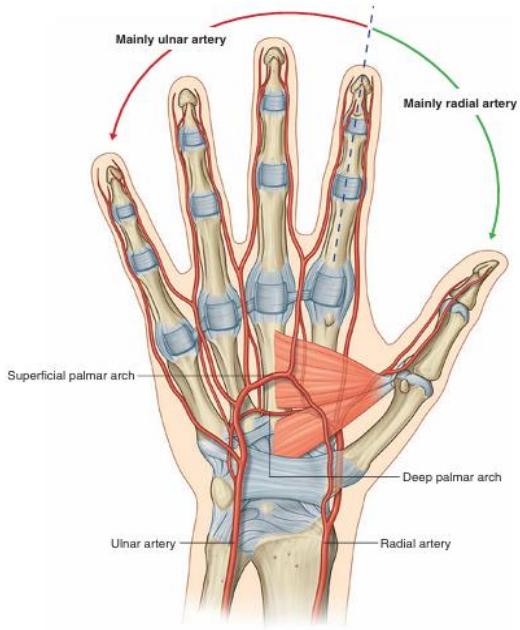
Arteries and veins

The blood supply to the hand is by the radial and ulnar arteries, which form two interconnected vascular arches (superficial and deep) in the palm. Vessels to the digits, muscles, and joints originate from the two arches and the parent arteries:

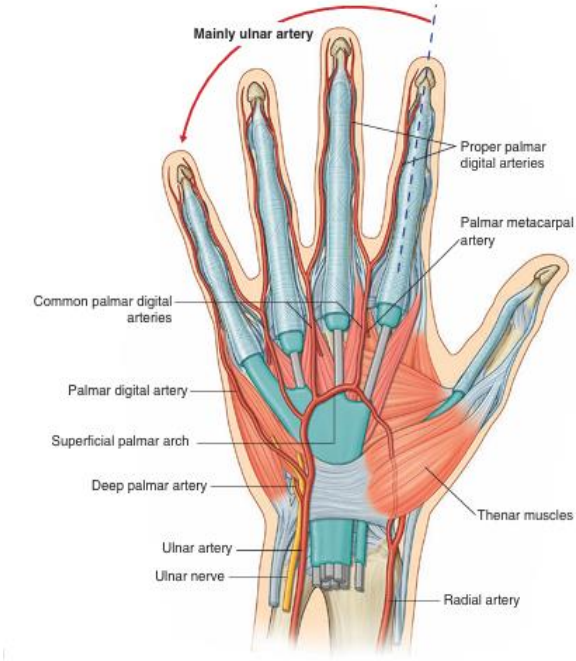


■ The radial artery contributes substantially to the supply of the thumb and the lateral side of the index finger.

■ The remaining digits and the medial side of the index finger are supplied mainly by the ulnar artery.

Ulnar artery and superficial palmar arch

The ulnar artery and ulnar nerve enter the hand on the medial side of the wrist. The vessel lies between the palmaris brevis and the flexor retinaculum and is lateral to the ulnar nerve and the pisiform bone. Distally, the ulnar artery is medial to the hook of the hamate bone and then swings laterally across the palm, forming the superficial palmar arch, which is superficial to the long flexor tendons of the digits and just deep to the palmar aponeurosis.



On the lateral side of the palm, the arch communicates with a palmar branch of the radial artery. One branch of the ulnar artery in the hand is the deep palmar branch, which arises from the medial aspect of the ulnar artery, just distal to the pisiform, and penetrates the origin of the hypothenar muscles. It curves medially around the hook of the hamate to access the deep plane of the palm and to anastomose with the deep palmar arch derived from the radial artery.

Branches from the superficial palmar arch include:

■ a palmar digital artery to the medial side of the little finger, and

■ three large, common palmar digital arteries, which ultimately provide the principal blood supply to the lateral side of the little finger, both sides of the ring and middle fingers, and the medial side of the index finger; they are joined by palmar metacarpal arteries from the deep palmar arch before bifurcating into the proper palmar digital arteries, which enter the fingers.

Radial artery and deep palmar arch

The radial artery curves around the lateral side of the wrist and passes over the floor of the anatomical snuffbox and into the deep plane of the palm by penetrating anteriorly through the back of the hand. It passes between the

two heads of the first dorsal interosseous muscle and then between the two heads of the adductor pollicis to access the deep plane of the palm and form the deep palmar arch.

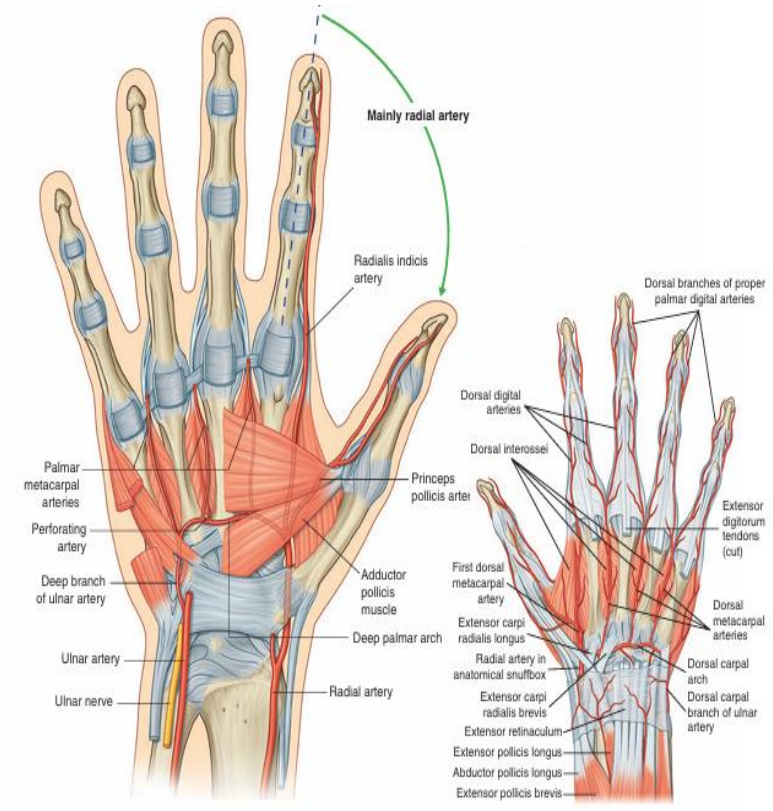
The deep palmar arch passes medially through the palm between the metacarpal bones and the long flexor tendons of the digits. On the medial side of the palm, it communicates with the deep palmar branch of the ulnar artery.

Before penetrating the back of the hand, the radial artery gives rise to two vessels:

■ a dorsal carpal branch, which passes medially as the dorsal carpal arch, across the wrist and gives rise to three dorsal metacarpal arteries, which subsequently divide to become small dorsal digital arteries, which enter the fingers; and

■ the first dorsal metacarpal artery, which supplies adjacent sides of the index finger and thumb.

Two vessels, the princeps pollicis artery and the radialis indicis artery, arise from the radial artery in the plane between the first dorsal interosseous and adductor pollicis. The princeps pollicis artery is the major blood supply to the thumb, and the radialis indicis artery supplies the lateral side of the index finger.



The deep palmar arch gives rise to:

■ three palmar metacarpal arteries, which join the common palmar digital arteries from the superficial palmar arch; and

■ three perforating branches, which pass posteriorly between the heads of origin of the dorsal interossei to anastomose with the dorsal metacarpal arteries from the dorsal carpal arch.

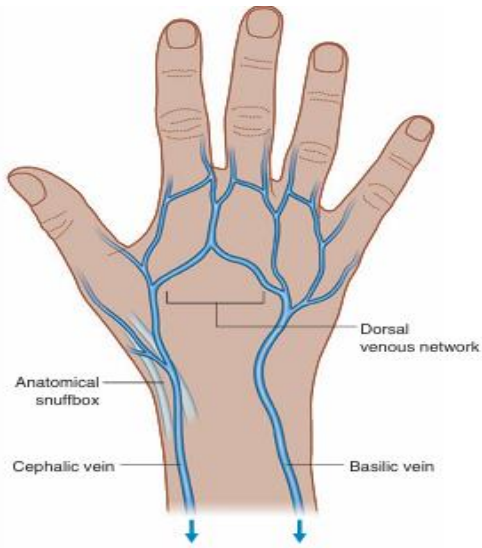
Allen's test

To test for adequate anastomoses between the radial and ulnar arteries, compress both the radial and ulnar arteries at the wrist, then release pressure from one or the other, and determine the filling pattern of the hand. If there is little connection between the deep and superficial palmar arteries, only the thumb and lateral side of the index finger will fill with blood (become red) when pressure on the radial artery alone is released.

Laceration of palmar arterial arches: The lacerated wounds of palmar arterial arches usually cause profuse and uncontrollable bleeding. The compression of brachial artery against humerus is the most effective method to control the bleeding. The ligation or clamping of the radial artery or ulnar artery or both proximal to wrist fails to control the bleeding because of connections of these arches with the palmar and dorsal carpal arches.

Veins

As generally found in the upper limb, the hand contains interconnected networks of deep and superficial veins. The deep veins follow the arteries; the superficial veins drain into a dorsal venous network on the back of the hand over the metacarpal bones.



The cephalic vein originates from the lateral side of the dorsal venous network and passes over the anatomical snuffbox into the forearm.

The basilic vein originates from the medial side of the dorsal venous network and passes into the dorsomedial aspect of the forearm.

Venipuncture

In many patients, venous access is necessary for obtaining blood for laboratory testing and administering fluid and intravenous drugs. The ideal sites for venous access are typically in the cubital fossa and in the cephalic vein adjacent to the anatomical snuffbox. The veins are simply distended by use of a tourniquet. A tourniquet should be applied enough to allow the veins to become prominent.

For straightforward blood tests the antecubital vein is usually the preferred site, and although it may not always be visible, it is easily palpated. The cephalic vein is generally the preferred site for a short-term intravenous cannula.

Nerves

The hand is supplied by the ulnar, median, and radial nerves. All three nerves contribute to cutaneous or general sensory innervation. The ulnar nerve innervates all intrinsic muscles of the hand except for the three thenar muscles and the two lateral lumbricals, which are innervated by the median nerve. The radial nerve only innervates skin on the dorsolateral side of the hand.

N.B. The ulnar nerve is the main motor nerve of the hand, whereas median nerve is the main sensory nerve of the hand.

Ulnar nerve

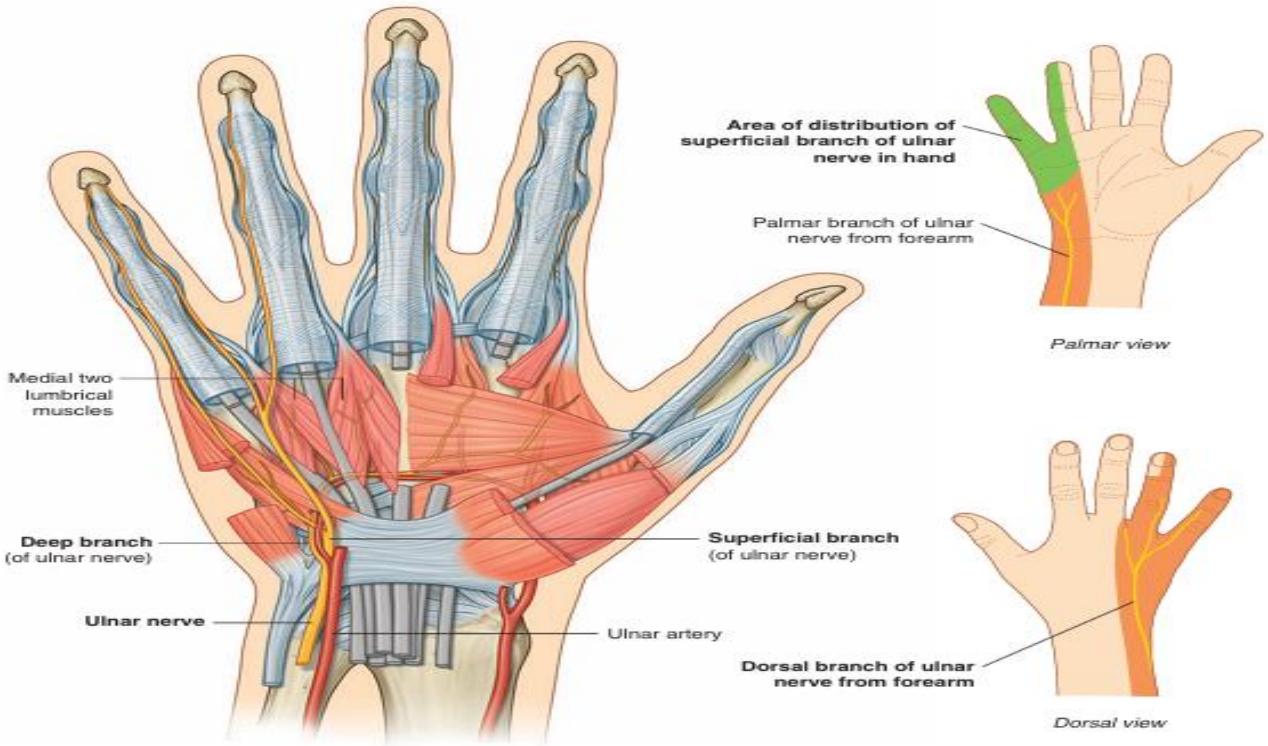
The ulnar nerve enters the hand lateral to the pisiform and posteromedially to the ulnar artery. Immediately distal to the pisiform, it divides into a deep branch, which is mainly motor, and a superficial branch, which is mainly sensory.

The deep branch of the ulnar nerve passes with the deep branch of the ulnar artery. It penetrates and supplies the hypothenar muscles to reach the deep aspect of the palm, arches laterally across the palm, deep to the long flexors of the digits, and supplies the interossei, the adductor pollicis, and the two medial lumbricals. In addition, the deep branch of the ulnar nerve contributes small articular branches to the wrist joint.

As the deep branch of the ulnar nerve passes across the palm, it lies in a fibro-osseous tunnel (Guyon's canal) between the hook of the hamate and the flexor tendons. Occasionally, small outpouchings of synovial membrane

(ganglia) from the joints of the carpus compress the nerve within this canal, producing sensory and motor symptoms.

The superficial branch of the ulnar nerve innervates the palmaris brevis muscle and continues across the palm to supply skin on the palmar surface of the little finger and the medial half of the ring finger.



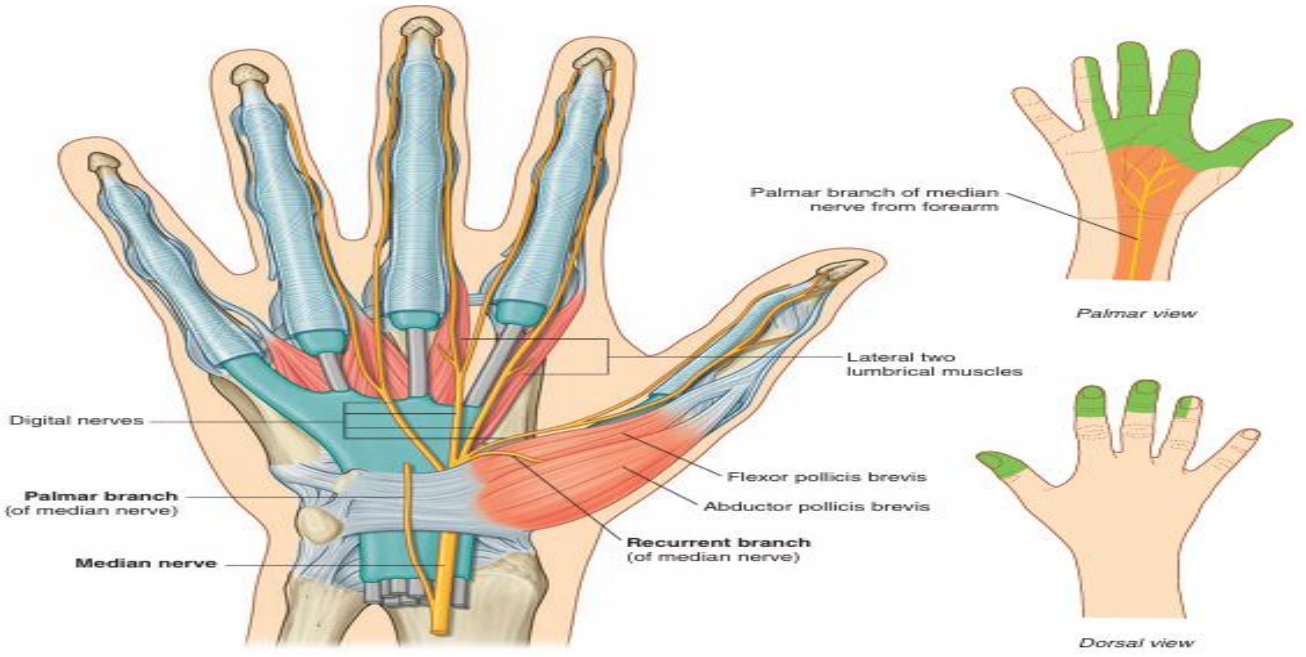
Median nerve

The median nerve is the most important sensory nerve in the hand because it innervates skin on the thumb, index and middle fingers, and lateral side of the ring finger. The nervous system, using touch, gathers information about the environment from this area, particularly from the skin on the thumb and index finger. In addition, sensory information from the lateral three and one-half digits enables the fingers to be positioned with the appropriate amount of force when using precision grip.

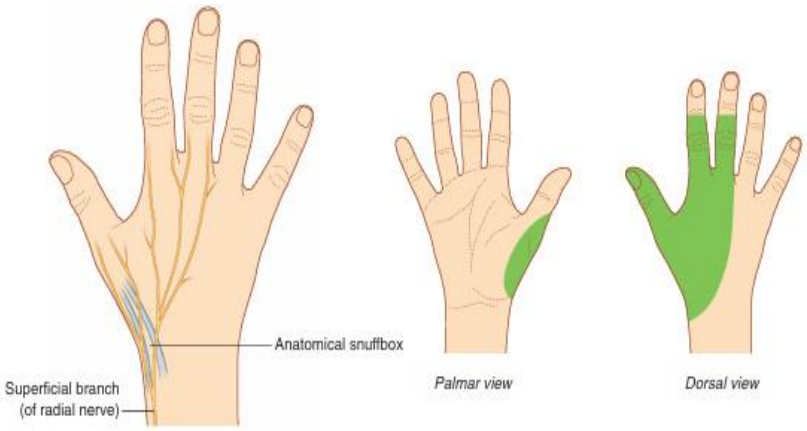
The median nerve also innervates the thenar muscles that are responsible for opposition of the thumb to the other digits. The median nerve enters the hand by passing through the carpal tunnel and divides into a recurrent branch and palmar digital branches.

The recurrent branch of the median nerve innervates the three thenar muscles. Originating from the lateral side of the median nerve near the distal margin of the flexor retinaculum, it curves around the margin of the retinaculum and passes proximally over the flexor pollicis brevis muscle. The recurrent branch then passes between the flexor pollicis brevis and abductor pollicis brevis to end in the opponens pollicis.

The palmar digital nerves cross the palm deep into the palmar aponeurosis and the superficial palmar arch and enter the digits. They innervate skin on the palmar surfaces of the lateral three and one-half digits and cutaneous regions over the dorsal aspects of the distal phalanges (nail beds) of the same digits. In addition to skin, the digital nerves supply the lateral two lumbrical muscles.



Superficial branch of the radial nerve



The only part of the radial nerve that enters the hand is the superficial branch. It enters the hand by passing over the anatomical snuffbox on the dorsolateral side of the wrist. Terminal branches of the nerve can be palpated or "rolled" against the tendon of the extensor pollicis longus as they cross the anatomical snuffbox.

The superficial branch of the radial nerve innervates skin over the dorsolateral aspect of the palm and the dorsal aspects of the lateral three and one-half digits distally to approximately the terminal interphalangeal joints.

Midpalmar Space

The triangular midpalmar space is located under the medial half of hollow of the palm.

Boundaries Anterior:

<u>From superficial to deep</u>, it is formed by:

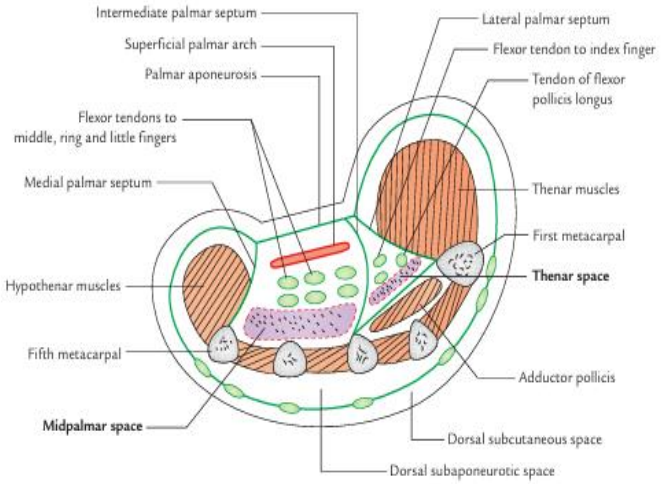
1. Palmar aponeurosis.

2. Superficial palmar arch.

3. Digital nerve and vessels supplying medial 3½ fingers.

4. Ulnar bursa enclosing flexor tendons of medial three fingers.

5. Medial three (2nd, 3rd, and 4th) lumbricals.



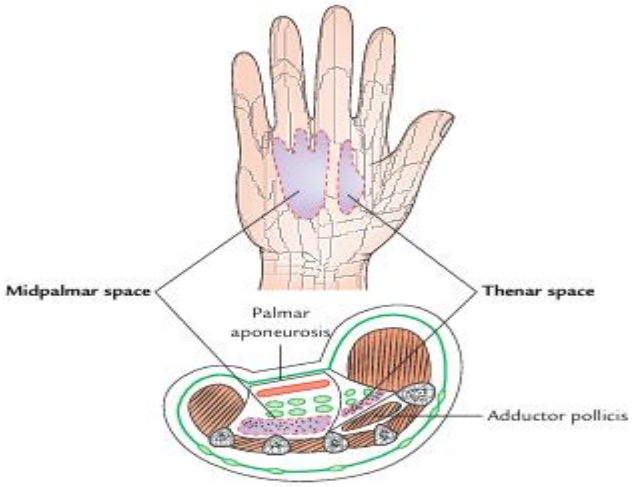
Posterior: Fascia covering interossei and medial three metacarpals.

Lateral: Intermediate palmar septum extending obliquely from near the medial edge of the palmar aponeurosis to the third metacarpal bone. This septum separates the mid-palmar space from the thenar space.

Medial: Medial palmar septum extending from medial edge of palmar aponeurosis to the fifth metacarpal. This septum separates the midpalmar space from hypothenar space occupied by the hypothenar muscles.

Proximal: Midpalmar space is continuous with the forearm space of Parona.

Distal: Midpalmar space is continuous with the medial three web-spaces through medial three lumbrical canals.



N.B. Web spaces: The web space is a subcutaneous space in each interdigital cleft and is filled with loose areolar tissue. It contains lumbrical tendon, interosseous tendon, digital nerve, and vessels. The web space extends from the free margin of the web, as far proximally as the level of transverse metacarpal ligaments.

Infection of midpalmar space: The ulnar bursa is considered as the inlet for infection and lumbrical canals as the outlets of infection in midpalmar space. The pus forms this space is drained by incisions in the medial two web spaces.

Thenar Space

The triangular thenar space is located under the outer half of the hollow of the palm. Boundaries

Anterior: From superficial to deep, it is formed by:

1. Palmar aponeurosis (lateral part).

2. Digital nerve and vessels of lateral 1½ digits.

3. Radial bursa enclosing tendon of flexor pollicis longus.

4. Flexor tendons of the index finger.

5. First lumbrical.

Lateral: Lateral palmar septum extending from lateral edge of palmar aponeurosis to the first metacarpal.

Medial: Intermediate palmar septum. Posterior: Fascia covering the transverse head of adductor pollicis.

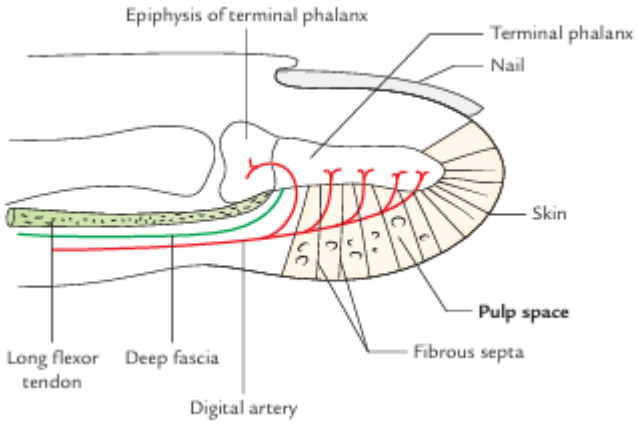
Proximal: The space is limited by the fusion of anterior and posterior walls in the carpal tunnel.

Distal: The space communicates with the first web space through the first lumbrical canal.

Infection of thenar space: The infection may reach the thenar space from infected radial bursa or synovial sheath of the index finger. The pus from thenar space is drained by an incision in the first web space (web space of the thumb).

PULP SPACES OF THE DIGITS

The pulp spaces of the digits are subcutaneous spaces on the palmar side of tips of the fingers and thumb. The pulp space is filled with subcutaneous fatty tissue. Boundaries Superficially: Skin and superficial fascia. Deeply: Distal two-third of distal phalanx.



Features

1. The space is traversed by numerous fibrous septa extending from skin to the periosteum of the terminal phalanx, dividing it into many loculi.

2. The deep fascia of pulp of each finger fuses with the periosteum of terminal phalanx distal to the insertion of long flexor tendon.

3. The digital artery that supplies the diaphysis of phalanx runs through this space. The epiphysis of distal phalanx receives its blood supply proximal to the pulp space.

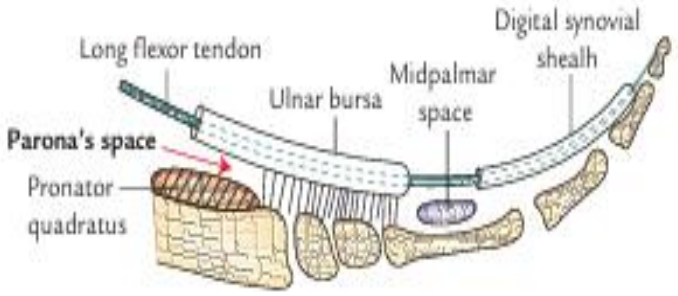
Pulp space infection: Being the most exposed parts of the digits the pulp spaces are prone for infection. An abscess in the pulp-space is called whitlow or felon. The rising tension in the pulp space causes severe throbbing pain. The pus from pulp space is drained by a lateral incision, opening all loculi and avoiding tactile skin sensation on the front of the finger. If neglected, the whitlow may lead to avascular necrosis of distal four-fifth of the terminal phalanx due to occlusion of digital artery as result of pressure. The proximal one-fifth phalanx (i.e., epiphysis) is not affected because the branch of digital artery supplying it does not traverse the pulp space.

Space of Parona (Forearm space) It is merely a fascial interval underneath the flexor tendons on the front of distal part of the forearm.

Boundaries

Anterior: (a) Tendon of flexor digitorum profundus and flexor digitorum superficialis surrounded by a synovial sheath (ulnar bursa).

(b) Tendon of flexor pollicis longus surrounded by a synovial bursa (radial bursa).



Proximal: Proximally, it is continuous with the inter muscular spaces of the forearm.

Distal: Distally it reaches the level of wrist.

Lateral: Outer border of the forearm.

Medial: Inner border of the forearm.

The forearm space (Parona's space) becomes infected from infected ulnar bursa. Pus collects behind the long flexor tendons.

Pulse points

Peripheral pulses can be felt at six locations in the upper limb.

■ Axillary pulse: axillary artery in the axilla lateral to the apex of the dome of skin covering the floor of the axilla.

■ Brachial pulse in midarm: brachial artery on the medial side of the arm in the cleft between the biceps brachii and triceps brachii muscles. This is the position where a blood pressure cuff is placed.

■ Brachial pulse in the cubital fossa: brachial artery medial to the tendon of the biceps brachii muscle. This is the position where a stethoscope is placed to hear the pulse of the vessel when taking a blood pressure reading.

■ Radial pulse in the distal forearm: radial artery immediately lateral to the tendon of the flexor carpi radialis muscle. This is the most common site for "taking a pulse."

■ Ulnar pulse in the distal forearm: ulnar artery immediately under the lateral margin of the flexor carpi ulnaris tendon and proximal to the pisiform.

■ Radial pulse in the anatomical snuffbox: radial artery as it crosses the lateral side of the wrist between the tendon of the extensor pollicis longus muscle and the tendons of the extensor pollicis brevis and abductor pollicis longus muscles.