

ANTERIOR COMPARTMENT OF THE FOREARM

Muscles

Muscles in the anterior (flexor) compartment of the forearm occur in three layers: superficial, intermediate, and deep. Generally, these muscles are associated with:

- movements of the wrist joint,
- flexion of the fingers including the thumb, and
- pronation.

All muscles in the anterior compartment of the forearm are innervated by the median nerve, except for the flexor carpi ulnaris muscle and the medial half of the flexor digitorum profundus muscle, which are innervated by the ulnar nerve.

Superficial layer All four muscles in the superficial layer—the flexor carpi ulnaris, palmaris longus, flexor carpi radialis, and pronator teres—have a common origin from the medial epicondyle of the humerus, and, except for the pronator teres, extend distally from the forearm into the hand.

Flexor carpi ulnaris The flexor carpi ulnaris muscle is the most medial of the muscles in the superficial layer of flexors, having a long linear origin from the olecranon and posterior border of the ulna, in addition to an origin from the medial epicondyle of the humerus. The ulnar nerve enters the anterior compartment of the forearm by passing through the triangular gap between the humeral and ulnar heads of the flexor carpi ulnaris. The muscle fibers converge on a tendon that passes distally and attaches to the pisiform bone of the wrist. From this point, force is transferred to the hamate bone of the wrist and to the base of metacarpal V by the pisohamate and pisometacarpal ligaments. The flexor carpi ulnaris muscle is a powerful flexor and adductor of the wrist and is innervated by the ulnar nerve.

Palmaris longus The palmaris longus muscle, which is absent in about 15% of the population, lies between the flexor carpi ulnaris and the flexor carpi radialis muscles. It is a spindle-shaped muscle with a long tendon, which passes into the hand and attaches to the flexor retinaculum and to a thick layer of deep fascia, the palmar aponeurosis, which underlies and is attached to the skin of the palm and fingers. In addition to its role as an accessory flexor of the wrist joint, the palmaris longus muscle also opposes shearing forces on the skin of the palm during gripping.

Flexor carpi radialis

The flexor carpi radialis muscle is lateral to the palmaris longus and has a large and prominent tendon in the distal half of the forearm. Unlike the tendon of the flexor carpi ulnaris, which forms the medial margin of the distal forearm, the tendon of the flexor carpi radialis muscle is positioned just lateral to the midline. In this position, the tendon can be easily palpated, making it an important landmark for finding the pulse in the radial artery, which lies immediately lateral to it. The tendon of the flexor carpi radialis passes through a compartment formed by bone and fascia on the lateral side of the anterior surface of the wrist and attaches to the anterior surfaces of the bases of metacarpals II and III. The flexor carpi radialis is a powerful flexor of the wrist and can also abduct the wrist.

Pronator teres

The pronator teres muscle originates from the medial epicondyle and supraepicondylar ridge of the humerus and from a small linear region on the medial edge of the coronoid process of the ulna. The median nerve often exits the cubital fossa by passing between the humeral and ulnar heads of this muscle. The pronator teres crosses the forearm and attaches to an oval roughened area on the lateral surface of the radius approximately midway along the bone. The pronator teres forms the medial border of the cubital fossa and rotates the radius over the ulna during pronation.

Intermediate layer

Flexor digitorum superficialis

The muscle in the intermediate layer of the anterior compartment of the forearm is the flexor digitorum superficialis muscle. This large muscle has two heads:

- the humero-ulnar head, which originates mainly from the medial epicondyle of the humerus and from the adjacent medial edge of the coronoid process of the ulna; and
- the radial head, which originates from the anterior oblique line of the radius. The median nerve and ulnar artery pass deep to the flexor digitorum superficialis between the two heads. In the distal forearm, the flexor digitorum superficialis forms four tendons, which pass through the carpal tunnel of the wrist and into the four fingers. The tendons for the ring and middle fingers are superficial to the tendons for the index and little fingers. In the forearm, carpal tunnel, and proximal regions of the four fingers, the tendons of the flexor digitorum superficialis are anterior to the tendons of the flexor digitorum profundus muscle. Near the base of the proximal phalanx of each finger, the tendon of the flexor digitorum superficialis splits into two parts to pass posteriorly around each side of the tendon of the flexor digitorum profundus and ultimately attach to the margins of the middle phalanx. The flexor digitorum superficialis flexes the metacarpophalangeal joint and proximal interphalangeal joint of each finger; it also flexes the wrist joint

Deep layer

There are three deep muscles in the anterior compartment of the forearm: the flexor digitorum profundus, flexor pollicis longus, and pronator quadratus.

Flexor digitorum profundus

The flexor digitorum profundus muscle originates from the anterior and medial surfaces of the ulna and from the adjacent half of the anterior surface of the interosseous membrane. It gives rise to four tendons, which pass through the carpal tunnel into the four medial fingers. Throughout most of their course, the tendons are deep to the tendons of the flexor digitorum superficialis muscle. Opposite the proximal phalanx of each finger, each tendon of the flexor digitorum profundus passes through a split formed in the overlying tendon of the flexor digitorum superficialis muscle and passes distally to insert into the anterior surface of the base of the distal phalanx. In the palm, the lumbrical muscles originate from the sides of the tendons of the flexor digitorum profundus.

Innervation of the medial and lateral halves of the flexor digitorum profundus varies as follows:

- The lateral half (associated with the index and middle fingers) is innervated by the anterior interosseous nerve (branch of the median nerve).
 - The medial half (the part associated with the ring and little fingers) is innervated by the ulnar nerve
- The flexor digitorum profundus flexes the metacarpophalangeal joints and the proximal and distal interphalangeal joints of the four fingers. Because the tendons cross the wrist, it can flex the wrist joint as well.

Flexor pollicis longus

The flexor pollicis longus muscle originates from the anterior surface of the radius and the adjacent half of the anterior surface of the interosseous membrane. It is a powerful muscle and forms a single large tendon, which passes through the carpal tunnel, lateral to the tendons of the flexor digitorum superficialis and flexor digitorum profundus muscles, and into the thumb where it attaches to the base of the distal phalanx. The flexor pollicis longus flexes the thumb and is innervated by the anterior interosseous nerve (branch of the median nerve).

Pronator quadratus

The pronator quadratus muscle is a flat square-shaped muscle in the distal forearm. It originates from a linear ridge on the anterior surface of the lower end of the ulna and passes laterally to insert onto the flat anterior surface of the radius. It lies deep to, and is crossed by, the tendons of the flexor digitorum profundus and flexor pollicis longus muscles. The pronator quadratus muscle pulls the distal end of the radius anteriorly over the ulna during pronation and is innervated by the anterior interosseous nerve (branch of the median nerve)

Arteries and veins

The largest arteries in the forearm are in the anterior compartment, pass distally to supply the hand, and give rise to vessels that supply the posterior compartment. The brachial artery enters the forearm from the arm by passing through the cubital fossa. At the apex of the cubital fossa, it divides into its two major branches, the radial and ulnar arteries.

Radial artery

The radial artery originates from the brachial artery at approximately the neck of the radius and passes along the lateral aspect of the forearm. It is:

- just deep to the brachioradialis muscle in the proximal half of the forearm,
- related on its lateral side to the superficial branch of the radial nerve in the middle third of the forearm, and
- medial to the tendon of the brachioradialis muscle and covered only by deep fascia, superficial fascia, and skin in the distal forearm. In the distal forearm, the radial artery lies immediately lateral to the large tendon of the flexor carpi radialis muscle and directly anterior to the pronator quadratus muscle and the distal end of the radius. In the distal forearm, the radial artery can be located using the flexor carpi radialis muscle as a landmark. The radial pulse can be felt by gently palpating the radial artery against the underlying muscle and bone. The radial artery leaves the forearm, passes around the lateral side of the wrist, and penetrates the posterolateral aspect of the hand between the bases of metacarpals I and II. Branches of the radial artery in the hand often provide the major blood supply to the thumb and lateral side of the index finger. Branches of the radial artery originating in the forearm include:
 - a radial recurrent artery, which contributes to an anastomotic network around the elbow joint and to numerous vessels that supply muscles on the lateral side of the forearm;
 - a small palmar carpal branch, which contributes to an anastomotic network of vessels that supply the carpal bones and joints;
 - a somewhat larger branch, the superficial palmar branch, which enters the hand by passing through, or superficial to, the thenar muscles at the base of the thumb and anastomoses with the superficial palmar arch formed by the ulnar artery.

Ulnar artery

The ulnar artery is larger than the radial artery and passes down the medial side of the forearm. It leaves the cubital fossa by passing deep to the pronator teres muscle, and then passes through the forearm in the fascial plane between the flexor carpi ulnaris and flexor digitorum profundus muscles. In the distal forearm, the ulnar artery often remains tucked under the anterolateral lip of the flexor carpi ulnaris tendon, and is therefore not easily palpable. In distal regions of the forearm, the ulnar nerve is immediately medial to the ulnar artery. The ulnar artery leaves the forearm, enters the hand by passing lateral to the pisiform bone and superficial to the flexor retinaculum of the wrist, and arches over the

palm. It is often the major blood supply to the medial three and one-half digits. Branches of the ulnar artery that arise in the forearm include:

- the ulnar recurrent artery with anterior and posterior branches, which contribute to an anastomotic network of vessels around the elbow joint;
- numerous muscular arteries, which supply surrounding muscles;
- the common interosseous artery, which divides into anterior and posterior interosseous arteries; and
- two small carpal arteries (dorsal carpal branch and palmar carpal branch), which supply the wrist. The posterior interosseous artery passes dorsally over the proximal margin of the interosseous membrane into the posterior compartment of the forearm. The anterior interosseous artery passes distally along the anterior aspect of the interosseous membrane and supplies muscles of the deep compartment of the forearm and the radius and ulna. It has numerous branches, which perforate the interosseous membrane to supply deep muscles of the posterior compartment; it also has a small branch, which contributes to the vascular network around the carpal bones and joints. Perforating the interosseous membrane in the distal forearm, the anterior interosseous artery terminates by joining the posterior interosseous artery.

Veins

Deep veins of the anterior compartment generally accompany the arteries and ultimately drain into brachial veins associated with the brachial artery in the cubital fossa.

Nerves

Nerves in the anterior compartment of the forearm are the median and ulnar nerves and the superficial branch of the radial nerve.

Median nerve

The median nerve innervates the muscles in the anterior compartment of the forearm except for the flexor carpi ulnaris and the medial part of the flexor digitorum profundus (ring and little fingers). It leaves the cubital fossa by passing between the two heads of the pronator teres muscle and passing between the humero-ulnar and radial heads of the flexor digitorum superficialis muscle. The median nerve continues a straight linear course distally down the forearm in the fascia on the deep surface of the flexor digitorum superficialis muscle. Just proximal to the wrist, it moves around the lateral side of the muscle and becomes more superficial in position, lying between the tendons of the palmaris longus and flexor carpi radialis muscles. It leaves the forearm and enters the palm of the hand by passing through the carpal tunnel deep to the flexor retinaculum. Most branches to the muscles in the superficial and intermediate layers of the forearm originate medially from the nerve just distal to the elbow joint.

- The largest branch of the median nerve in the forearm is the anterior interosseous nerve, which originates between the two heads of the pronator teres, passes distally down the forearm with the anterior interosseous artery, innervates the muscles in the deep layer (the flexor pollicis longus, the lateral half of the flexor digitorum profundus, and the pronator quadratus) and terminates as articular branches to joints of the distal forearm and wrist.
- A small palmar branch originates from the median nerve in the distal forearm immediately proximal to the flexor retinaculum, passes superficially into the hand, and innervates the skin over the base and central palm. This palmar branch is spared in carpal tunnel syndrome because it passes into the hand superficial to the flexor retinaculum of the wrist.

Ulnar nerve

The ulnar nerve passes through the forearm and into the hand, where most of its major branches occur. In the forearm, the ulnar nerve innervates only the flexor carpi ulnaris muscle and the medial part (ring and little fingers) of the flexor digitorum profundus muscle. The ulnar nerve enters the anterior compartment of the forearm by passing posteriorly around the medial epicondyle of the humerus and between the humeral and ulnar heads of the flexor carpi ulnaris muscle. After passing down the medial side of the forearm in the plane between the flexor carpi ulnaris and the flexor digitorum profundus muscles, it lies under the lateral lip of the tendon of the flexor carpi ulnaris proximal to the wrist. The ulnar artery is lateral to the ulnar nerve in the distal two-thirds of the forearm, and both the ulnar artery and nerve enter the hand by passing superficial to the flexor retinaculum and immediately lateral to the pisiform bone. In the forearm the ulnar nerve gives rise to:

- muscular branches to the flexor carpi ulnaris and to the medial half of the flexor digitorum profundus that arise soon after the ulnar nerve enters the forearm; and
- two small cutaneous branches—the palmar branch originates in the middle of the forearm and passes into the hand to supply skin on the medial side of the palm; the larger dorsal branch originates from the ulnar nerve in the distal forearm and passes posteriorly deep to the tendon of the flexor carpi ulnaris and innervates skin on the posteromedial side of the back of the hand and most skin on the posterior surfaces of the medial one and one-half digits.

Radial nerve

The radial nerve bifurcates into deep and superficial branches under the margin of the brachioradialis muscle in the lateral border of the cubital fossa.

- The deep branch is predominantly motor and passes between the superficial and deep layers of the supinator muscle to access and supply muscles in the posterior compartment of the forearm.
- The superficial branch of the radial nerve is sensory. It passes down the anterolateral aspect of the forearm deep to the brachioradialis muscle and in association with the radial artery. Approximately two-thirds of the way down the forearm, the superficial branch of the radial nerve passes laterally and posteriorly around the radial side of the forearm deep to the tendon of the brachioradialis. The nerve continues into the hand where it innervates skin on the posterolateral surface.

Reference:

Gray's for student 4th Ed.