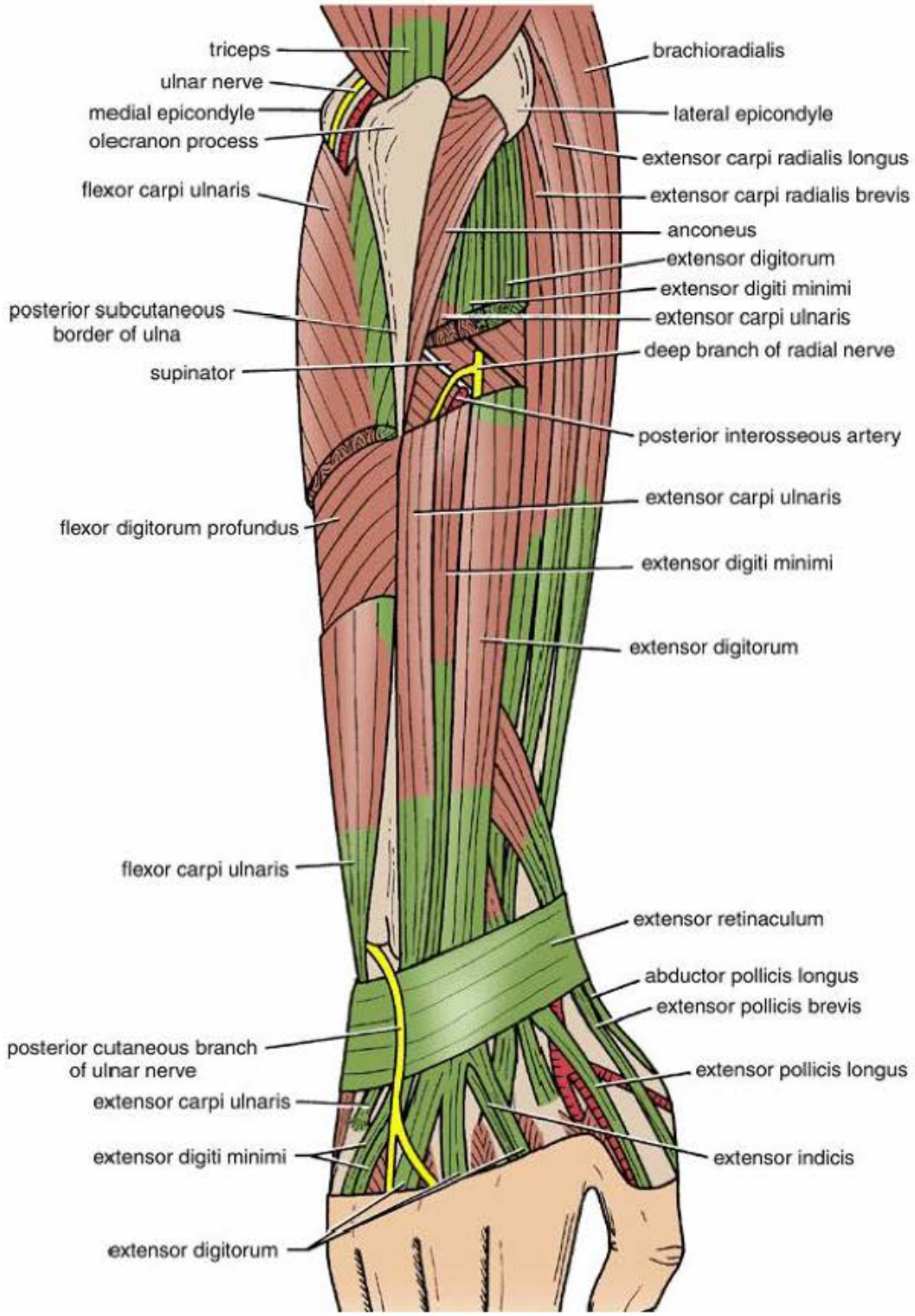


Fig. 35: Posterior view of the forearm. Parts of the extensor digitorum, extensor digiti minimi, and extensor carpi ulnaris have been removed to show the deep branch of the radial nerve and the posterior interosseous artery.

ANATOMICAL SNUFF-BOX
(Fig. 36)

Boundaries:

Laterally: Tendons of abductor pollicis longus and extensor pollicis brevis

Medially: Tendon of extensor pollicis longus

Floor: Scaphoid and trapezium (Fig. 38)

Roof:

1. Digital branches of radial nerve
2. Cephalic vein

Content: Radial artery

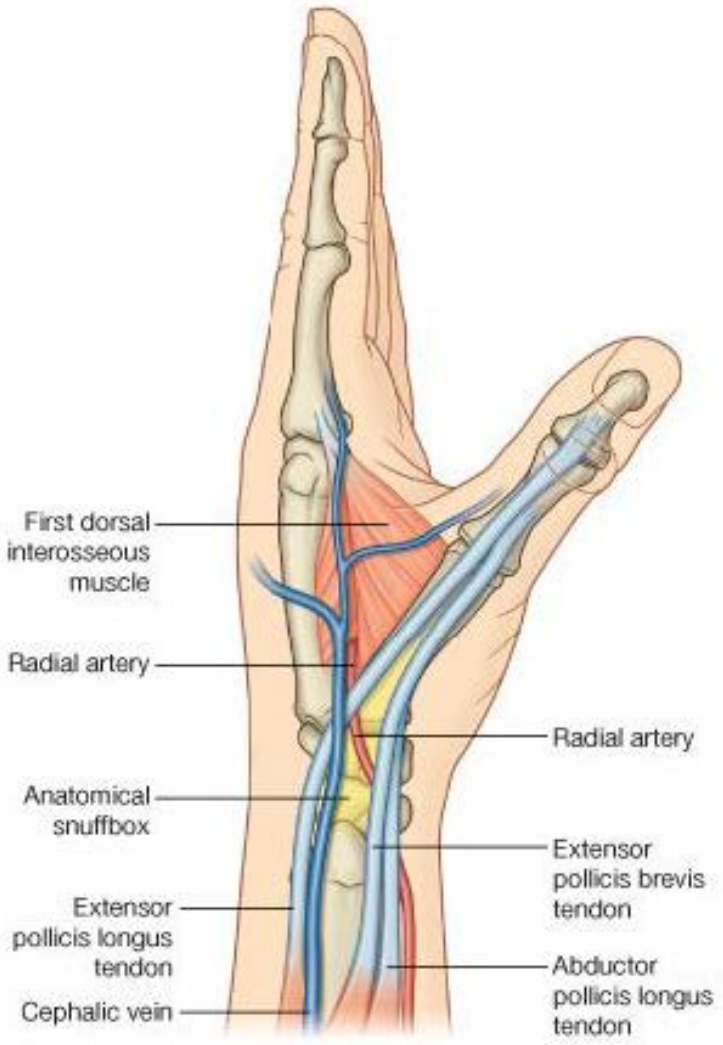


Fig. 36: Anatomical snuff box

FLEXOR RETINACULUM

- Thick fibrous band (retiaculum means rope)
- Lies in front of the carpus, converting its concavity into a tunnel (carpal tunnel)

Attachments:

- **Medially**: Pisiform bone and hook of hamate
- **Laterally**: Tubercle of scaphoid and tubercle (crest) of trapezium. It is splitted into superficial and deep laminae to enclose tendon of flexor carpi radialis

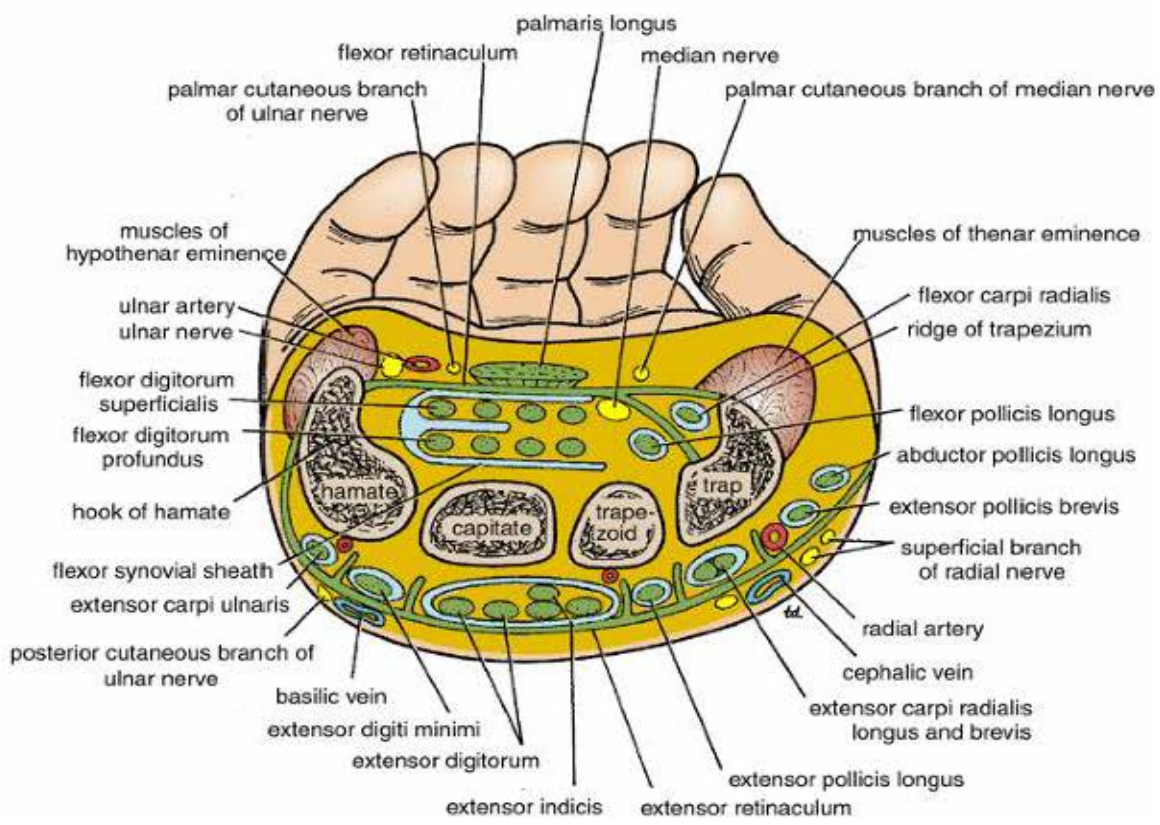


Fig. 37: Cross section of the hand showing the relation of the tendons, nerves, and arteries to the flexor and extensor retinacula.

Relations:

Superficial Relations (from medial to lateral):

1. Ulnar nerve
2. Ulnar artery
3. Palmar cutaneous branch of ulnar nerve
4. Tendon of palmaris longus
5. Palmar cutaneous branch of median nerve

Deep Relations (inside carpal tunnel):

1. Tendons of flexor digitorum superficialis
2. Tendons of flexor digitorum profundus
3. Tendon of flexor pollicis longus
4. Median nerve
5. Synovial sheaths around the long tendons

Pressure on the median nerve inside carpal tunnel leads to 'carpal tunnel syndrome'

EXTENSOR RETINACULUM

(Fig. 35)

- Thick fibrous band
- Extends obliquely across the back of wrist
- Its deep surface sends septa dividing the space beneath it into 6 compartments

Attachments:

- **Medially**: Styloid process of ulna, triquetral and pisiform bones
- **Laterally**: Anterior border of lower end of radius

Superficial Relations:

1. Dorsal cutaneous branch of ulnar nerve
2. Basilic vein
3. Cephalic vein
4. Superficial branch of radial nerve

Deep Relations (from lateral to medial):

I. First compartment:

- Lies on lateral surface of lower end of radius
- Transmits tendons of:
  - Abductor pollicis longus
  - Extensor pollicis brevis

II. Second compartment:

- Transmits tendons of:
  - Extensor carpi radialis longus
  - Extensor carpi radialis brevis

III. Third compartment:

- Lies medial to dorsal tubercle of the radius
- Transmits only the tendon of:
  - Extensor pollicis longus

IV. Fourth compartment:

- Lies on lateral part of posterior surface of the radius
- Transmits 4 structures:
  - Extensor digitorum
  - Extensor indicis
  - Termination of anterior interosseous artery
  - Termination of posterior interosseous nerve

V. Fifth compartment:

- Lies opposite interval between radius and head of ulna (posterior to distal radioulnar joint)
- Transmits only tendon of:
  - Extensor digiti minimi

VI. Sixth compartment:

- Lies between head of the ulna and its styloid process
- Transmits only tendon of:
  - Extensor carpi ulnaris

RADIAL ARTERY

Beginning of Radial Artery:

- One of 2 terminal branches of brachial artery
- At level of neck of the radius in cubital fossa

End of Radial Artery:

- Continues as deep palmar arch
- At base of the 5th metacarpal bone (palm)

Superficial (Anterior) Relations:

Upper 2/3 of forearm: Covered only by brachioradialis

Lower 1/3 of forearm: Subcutaneous and its pulsations can be felt

Deep (Posterior) Relations:

1. Tendon of biceps brachii
2. Supinator
3. Pronator teres
4. Radial head of flexor digitorum superficialis
5. Flexor pollicis longus
6. Pronator quadratus
7. Lower end of radius

1. To 2. Swim 3. Properly 4. Flex 5. Forearm 6. Pronate 7. Radius

Branches of Radial Artery:

- **In the forearm:**

1. ***Radial recurrent artery:***
   - Runs upwards and laterally front lateral epicondyle
   - Anastomoses with anterior descending branch of profunda brachii artery
2. ***Muscular branches:*** To muscles of lateral side of the forearm
3. ***Palmar carpal artery:***
   - Arises near lower border of pronator quadratus to descend front carpal bones
   - Joins palmar carpal branch of ulnar artery to form palmar carpal arch
4. ***Superficial palmar artery:***
   - Arises from lowermost part of radial artery in forearm
   - Penetrates thenar muscles
   - Joins end of superficial palmar arch

Surface Anatomy of Radial Artery In Forearm:

- Represented by a line extending from midpoint of cubital fossa (midway between the 2 epicondyles) to a point on front of lower end of radius where the pulsations are felt.

Course and Relations:

I. **In the back of the hand:**

- Winds backwards lateral to wrist joint
- Deep to tendons of abductor pollicis longus and extensor pollicis brevis
- Passes on floor of anatomical snuff-box
- Deep to tendon of extensor pollicis longus
- Reaches 1st interosseous space

II. **In the palm of the hand:**

- Enters the palm between 2 heads of 1st dorsal interosseous and 2 heads of adductor pollicis muscles.
- Continues as deep palmar arch

Branches of Radial Artery:

I. In the back of the hand:

1. Posterior carpal artery:

- Arises in anatomical snuff-box

- Passes medially on back of carpus
- Anastomoses with posterior carpal artery from ulnar artery to form posterior carpal arch which gives off 3 dorsal metacarpal arteries, each divides into 2 dorsal digital arteries to adjacent sides of medial 3 fingers.

2. First dorsal metacarpal artery:

- Divides into 2 dorsal digital branches to adjacent sides of thumb and index

3. Dorsal digital artery to radial side of thumb

II. In the palm of the hand:

1. Princeps pollicis artery: Divides into 2 palmar digital arteries

2. Radialis indicis artery:

- Arises in common with princeps pollicis
- Passes along radial side of index finger

3. Deep palmar arch (Fig. 41):

- Continuation of end of radial artery
- **Gives:**

a. 3 palmar metacarpal arteries:

- Run along medial 3 interosseous spaces
- Join common digital branches of superficial palmar arch

b. 3 perforating arteries:

- Perforate medial 3 spaces between 2 heads of respective dorsal interosseous muscles.
- Join the 3 dorsal metacarpal arteries on back of hand

c. Recurrent branch/branches:

- Ascends/ascend in front of the carpal bones
- Join the anterior carpal arch

ULNAR ARTERY
(Fig. 34)

Beginning of Ulnar Artery:

- Opposite neck of radius
- Larger terminal branch of brachial artery

End of Ulnar Artery:

- Lateral to pisiform bone
- Divides into 2 terminal branches;superficial and deep.
- Superficial branch: (continuation of ulnar artery) forms superficial palmar arch with superficial palmar branch of radial artery

- Deep branch: joins end of radial artery to form deep palmar arch

Course and Relations:

I. In the forearm:

Upper 1/3 of forearm:

- Passes obliquely downwards and medially
- Deep to:
  1. Pronator teres
  2. Flexor carpi radialis
  3. Palmaris longus
  4. Flexor digitorum superficialis
  5. Flexor carpi ulnaris
- Deep head of pronator teres separates ulnar artery from median nerve
- Superficial to: Flexor digitorum profundus

Lower 2/3 of forearm:

- Descends vertically along medial side of forearm
- Deep to: Flexor carpi ulnaris
- Superficial to: Flexor digitorum profundus

II. In the hand:

- Enters the hand superficial to flexor retinaculum lateral to ulnar nerve
- Covered by palmaris brevis muscle

Branches of Ulnar Artery:

I. In the forearm:

1. Anterior ulnar recurrent artery:

- Ascends in the front of medial epicondyle (humerus)
- Anastomoses with anterior branch of inferior ulnar collateral artery

2. Posterior ulnar recurrent artery:

- Ascends in the back of medial epicondyle of humerus
- Anastomoses with superior ulnar collateral artery and posterior division of inferior ulnar collateral artery

3. Common interosseous artery:

- Passes backwards to upper border of interosseous membrane
- Divides into anterior & posterior interosseous arteries:
  a. Anterior interosseous artery:
  - Descends front of interosseous membrane
  - Between flexor pollicis longus and flexor digitorum profundus

- Accompanied by anterior interosseous nerve
- Pierces interosseous membrane, at upper border of pronator quadratus
- Continues downwards on back of wrist deep to extensor retinaculum

Branches of Anterior Interosseous Artery:

1) Nutrient artery to radius
2) Nutrient artery to ulna
3) Median artery: Accompanies median nerve.
4) Carpal (descending) branch to: Anterior carpal arch
5) Muscular branches to:
   Deep flexor muscles of forearm

b. Posterior interosseous artery:

- Passes backwards above upper border of interosseous membrane
- Between radius and ulna and between supinator and abductor pollicis longus.
- Descends between superficial and deep layers of extensor muscles
- Anastomoses with end of anterior inter-osseous artery and posterior carpal arch.
- Gives: Interosseous recurrent artery which ascends behind lateral epicondyle to anastomose with posterior descending branch of profunda brachii artery.

4. Anterior carpal artery:

- Joins anterior carpal branch of radial artery to form anterior carpal arch

5. Posterior carpal artery:

- Joins posterior carpal branch of radial artery to form posterior carpal arch

II. Branches of ulnar artery in the hand:

(Superficial palmar arch):

a. 3 common palmar digital arteries:
   - Each divides into 2 palmar digital arteries to adjacent sides of medial 4 fingers
   - Each common digital artery is joined by end of corresponding palmar metacarpal artery (deep palmar arch)

b. Palmar digital artery to medial side of little finger

Surface Anatomy of Ulnar Artery in Forearm:

Corresponds to a line drawn from a point in cubital fossa (midway between 2 epicondyles) and 2nd point on medial side of forearm at junction of its upper 1/3

and lower 2/3 (oblique part) and the line continues vertically to 3rd point just lateral to pisiform bone.

Surface Anatomy of Superficial Palmar Arch:

Represented by a transverse line drawn across the palm in line with distal border of the extended thumb.

Surface Anatomy of Deep Palmar Arch:

Represented by a transverse line drawn across the palm from hook of the hamate towards the thumb. It is 1 Cm proximal and parallel to the line of the superficial palmar arch

ANASTOMOSIS AROUND THE WRIST

Anastomosis between radial and ulnar arteries

I. Front The Wrist (Anterior Carpal Arch):

1. Anterior carpal branch of radial artery
2. Anterior carpal branch of ulnar artery
3. Descending (carpal) branch from anterior interosseous artery (ulnar)
4. Ascending (recurrent) branch from deep palmar arch (mainly radial)

II. Behind The Wrist (Posterior Carpal Arch):

1. Posterior carpal branch of radial artery
2. Posterior carpal branch of ulnar artery
3. End of anterior interosseous artery (ulnar)
4. End of posterior interosseous artery (ulnar)

ANASTOMOSIS IN THE HAND
(FIG. 38)

Between Radial and Ulnar Arteries:

1. Anterior carpal arch
2. Posterior (dorsal) carpal arch
3. Superficial palmar arch
4. Deep palmar arch

Between Deep and Superficial Palmar Arches:

- 3 palmar metacarpal arteries from deep palmar arch
- 3 Common palmar digital arteries from superficial palmar arch

Between Deep Palmar Arch and Dorsal Metacarpal Arteries:

- 3 perforating arteries of deep palmar arch
- 3 dorsal metacarpal arteries

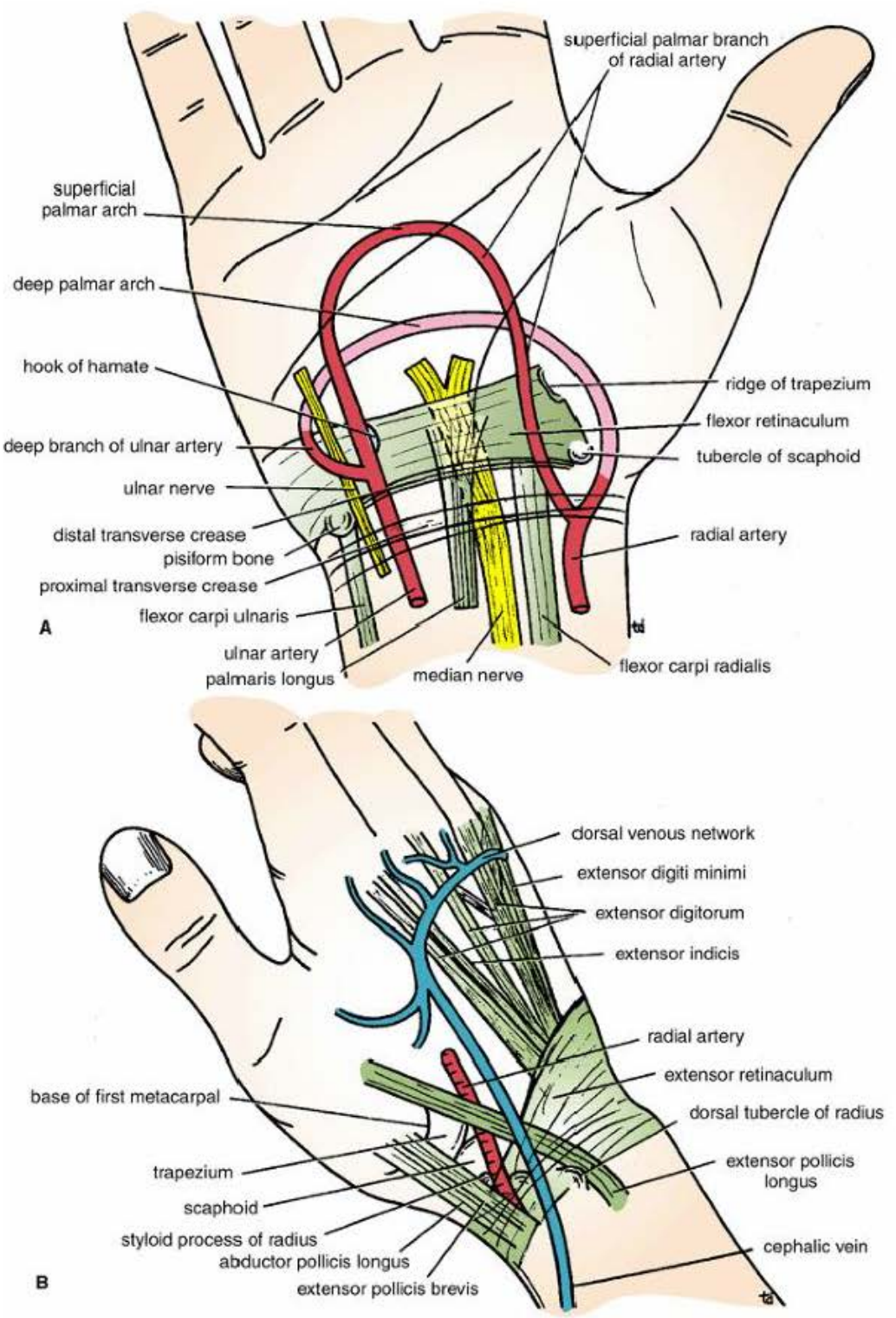


Fig.38: Surface anatomy and anastomosis of radial and ulnar arteries in the hand

Dorsal Carpal Arch (Fig. 41)

- Lies on dorsal surface of the wrist
- Deep to extensor tendons

Branches of dorsal carpal arch:

- 3 dorsal metacarpal arteries: Each divides into 2 dorsal digital arteries to adjacent sides of medial 4 fingers
- Dorsal digital artery to medial side of little finger

HAND

Skin of The Hand

- Skin of dorsum of hand is thin and mobile
- Skin of palm is thick and firmly fixed to underlying subcutaneous tissue, hairless, has flexion creases and papillary ridges to adapt the hand for grasping activities
- 2 transverse creases (proximal and distal) at junction of palm with front of forearm
- Distal crease corresponds to proximal border of flexor retinaculum
- Proximal crease lies one inch proximally
- At the creases the skin is firmly adherent to subcutaneous tissue
- Papillary ridges at tips and roots of the fingers responsible for finger-prints.

Deep Fascia of The Palm:

Consists of 3 parts:

1. Lateral part: Thin and covers the thenar eminence
2. Medial part: Thin and covers the hypothenar eminence
3. Cental part: Thick and triangular and covers intermediate compartment of the hand (palmar aponeurosis).

Palmar Aponeurosis (Fig. 39):

- Triangular with an apex directed proximally and a base directed distally
- The apex is continuous with tendon of palmaris longus and distal border of flexor retinaculum
- The base divides into 4 slips, one for each of the medial 4 fingers
- Each slip is attached to skin of the palm and fibrous flexor sheath of long tendons at roots of the fingers
- A septum extends from its medial border to get attached to the 5th metacarpal bone.

- Another septum extends from its lateral border to get attached to the 1st metacarpal bone (medial and lateral boundaries of intermediate compartment of the palm)

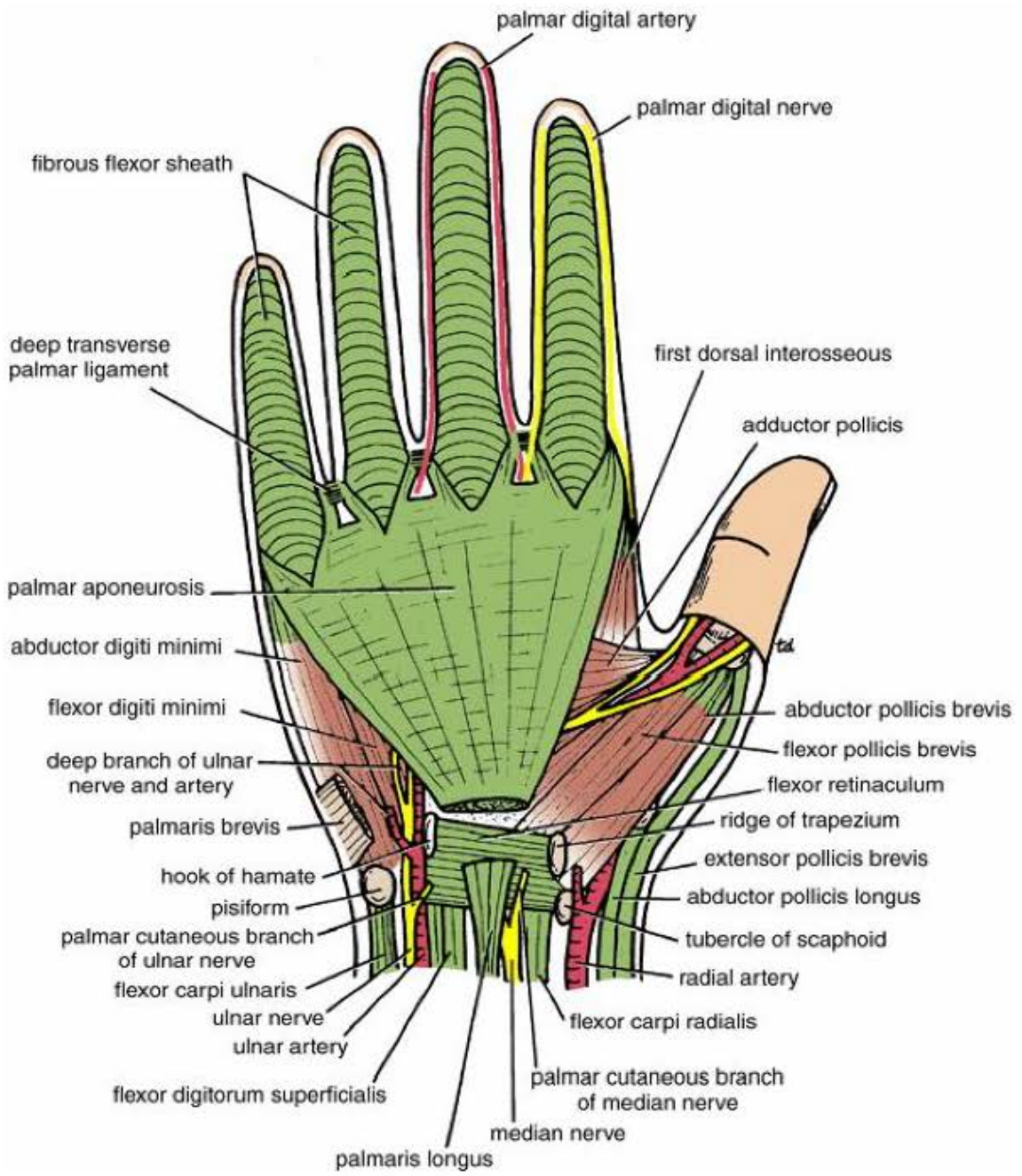


Fig.39: Anterior view of the palm of the hand. The palmar aponeurosis has been left in position

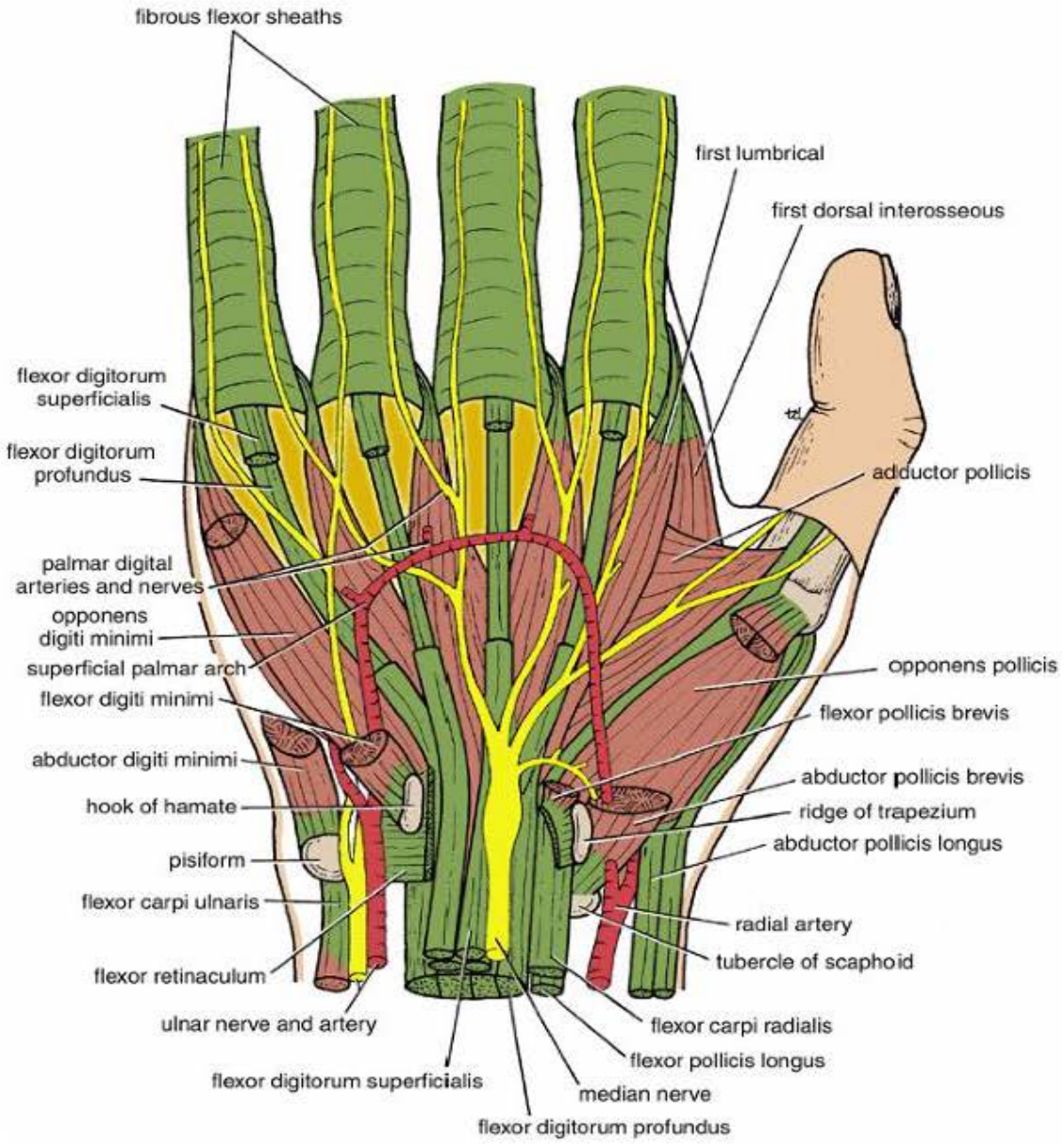


Fig. 40: Anterior view of the palm of the hand. The palmar aponeurosis and the greater part of the flexor retinaculum have been removed to display the superficial palmar arch, the median nerve, and the long flexor tendons. Segments of the tendons of the flexor digitorum superficialis have been removed to show the underlying tendons of the flexor digitorum profundus.

Structures Deep to Palmar Aponeurosis (Fig. 40):

(From superficial to deep)

1. Superficial palmar arch
2. Common palmar digital branches
3. Digital branches of median nerve
4. Tendons of flexor digitorum superficialis
5. Tendons of flexor digitorum profundus

6. Lumbrical muscles
7. Deep palmar arch
8. Deep branch of ulnar nerve

MUSCLES OF THE HAND
(Figs. 39-40)

- Muscles of thenar eminence
- Muscles of hypothenar eminence
- Muscles in intermediate compartment (interosseoi and lumbricals)

I. **Muscles of Thenar Eminence (ball of thumb):**
   1. Abductor pollicis brevis
   2. Flexor pollicis brevis
   3. Opponens pollicis
   4. Adductor pollicis

II. **Muscles Of Hypothenar Eminence:**
   1. Abductor digiti minimi: Medial one.
   2. Flexor digiti minimi: Lateral one.
   3. Opponens digiti minimi: Deep to abductor and flexor digiti minimi
   4. Palmaris brevis

III. **Muscles In Intermediate Compartment:**
   1. Palmar interosseoi (4 muscles)
   2. Dorsal interosseoi (4 muscles)
   3. Lumbricals (4 muscles)

ABDUCTOR POLLICIS BREVIS

Origin:
- Flexor retinaculum
- Tubercles of trapezium and scaphoid bones

Insertion: Lateral side of the base of proximal phalanx.
Nerve supply: Median nerve
Action: Abduction of the thumb.

FLEXOR POLLICIS BREVIS

Origin:
- Flexor retinaculum
- Tubercle of trapezium and trapezoid

Insertion:

- Lateral side of base of proximal phalanx of the thumb (with abductor pollicis brevis).

Nerve supply:

1. Median nerve
2. Deep branch of ulnar nerve

Action: Flexion of the thumb

OPPONENS POLLICIS

- Lies directly on the 1st metacarpal bone
- Under abductor and flexor pollicis brevis

Origin:

- Flexor retinaculum
- Tubercle (crest) of trapezium

Insertion: Shaft of 1st metacarpal bone.

Nerve supply: Median nerve

Action: Opposes thumb to meet other fingers

ADDUCTOR POLLICIS (Fig. 41)

Origin: By 2 heads (Oblique and Transverse)

- Oblique head: Capitate and bases of 2nd and 3rd metacarpal bones
- Transverse head: Front of the shaft of 3rd metacarpal bone

Insertion: Medial side of base of proximal phalanx of thumb

Nerve supply: Deep branch of ulnar nerve

Action: Adduction of the thumb

PALMARIS BREVIS

- Thin muscle, in superficial fascia
- On medial side of hypothenar eminence

Origin:

- Flexor retinaculum
- Medial border of palmar aponeurosis

Insertion: Skin of medial side of the hand

Nerve supply: Superficial branch of ulnar nerve

Action:

- Wrinkles the skin on medial side of hand
- Elevates medial side of hand, deepening hollow of palm to provide a firm grip

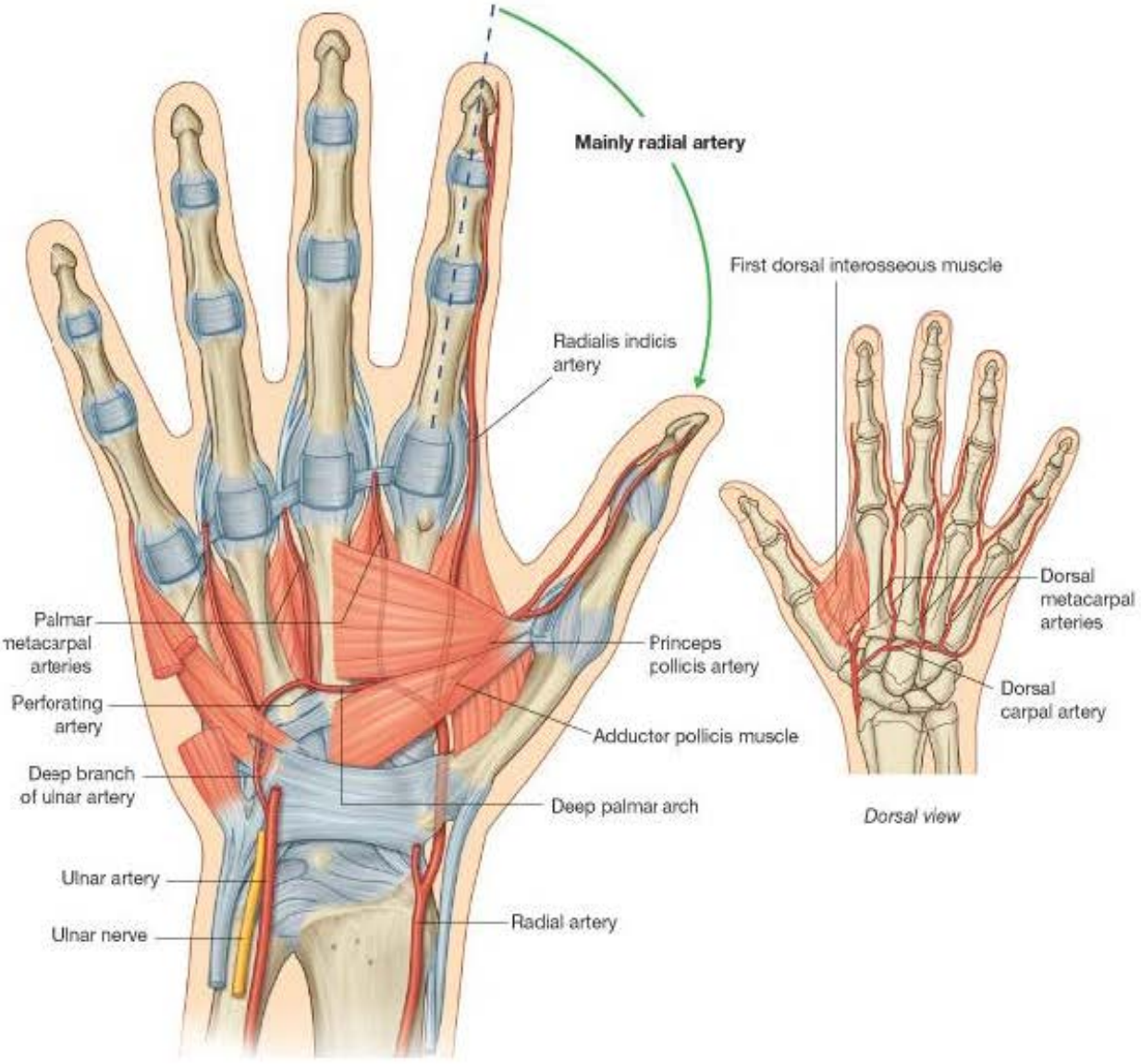


Fig. 41: Deep palmer arch

ABDUCTOR DIGITI MINIMI

Origin:

- Pisiform bone
- Piso-hamate ligament

Insertion: Medial side of base of proximal phalanx of little finger
Nerve supply: Deep branch of ulnar nerve
Action: Abduction of little finger

FLEXOR DIGITI MINIMI

Origin:
- Flexor retinaculum
- Hook of hamate

Insertion: Medial side of base of proximal phalanx of little finger
Nerve supply: Deep branch of ulnar nerve
Action: Flexion of proximal phalanx of little finger

OPPONENS DIGITI MINIMI

Origin:
- Hook of hamate
- Flexor retinaculum

Insertion: Whole length of medial margin of the 5th metacarpal bone
Nerve supply: Deep branch of ulnar nerve
Action: Opposition of little finger

- *Pierced by deep branch of ulnar nerve and deep branch of ulnar artery*

LUMBRICAL MUSCLES

Origin: 4 slender muscles
- Tendons of flexor digitorum profundus

Insertion:
- Lateral margin of extensor expansion
- Each tendon passes along lateral side of corresponding metacarpophalangeal joint.

Nerve supply:
- ***Lateral 2 muscles***: Median nerve
- ***Medial 2 muscles***: Ulnar nerve

Action:
- Flexion of metacarpophalangeal joints and extension of interphalangeal joints of medial 4 fingers (writing position).

PALMAR INTEROSSEOI

- 4 muscles but the 1st muscle may be absent

Origin:

1st: Base of the 1st metacarpal bone
2nd: Whole length of the 2nd metacarpal bone
3rd: Whole length of the 4th metacarpal bone
4th: Whole length of the 5th metacarpal bone

Insertion of palmar interosseoi:

1st: Medial side of base of proximal phalanx of thumb
2nd: Medial border of extensor expansion of index finger
3rd: Lateral border of extensor expansion of ring finger
4th: Lateral margin of extensor expansion of little finger

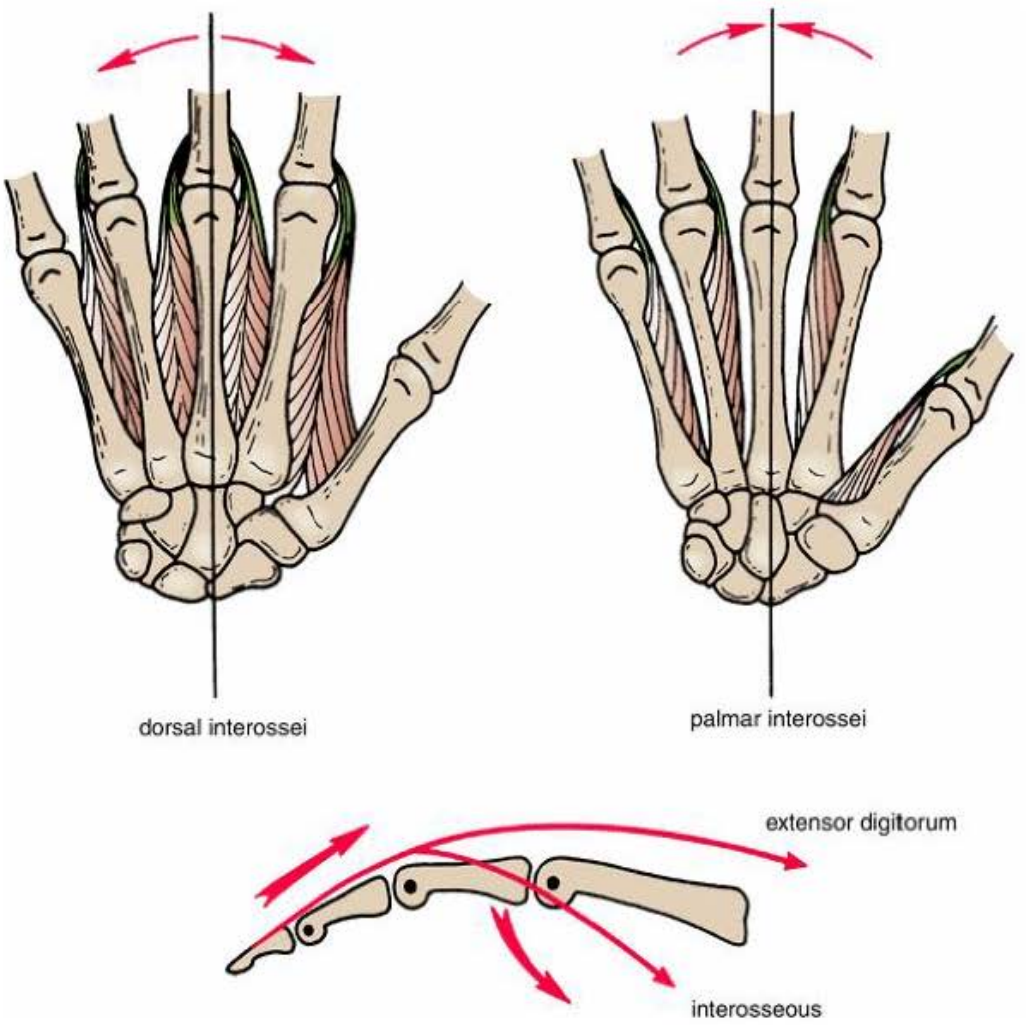


Fig. 42: Origins and insertion of the palmar and the dorsal interossei muscles. The actions of these muscles are also shown.

Nerve supply: Deep branch of ulnar nerve

Action: (PAD)

- *Acting alone* : Adduction of 2nd, 4th and 5th fingers towards middle finger
- *Acting with dorsal interosseoi and lumbricals*: Flexion of metacarpophalangeal joints (MCPJ) and extension of interphalangeal joints (IPJ) of medial 4 fingers (writing position).

DORSAL INTEROSSEOI

Origin: (Each muscle is originated by 2 heads)

1st: Adjacent sides of the 1st and 2nd metacarpal bones

2nd: Adjacent sides of the 2nd and 3rd metacarpal bones

3rd: Adjacent sides of the 3rd and 4th metacarpal bones

4th: Adjacent sides of the 4th and 5th metacarpal bones

Insertion:

1st: Lateral side of base of proximal phalanx of index finger and its extensor expansion

2nd: Lateral side of base of proximal phalanx of middle finger and its extensor expansion

3rd: Medial side of base of proximal phalanx of middle finger and its extensor expansion

4th: Medial side of base of proximal phalanx of ring finger and its extensor expansion

Nerve supply: Deep branch of ulnar nerve

Action: (DAB)

- *Acting alone*: Abduction of 2nd and 4th fingers away from the middle finger
- *Acting with palmar interosseoi and lumbricals*: Flexion of MCPJ and extension of IPJ of medial 4 fingers (writing position)

JOINTS OF THE HAND AND FINGERS
(Fig. 31)

Intercapal Joints:

Articulation: Between

- Individual bones of proximal row of carpus
- Individual bones of distal row of carpus
- Proximal and distal rows of carpus

Type: Synovial plane joints
Capsule: Surrounds each joint
Ligaments: Anterior, posterior, interosseous
Synovial membrane:

- Lines the capsule
- Attached to margins of articular surfaces
- Extends between: The two rows, individual bones of proximal row and individual bones of distal row.

Nerve supply:

1. Anterior interosseous nerve
2. Deep branch of radial nerve
3. Deep branch of ulnar nerve

Movements: Gliding movement

Carpometacarpal and Interphalangeal Joints:

- Synovial plane joints
- Have anterior, posterior and interosseous ligaments
- Have common joint cavity
- Gliding movement is possible

Carpometacarpal Joint of Thumb:
Articulation: Between

- Trapezium
- Saddle-shaped base of 1st metacarpal bone

Type: Synovial saddle-shaped joint
Capsule: Surrounds the joint
Synovial membrane: Lines the capsule
Movements:

- **Flexion**: Flexor pollicis brevis and opponens pollicis
- **Extension**: Extensor pollicis longus and brevis
- **Abduction**: Abductor pollicis longus and brevis
- **Adduction**: Adductor pollicis, 1st palmar interosseous (if present)
- **Opposition**: Opponens pollicis

Metacapophalangeal Joints:
Articulation: Between heads of metacarpal bones and bases of proximal phalanges

Type: Synovial condyloid joints
Capsule: Surrounds the joint
Ligaments:

1. **Palmar ligaments:** From phalanx to metacarpal bone. Palmar ligaments of 2nd, 3rd, 4th and 5th joints are united with deep transverse metacarpal ligaments.
2. **Collateral ligaments:** On each side of the joints, from head of metacarpal bone to base of phalanx.

Movements:

- **Flexion:** Lumbricals, interosseoi, flexor digitorum superficialis, flexor digitorum profundus
- **Extension:** Extensor digitorum, extensor indicis, extensor digiti minimi
- **Abduction:** Dorsal interosseoi
- **Adduction:** Palmar interosseoi
- *Flexion of thumb is done by flexor pollicis longus and brevis while the extension is done by extensor pollicis longus and brevis.*
- *Abduction and adduction occurs at carpometacarpal joint of thumb*
- *Interphalangeal joints: Synovial hinge joints*

CUTANEOUS NERVES

I. The Arm:

1. **Lateral supraclavicular nerve (cervical plexus):** To skin on top of shoulder and skin over upper ½ of deltoid
2. **Upper lateral cutaneous nerve of arm (axillary nerve):** To skin on lower ½ of deltoid and upper part of lateral side of arm
3. **Lower lateral cutaneous nerve of arm (radial nerve, in spiral groove):** To skin of lower part of lateral side of the arm
4. **Medial cutaneous nerve of arm (medial cord of brachial plexus):** To skin of medial side of arm, joins intercostobrachial nerve (lateral cutaneous branch of the 2nd intercostal nerve) to supply floor of axilla
5. **Posterior cutaneous nerve of arm (radial nerve, in axilla):** To skin on back of the arm

II. The Forearm:

1. **Medial cutaneous nerve of forearm (medial cord of brachial plexus):** To skin of medial side of forearm

2. **Lateral cutaneous nerve of forearm,** continuation of musculocutaneous nerve: To skin of lateral side of forearm
3. **Posterior cutaneous nerve of forearm** (radial nerve, spiral groove): To skin on back of forearm

III. The Hand:

1. Median nerve:

- Palmar cutaneous nerve: To lateral 2/3 of the palm
- Palmar digital nerves: To palmar aspects of lateral 3.5 fingers and dorsum of distal phalanx of thumb and dorsum of middle and distal phalanges of index, middle and lateral ½ of ring fingers

2. Ulnar nerve:

- Palmar cutaneous nerve: To medial 1/3 of the palm
- Palmar digital nerves: To palmar surfaces of medial 1.5 fingers
- Dorsal cutaneous nerve: To back of medial 1/3 of the hand and dorsum of medial 1.5 fingers

3. Radial nerve (superficial branch):

Supplies skin on back of:

- Lateral 2/3 of the hand
- Proximal phalanges of lateral 3.5 fingers

DERMATOMES

- Strip of skin supplied by a specific segment of the spinal cord
- Segments of spinal cord supplying upper limb are those forming brachial plexus (C5, 6, 7, 8, T1) plus C4 (cervical plexus) and T2 (intercostobrachial nerve)
- C4 supplies top of shoulder and skin on upper of deltoid
- T2 supplies floor of axilla
- C5, 6 supply skin of lateral side of arm
- C6, 7, 8 supply skin of the hand
- C8, T1 supply medial side of upper limb

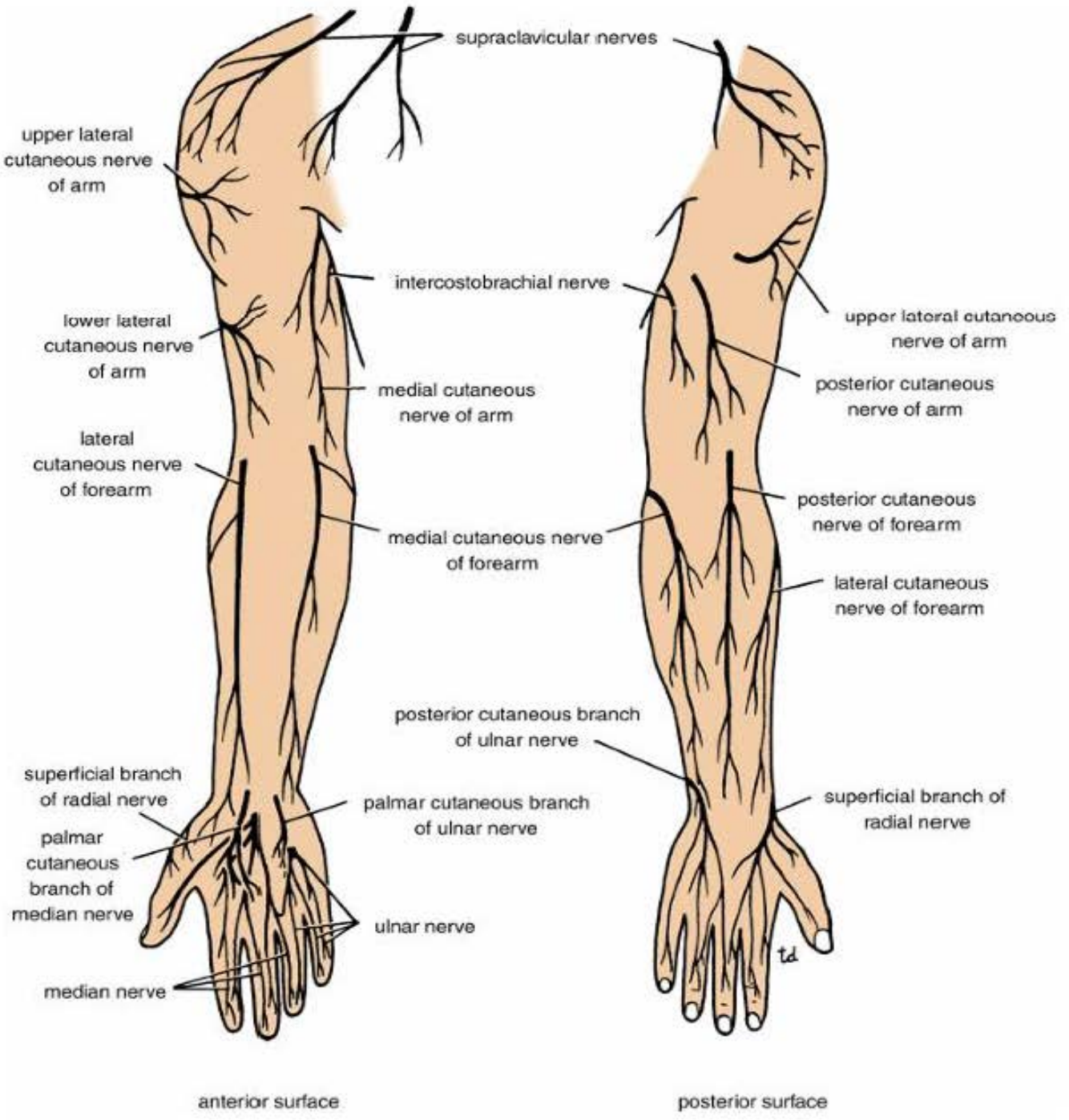


Fig. 43: Cutaneous innervation of the upper limb.

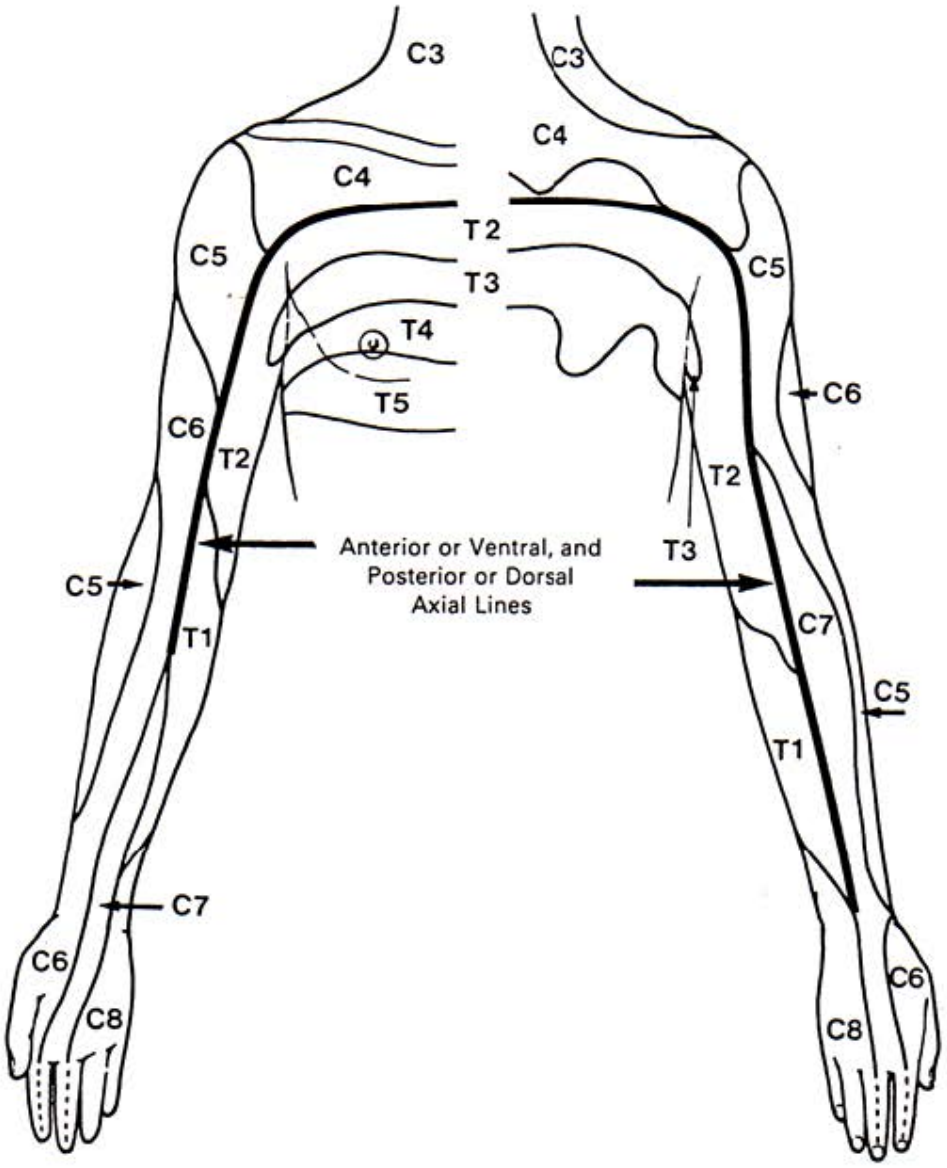


Fig. 44: Dermatomes of upper limb

DEEP VEINS

- Follow course of the arteries in the form of venae comitantes
- Freely connected with superficial veins
- Venae comitantes of radial and ulnar arteries join together in cubital fossa to form venae comitantes of brachial artery
- Venae comitantes of brachial artery united with basilic vein to form axillary vein or join axillary vein at lower border of subscapularis

Superficial Veins (Fig. 45):

Dorsal venous arch:

- Lies across lower part of dorsum of hand
- Receives 3 dorsal metacarpal veins which receive dorsal digital veins from the fingers
- Gives origin to cephalic and basilic veins

Cephalic vein:

- *Begins from lateral end of dorsal venous arch*
- Ascends on lateral side of forearm
- Front elbow, communicates with basilic vein through median cubital vein
- Ascends on lateral margin of biceps brachii
- Continues in deltopectoral groove
- Pierces clavipectoral fascia
- *Ends in axillary vein*

Basilic vein:

- *Begins from medial end of dorsal venous arch*
- Ascends on medial side of forearm
- Passes front medial epicondyle
- Joined by median cubital vein
- Ascends along medial margin of biceps
- Pierces deep fascia close to insertion of coracobrachialis
- *At lower border of teres major it becomes axillary vein*

Median cubital vein:

- Lies obliquely front elbow joint
- Joins cephalic vein 1 inch below lateral epicondyle and joins basilic vein 1 inch above medial epicondyle
- Separated from brachial artery by bicipital aponeurosis
- Common site for intravenous injection

Median vein of forearm:

- Begins on front of the hand
- Ascends on front of forearm to reach elbow
- Joins median cubital or cephalic or basilic

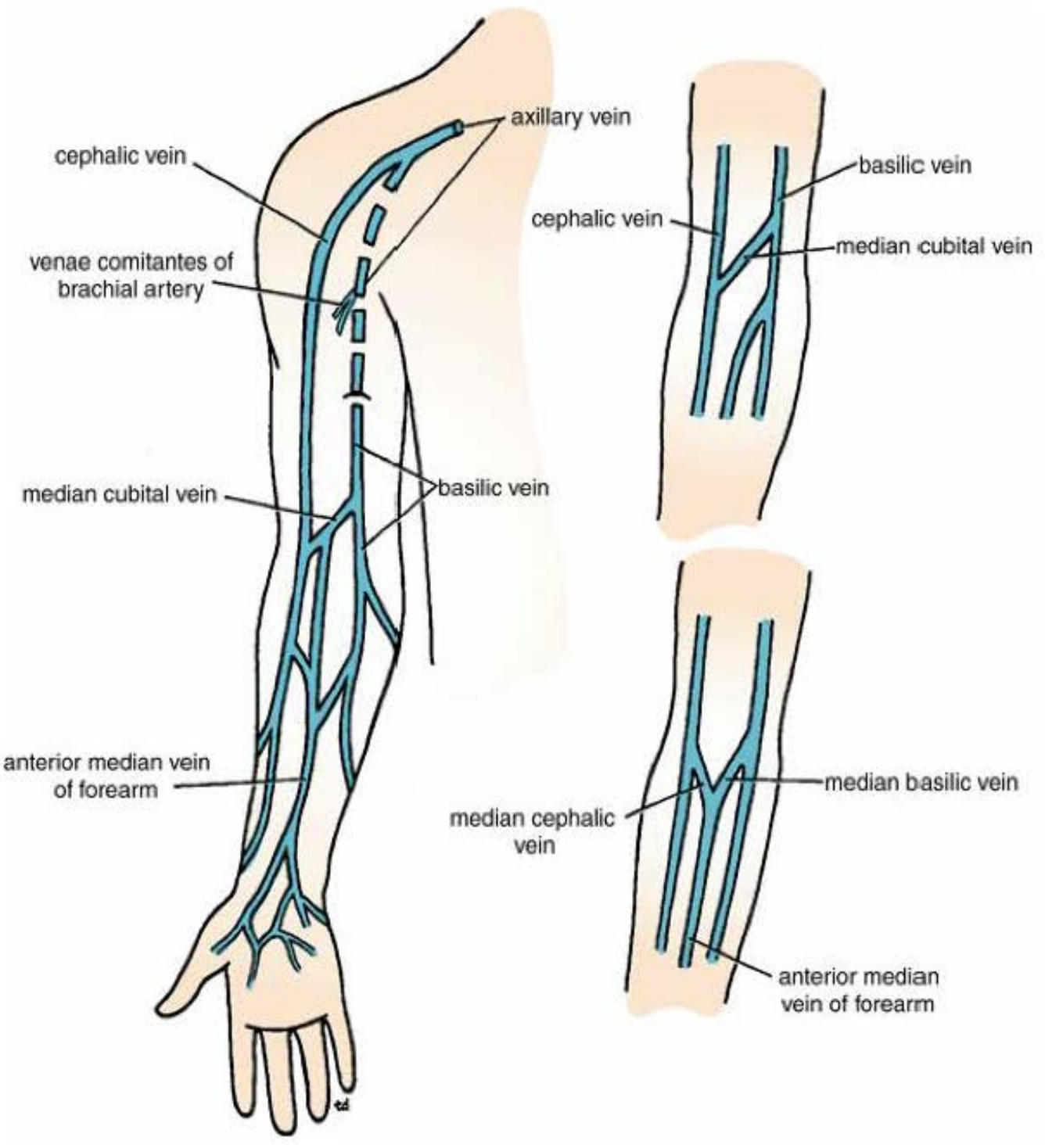


Fig. 45: Superficial veins of the upper limb. Note the common variations seen in the region of the elbow.

LYMPHATIC DRAINAGE
(Fig. 46)

Lymph Nodes:

I. Deep nodes (axillary nodes):

5 groups: anterior, posterior, lateral, central, apical

II. Superficial nodes:

1. Infraclavicular (deltopectoral) nodes:
   1-2 nodes lie in deltopectoral groove along cephalic vein
2. Supratrochlear nodes:
   1-2 nodes lie alongside basilic vein above medial epicondyle

Lymph Vessels:

I. Superficial vessels:

- Numerous lymph vessels in the palm and fingers Most of them pass backwards to dorsum of hand
- Few vessels ascend front the wrist to end in lymph node
- Majority of vessels accompany basilic vein to end in lateral group of axillary nodes
- Few vessels ascend with cephalic vein to end in infraclavicular group of nodes
- Few vessels from ulnar side of the hand end directly into supratrochlear nodes

II. Deep vessels:

- Drain deep structures and accompany blood vessels; radial, ulnar, brachial arteries to end in lateral group of axillary nodes
- All lymph from the upper limb drains into apical group of axillary nodes from which subclavian lymph trunk emerges and drains into:
  1. Right lymphatic trunk
  2. Thoracic duct

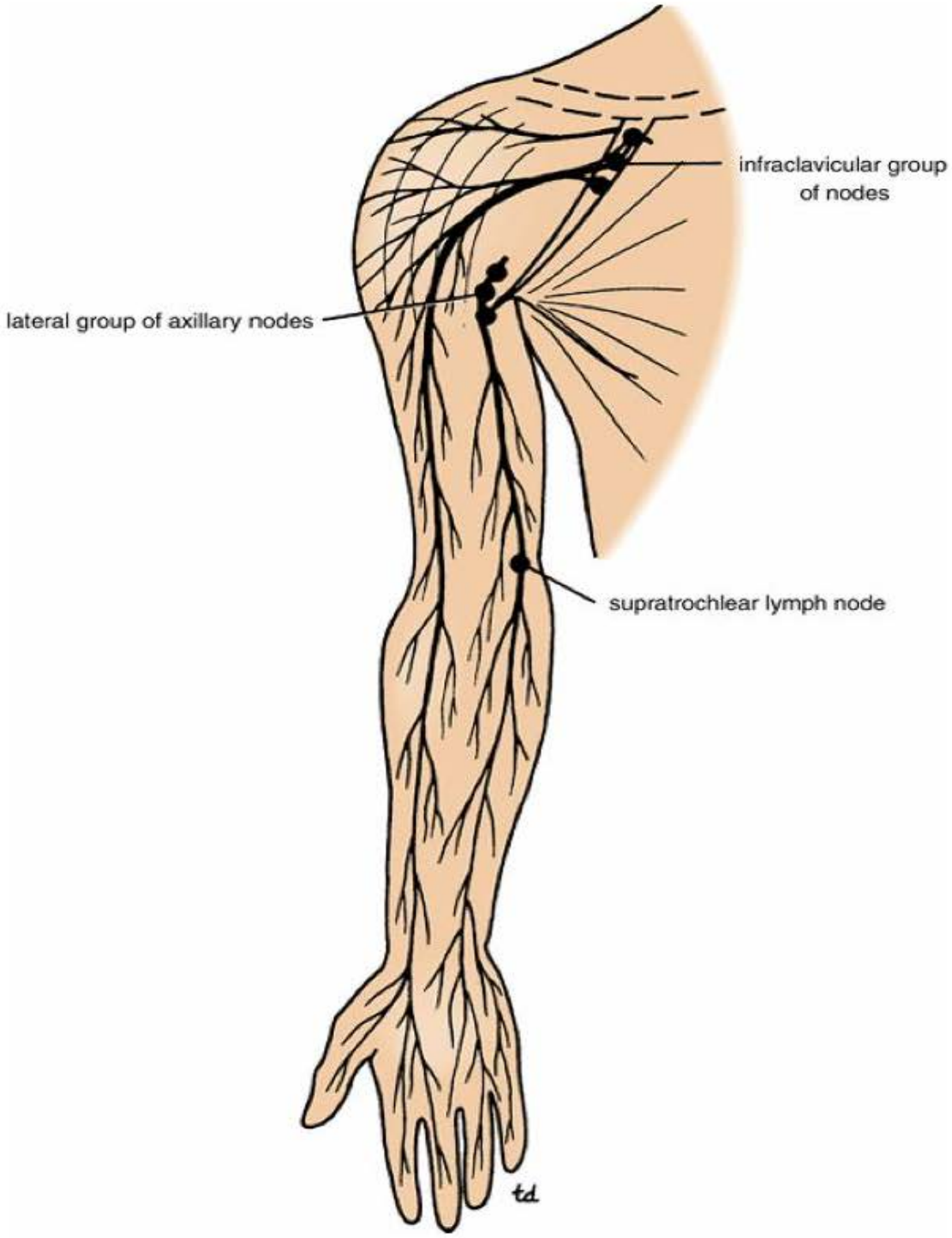


Fig. 46: Superficial lymphatics of the upper limb. Note the positions of the lymph nodes.

AXILLARY SHEATH

- Prolongation of prevertebral layer of deep cervical fascia
- One of contents of axilla

Contents of Axillary Sheath:

1. Axillary artery
2. Axillary vein
3. Cords of brachial plexus

OBLIQUE CORD

- Small inconstant flat fascial band on deep head of supinator
- Extends from lateral side of ulnar tuberosity to the radius below its tuberosity
- Its fibers are at right angles to those of interosseous membrane
- Its function is dubious

FIBROUS FLEXOR SHEATHS
(Fig. 39)

- Sheaths of deep fascia that partially surround long flexor tendons; superficialis and profundus in their course in the digits
- Form together with bones of phalanges tunnels for the tendons (osteo-fascial canals) which are lined by synovial sheaths

FASCIAL SPACES OF THE HAND
(Fig. 47)

I. Intermediate Compartment of Palm:

Divided by intermediate palmar septum into:

1. Mid-Palmar Space:

Boundaries of mid-palmar space:

- Laterally: Intermediate palmar septum
- Medially: Medial palmar septum
- Ventrally: Palmar aponeurosis
- Dorsally: 3rd, 4th, 5th metacarpal bones and related interosseous muscles

Contents of mid-palmar space:

- Tendons of flexor digitorum superficialis and profundus to the 3rd, 4th and 5th fingers
- Superficial palmar arch
- Palmar digital nerves and vessels to medial 3 fingers (little, ring and middle)

Communications of palmar space:

- Distally: With webs between medial 4 fingers
- Proximally: With the space deep to common synovial sheath in the carpal tunnel

2. Thenar Space:

Boundaries of thenar space:

- Laterally: Lateral palmar septum
- Medially: Intermediate palmar septum
- Ventrally: Palmar aponeurosis
- Dorsally: Transverse head of adductor pollicis and its covering deep fascia

Contents of thenar space:

- Tendons of the thumb and the index finger
- 1st lumbrical muscle
- Palmar digital nerves and vessels to the thumb and the index finger

Communications of thenar space:

- Distally: With web of thumb (fold of skin between thumb and index finger)
- Proximally: With the space deep to common synovial sheath in the carpal tunnel

III. Pulp Space:

- Lies over palmar surface of distal ¾ of terminal phalanx.
- Bounded dorsally by bone of terminal phalanx and ventrally by deep fascia.
- Traversed by fibrous septa (extending between deep fascia and bone) and branches from digital arteries to supply shaft and distal end of terminal phalanx.
- *Infection of pulp space with accumulation of pus leads to thrombosis and obstruction of the arteries inside the space with necrosis of distal ¾ of terminal phalanx.*
- *Base of terminal phalanx is not involved because it gets its blood supply by a separate branch outside pulp space.*

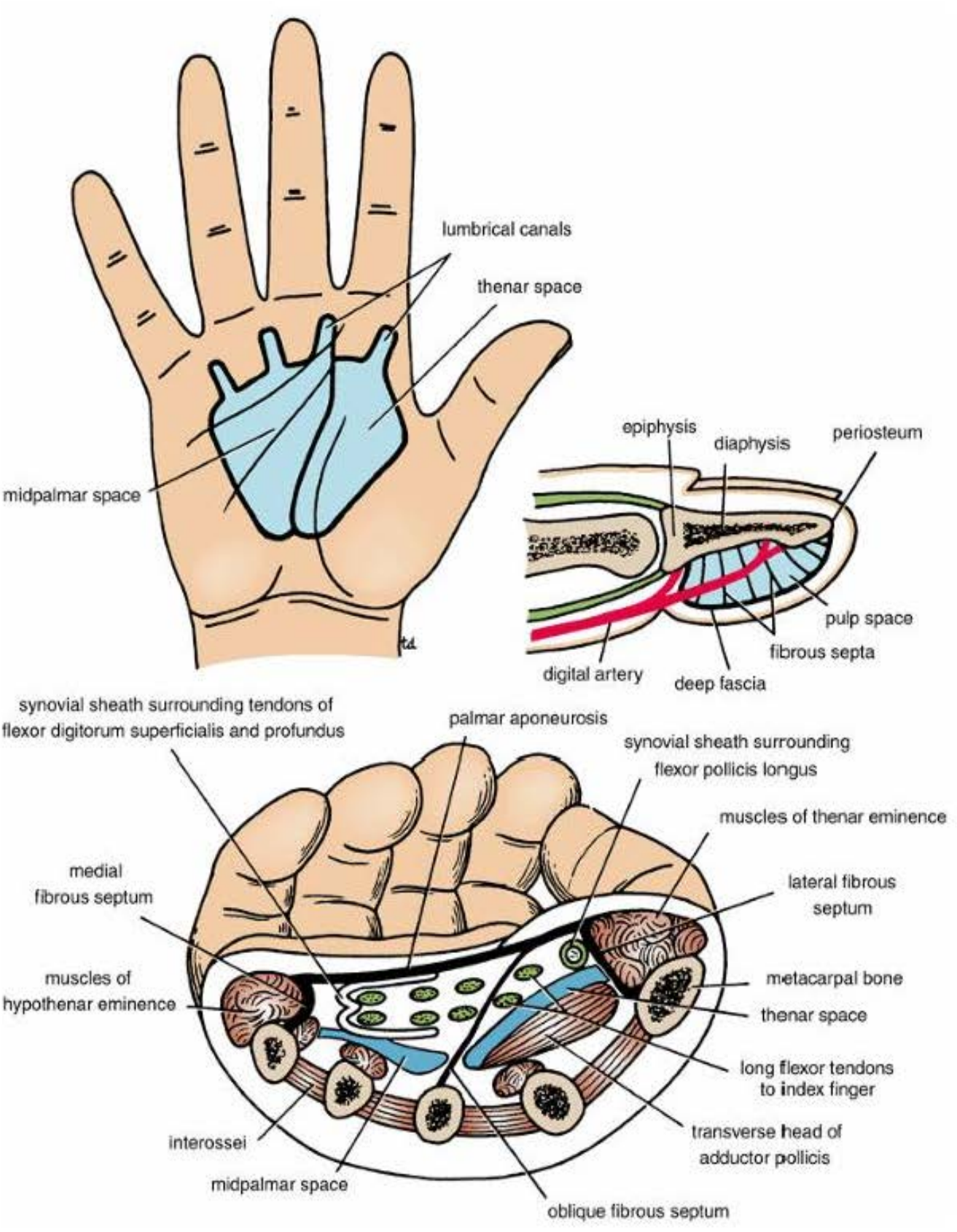


Fig. 47: Palmar and pulp fascial spaces.

Contents of upper limb

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