Muscles of the Upper Limb
Lectures Objectives

• List the muscles that are attached to the arm and forearm.
• Describe the attachments and the action of the above mentioned muscle and their nerve supply.
• Identify the flexor and extensor retinaculea.
• Identify the carpal tunnel.
• Identify the snuff box relation.
• Explain the tendon arteries relation and surface anatomy.
Upper Limp Fascia
Upper Limb Innervation

(b) Distribution of nerves from the brachial plexus
Upper arm arteries
Superficial Veins of the Upper Limb

- Lies in the superficial fascia
- Dorsal venous network (arch)
  - Drains blood into:
    - Deep veins
    - Superficial veins
      - Medially into basilic vein
      - Laterally into cephalic vein
- Basilic vein
  - United with the brachial vein to form axillary vein
- Cephalic vein
  - Drain into axillary vein from the deltopectoral triangle
- Median cubital vein
  - Between basilic and cephalic veins
- Median vein of forearm
  - Drains into basilic, cephalic, or both
Arm compartments

ANTERIOR (Flexor compartment)
- Biceps brachii
- Musculocutaneous nerve
- Cephalic vein
- Lateral cutaneous nerve of forearm
- Humerus
- Brachialis
- Radial nerve
- Posterior cutaneous nerve of forearm
- Lateral intermuscular septum
- Deep artery and veins of arm
- Triceps brachii

POSTERIOR (Extensor compartment)
- Biceps brachii: short head
- Lateral head
- Medial head
- Long head
- Cephalic vein
- Brachialis
- Medial intermuscular septum
- Radial nerve and deep artery and veins of arm

Interior views of transverse sections

(B) Level of (B) and (C)

(C)
Arm muscles

• Anterior compartment (flexors)
  • Biceps brachii m.
  • Brachialis m.
  • Coracobrachialis m.

• Posterior compartment (extensors)
  • Triceps m.
  • Anconeus m.
Anterior Compartment

- Biceps brachii m.
  - Long head
    - Transverse humeral ligament
  - Short head
  - Biceps tendon
  - Bicipital aponeurosis
- Brachialis
  - Deep to biceps brachii m.
  - Main flexor of the forearm
- Chorachobrachialis m.
Anterior Compartment

• Relations
Brachial Artery

- Relations
- Branches
  - Muscular branches
    - Anterior compartment of upper arm
  - Nutrient a. to humerus
  - Profunda (deep brachial) a.
    - Radial nerve
  - Superior ulnar collateral a.
    - Ulnar nerve
  - Inferior ulnar collateral a.
    - Elbow joint
Musculocutaneous Nerve

- Relations
  - Pierces coracobrachialis m.
  - Deep to biceps
- Innervate the anterior compartment of arm mm.
Median Nerve

• Relations
  – In arm
    • Brachial a.
Ulnar Nerve

• Relations
  – In arm
    • Brachial artery
    • Medial intermuscular septum
    • Medial epicondyle
Posterior Compartment

- Triceps brachii m.
  - Long head, Medial head, Lateral head
  - Triceps tendon

- Anconeus m.
Posterior Compartment: Relations
Radial Nerve

• Relations
  – in arm
    • Brachial a.
    • Spiral groove
    • Profunda a.
    • Lateral intermuscular septum
    • Lateral epicondyle
Axillary Nerve

• Relations
  – Quadrangular space
  – Posterior circumflex humeral vessels
<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Nerve Supply</th>
<th>Nerve Roots</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior Compartment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supinator of forearm and flexor of elbow joint; weak flexor of shoulder joint</td>
</tr>
<tr>
<td>Biceps brachii</td>
<td>Supraglenoid tubercle of scapula</td>
<td>Tuberosity of radius and bicipital aponeurosis into deep fascia of forearm</td>
<td>Musculocutaneous nerve</td>
<td>C5, 6</td>
<td></td>
</tr>
<tr>
<td>Short head</td>
<td>Coracoid process of scapula</td>
<td>Medial aspect of shaft of humerus</td>
<td>Musculocutaneous nerve</td>
<td>C5, 6, 7</td>
<td>Flexes arm and also weak adductor</td>
</tr>
<tr>
<td>Coracobrachialis</td>
<td>Coracoid process of scapula</td>
<td>Coronoid process of ulna</td>
<td>Musculocutaneous nerve</td>
<td>C5, 6</td>
<td>Flexor of elbow joint</td>
</tr>
<tr>
<td>Brachialis</td>
<td>Front of lower half of humerus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior Compartment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triceps</td>
<td>Infraglenoid tubercle of scapula</td>
<td>Olecranon process of ulna</td>
<td>Radial nerve</td>
<td>C8, 7, 8</td>
<td>Extensor of elbow joint</td>
</tr>
<tr>
<td>Long head</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral head</td>
<td>Upper half of posterior surface of shaft of humerus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial head</td>
<td>Lower half of posterior surface of shaft of humerus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The predominant nerve root supply is indicated by boldface type.

Forearm Compartments

Key

- Flexor-pronator compartment
- Extensor-supinator compartment

(D) Anterosuperior view

(E) Anterior view

- Ulna
- Interosseous membrane
- Radius
- Radial artery
- Flexor digitorum superficialis
- Pronator quadratus
- Ulnar artery and nerve
- Dorsal (cutaneous) branch
- Dorsal carpal branch
- Flexor digitorum profundus
- Persisting median artery
- Median nerve
- Palmaris longus
- Flexor carpi radialis
- Flexor pollicis longus
- Pronator quadratus
- Palmar carpal branch
- Palmar radiocarpal ligament
- Superficial palmar branch
Forearm Compartments

- Anterior compartment
  - Flexors and pronators of the forearm
  - Mostly innervated by median nerve

- Posterior compartment
  - Extensors and supinators of the forearm
  - All innervated by radial nerve

- Both compartments are separated by:
  - Subcutaneous border of ulna..posteromedial
  - Radial artery...anteriolateral
Forearm Compartments

- Flexor retinaculum
- Extensor retinaculum
Flexor Retinaculum

- Attachments
  - Medial
    - Hamate & pisiform
  - Lateral
    - Scaphoid & trapezium
      - Subtunnel
        » Flexor carpi radialis m.

- Carpal tunnel
  - Syndrome
Extensor Retinaculum

- Attachments
  - Medial
    - Hamate & pisiform
  - Lateral
    - Radius
- 6 tunnels & tendon sheaths
Flexors and Pronators of the Forearm

- Anterior compartment
- Their tendons cross wrist anteriorly
- Held in place by palmar carpal ligament and flexor retinaculum
- Three layers
  - Superficial layer
    - Pronator teres
    - Flexor carpi radialis
    - Palmaris longus
    - Flexor carpi ulnaris
  - Intermediate layer
    - Flexor digitorum superficialis
  - Deep layer
    - Flexor digitorum profundus
    - Flexor pollicis longus
    - Pronator quadratus
Flexors and Pronators of the Forearm
Anterior compartment

• Superficial layer
  • Pronator teres
    • The most lateral muscle of the flexors
    • Medial boundary of the cubital fossa
  • Flexor carpi radialis
    • Cross wrist through canal in the lateral part of the flexor retinaculum in its own tendinous sheath
  • Palmaris longus
    • Its tendon pass superficial to the flexor retinaculum
    • Relation with median nerve
• Flexor carpi ulnaris
  • The most medial
  • Humeral and ulnar heads
  • Ulnar nerve pass to the forearm between heads and innervate the muscle
  • Relation with ulnar nerve and artery
<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Superficial (first) layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pronator teres</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulnar head</td>
<td>Coronoid process</td>
<td>Middle of convexity of lateral surface of radius</td>
<td>Median nerve (C6, C7)</td>
<td>Pronates and flexes forearm (at elbow)</td>
</tr>
<tr>
<td>Humeral head</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexor carpi radialis (FCR)</td>
<td>Medial epicondyle of humerus (common flexor origin)</td>
<td>Base of 2nd metacarpal</td>
<td>Median nerve (C7, C8)</td>
<td>Flexes and abducts hand (at wrist)</td>
</tr>
<tr>
<td>Palmaris longus</td>
<td></td>
<td>Distal half of flexor retinaculum and apex of palmar aponeurosis</td>
<td>Median nerve (C7, C8)</td>
<td>Flexes hand (at wrist) and tenses palmar aponeurosis</td>
</tr>
<tr>
<td>Flexor carpi ulnaris (FCU)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humeral head</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulnar head</td>
<td>Olecranon and posterior border (via aponeurosis)</td>
<td>Pisiform, hook of hamate, 5th metacarpal</td>
<td>Ulnar nerve (C7, C8)</td>
<td>Flexes and adducts hand (at wrist)</td>
</tr>
</tbody>
</table>
Anterior compartment

- Intermediate layer
  - Flexor digitorum superficialis
    - Median nerve and ulnar artery enter forearm by passing between its heads
    - At wrist: its tendons enclosed by common flexor sheath with flexor digitorum profundus
  - Insertion
    - Insertion of 2 muscles in the phalanges
Anterior compartment

- Deep layer
  - Flexor digitorum profundus
    - Covers the ulna anteriorly
    - Only flexor for distal interphalangeal joints
    - Innervation: median and ulnar nerves
  - Flexor pollicis longus
    - Covers the distal half of radius anteriorly
    - At wrist it passes in its own sheath lateral to the common flexor sheath
- Pronator quadratus
  - Prime mover for pronation
### TABLE 6.10. MUSCLES OF ANTERIOR COMPARTMENT OF FOREARM (Continued)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation[^a]</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intermediate (second) layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexor digitorum superficialis (FDS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humeroulnar head</td>
<td>Medial epicondyle (common flexor origin and coronoid process)</td>
<td>Shafts of middle phalanges of medial four digits</td>
<td>Median nerve (C7, C8, T1)</td>
<td>Flexes middle phalanges at proximal interphalangeal joints of middle four digits; acting more strongly, it also flexes proximal phalanges at metacarpophalangeal joints</td>
</tr>
<tr>
<td>Radial head</td>
<td>Superior half of anterior border</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deep (third) layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexor digitorum profundus (FDP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial part</td>
<td>Proximal three quarters of medial and anterior surfaces of ulna and interosseous membrane</td>
<td>Bases of distal phalanges of 4th and 5th digits</td>
<td>Ulnar nerve (C8, T1)</td>
<td>Flexes distal phalanges 4 and 5 at distal interphalangeal joints</td>
</tr>
<tr>
<td>Lateral part</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexor pollicis longus (FPL)</td>
<td>Anterior surface of radius and adjacent interosseous membrane</td>
<td>Base of distal phalanx of thumb</td>
<td>Anterior interosseous nerve, from median nerve (C8, T1)</td>
<td>Flexes phalanges of 1st digit (thumb)</td>
</tr>
<tr>
<td>Pronator quadratus</td>
<td>Distal quarter of anterior surface of ulna</td>
<td>Distal quarter of anterior surface of radius</td>
<td></td>
<td>Pronates forearm; deep fibers bind radius and ulna together</td>
</tr>
</tbody>
</table>

[^a]: The spinal cord segmental innervation is indicated (e.g., “C6, C7” means that the nerves supplying the pronator teres are derived from the sixth and seventh cervical segments of the spinal cord). Numbers in boldface (C7) indicate the main segmental innervation. Damage to one or more of the listed spinal cord segments or to the motor nerve roots arising from them results in paralysis of the muscles concerned.
Forearm relations
Radial Artery

- Relations
- Branches in the forearm
  - Muscular branches
  - Recurrent branch
  - Superficial palmar branch

The radial artery is the smaller of the terminal branches of the brachial artery. It begins in the cubital fossa at the level of the neck of the radius. It passes downward and laterally beneath the brachioradialis muscle and resting on the deep muscles of the forearm. In the middle third of its course, the superficial branch of the radial nerve lies on its lateral side. In the distal part of the forearm, the radial artery lies on the anterior surface of the radius and is covered only by skin and fascia. Here, the artery has the tendon of brachioradialis on its lateral side and the tendon of flexor carpi radialis on its medial side (site for taking the radial pulse). The radial artery leaves the forearm by winding around the lateral aspect of the wrist to reach the posterior surface.
Ulnar Artery

- **Relations**
  - **Branches**
    - Muscular branches
    - Recurrent branches
    - Branches for arterial anastomosis around wrist joint
    - Common interosseous a.
      - Anterior & Posterior interosseous aa.
      - Nutrient aa.
    - The deep palmar branch
      - Deep palmar arch
Median Nerve

- Relations
  - In forearm
    - Pronator teres m.
    - Flexor digitorum superficialis m.
  - In hand
    - Flexor retinaculum
Ulnar Nerve

- Relations
  - In forearm
    - Flexor carpi ulnaris m.
    - Ulnar a.
  - In hand
    - Flexor retinaculum
    - Pisiform
Radial Nerve

• Relations
  – In forearm
    • Superficial branch
      – Brachioradialis
      – Radial a.
    • Deep branch
      – Supinator m.
Extensor Muscles of Forearm

- The posterior compartment
- Radial nerve
- Extensor retinaculum
- Two layers
  - Superficial layer
  - Deep layer
Posterior Compartment

- **Superficial layer**
  - Brachioradialis
    - Lateral border of the cubital fossa
    - Flexes forearm
    - Overlies the radial nerve and artery
    - Its tendon is covered distally by abductor pollicis longus and extensor pollicis brevis

- **Extensor carpi radialis longus**
  - Its tendon is covered distally by abductor pollicis longus and extensor pollicis brevis

- **Extensor carpi radialis brevis**
  - Extensor carpi radialis sheath with the extensor carpi radialis longus
• **Superficial layer (continue..)**
  • **Extensor digitorum**
    • Common tendinous sheath with extensor indicis
    • Intertendinous connections between tendons, limit independent extension
    • In phalanges, tendons form extensor expansions
      • Hood: circles the head of the metacarpal and attach to the palmar ligament
      • Extensor expansion cover the proximal phalanx
      • Median band: middle phalanx
      • Lateral bands: distal phalanx
  • **Extensor digiti minimi**
    • Its tendon separates into medial and lateral tendons
    • Lateral tendon join the tendon of the extensor digitorum
    • All tendons attach to the extensor expansion
  • **Extensor carpi ulnaris**
    • At wrist passes in a separate compartment
    • Passes in a groove between ulnar head and styloid process
Posterior Compartment

- Deep layer
  - Supinator
    - Traversed by the deep branch of the radial nerve in its way posteriorly
  - Abductor pollicis longus
    - Common tendinous sheath with extensor pollicis brevis
  - Extensor pollicis brevis
    - Anatomical snuff box
  - Extensor pollicis longus
    - Anatomical snuff box: contents
    - Medial to the dorsal tubercle of radius
  - Extensor indicis
Anatomic Snuffbox

- Boundaries
- Floor
- Content
### TABLE 6.11. MUSCLES OF POSTERIOR COMPARTMENT OF FOREARM

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation(^a)</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Superficial layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brachioradialis</td>
<td>Proximal two thirds of supraepicondylar ridge of humerus</td>
<td>Lateral surface of distal end of radius proximal to styloid process</td>
<td>Radial nerve (C5, C6, C7)</td>
<td>Relatively weak flexion of forearm; maximal when forearm is in mid-pronated position</td>
</tr>
<tr>
<td>Extensor carpi radialis longus (ECRL)</td>
<td>Lateral supraepicondylar ridge of humerus</td>
<td>Dorsal aspect of base of 2nd metacarpal</td>
<td>Radial nerve (C6, C7)</td>
<td>Extend and abduct hand at the wrist joint; ECRL active during fist clenching</td>
</tr>
<tr>
<td>Extensor carpi radialis brevis (ECRB)</td>
<td>Lateral epicondyle of humerus (common extensor origin)</td>
<td>Dorsal aspect of base of 3rd metacarpal</td>
<td></td>
<td>Extends medial four digits primarily at metacarpophalangeal joints, secondarily at interphalangeal joints</td>
</tr>
<tr>
<td>Extensor digitorum</td>
<td>Lateral epicondyle of humerus (common extensor origin)</td>
<td>Extensor expansions of medial four digits</td>
<td></td>
<td>Extends 5th digit primarily at metacarpophalangeal joint, secondarily at interphalangeal joint</td>
</tr>
<tr>
<td>Extensor digiti minimi (EDM)</td>
<td>Lateral epicondyle of humerus; posterior border of ulna via a shared aponeurosis</td>
<td>Extensor expansion of 5th digit</td>
<td>Deep branch of radial nerve (C7, C8)</td>
<td>Extends and adducts hand at wrist joint (also active during fist clenching)</td>
</tr>
<tr>
<td>Extensor carpi ulnaris (ECU)</td>
<td>Lateral epicondyle of humerus; posterior border of ulna via a shared aponeurosis</td>
<td>Dorsal aspect of base of 5th metacarpal</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deep layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supinator</td>
<td>Lateral epicondyle of humerus; radial collateral and anular ligaments; supinator fossa; crest of ulna</td>
<td>Lateral, posterior, and anterior surfaces of proximal third of radius</td>
<td>Deep branch of radial nerve (C7, C8)</td>
<td>Supinates forearm; rotates radius to turn palm anteriorly or superiorly (if elbow is flexed)</td>
</tr>
<tr>
<td>Extensor indicis</td>
<td>Posterior surface of distal third of ulna and interosseous membrane</td>
<td>Extensor expansion of 2nd digit</td>
<td>Posterior interosseous nerve (C7, C8), continuation of deep branch of radial nerve</td>
<td>Extends 2nd digit (enabling its independent extension); helps extend hand at wrist</td>
</tr>
<tr>
<td>Muscle</td>
<td>Proximal Attachment</td>
<td>Distal Attachment</td>
<td>Innervation&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Main Action</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Abductor pollicis longus (APL)</td>
<td>Posterior surface of proximal halves of ulna, radius, and interosseous membrane</td>
<td>Base of 1st metacarpal</td>
<td>Posterior interosseous nerve (C7, C8), continuation of deep branch of radial nerve</td>
<td>Abducts thumb and extends it at carpometacarpal joint</td>
</tr>
<tr>
<td>Extensor pollicis longus (EPL)</td>
<td>Posterior surface of middle third of ulna and interosseous membrane</td>
<td>Dorsal aspect of base of distal phalanx of thumb</td>
<td></td>
<td>Extends distal phalanx of thumb at interphalangeal joint; extends metacarpophalangeal and carpometacarpal joints</td>
</tr>
<tr>
<td>Extensor pollicis brevis (EPB)</td>
<td>Posterior surface of distal third of radius and interosseous membrane</td>
<td>Dorsal aspect of base of proximal phalanx of thumb</td>
<td></td>
<td>Extends proximal phalanx of thumb at metacarpophalangeal joint; extends carpometacarpal joint</td>
</tr>
</tbody>
</table>

<sup>a</sup>The spinal cord segmental innervation is indicated (e.g., "C7, C8" means that the nerves supplying the extensor carpi radialis brevis are derived from the seventh and eighth cervical segments of the spinal cord). Numbers in boldface (C7) indicate the main segmental innervation. Damage to one or more of the listed spinal cord segments or to the motor nerve roots arising from them results in paralysis of the muscles concerned.
Surface Anatomy of Upper Limb Bones
Surface Anatomy of Brachial Region
Surface Anatomy of Brachial Region

- Deltoid
- Biceps brachii
- Medial bicipital groove
- Biceps brachii tendon
- Bicipital aponeurosis in cubital fossa
- Brachialis
- Location of medial intermuscular septum
- Medial epicondyle of the humerus
- Triceps brachii

(B) Medial view
Surface Anatomy of Brachial Region
Surface Anatomy of Forearm
Surface Anatomy of Forearm

(A) Anterior view of supinated forearm
Surface Anatomy of Forearm

- Dorsal venous network
- Styloid process of ulna
- Head of ulna
- Cephalic vein
- Extensor-supinator muscles of forearm
- 1 cm
- Styloid process of radius
- Anatomical snuff box
- Course of radial artery
- Cubital fossa
- Flexor–pronator muscles of forearm
Surface Anatomy of Wrist Region

Hypothenar eminence

Location of pisiform bone

Tendon of flexor carpi ulnaris (FCU)

Tendon of palmaris longus

Thenar eminence

Tendon of abductor pollicis longus (APL)

Site for taking radial artery pulse

Tendon of flexor carpi radialis (FCR)

Anterolateral view

S = location of tendons of FDS
Cutaneous Innervation of the Upper Limb

- Musculocutaneous
- Axillary
- Radial
- Ulnar
- Median
- Medial cord