Anatomy of the hand 1 & 2

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Palm of Hand

- The skin of the palm of the hand is thick and hairless.
- It is bound down to the underlying deep fascia by numerous fibrous bands.
- The skin shows many flexure creases at the sites of skin movement, which are not necessarily placed at the site of joints.
- Sweat glands are present in large numbers.
INTRINSIC MUSCLES

• **LATERAL GROUP:**
  FOUR THENAR MUSCLES

• **MEDIAL GROUP:**
  THREE HYPOTHENAR MUSCLES
  PALMARIS BREVIS

• **CENTRAL GROUP:**
  FOUR LUMBRICALS
  FOUR PALMAR INTEROSSEI
  FOUR DORSAL INTEROSSEI

• **ALL MUSCLES ARE SUPPLIED BY C8 & T1 SPINAL SEGMENTS THROUGH MEDIAN & ULNAR NERVES**
Small Muscles of Hand

The small muscles of the hand include:

- The 4 four lumbrical muscles
- The 8 eight interossei muscles
- The short muscles of the thumb
- The short muscles of the little finger
Short Muscles of Thumb

The short muscles of the thumb are:

- The abductor pollicis brevis
- The flexor pollicis brevis
- The opponens pollicis
- The adductor pollicis
- The first three of these muscles form the thenar eminence.

- AFOA

Short Muscles of Little Finger

The short muscles of the little finger are:

- The abductor digiti minimi
- The flexor digiti minimi brevis
- The opponens digiti minimi
- Together they form the hypothenar eminence

- AFO
INTRINSIC MUSCLES
INTRINSIC MUSCLES

THENAR MUSCLES
1. Have general origin (lateral side of flexor retinaculum & lateral 2 carpal bones: scaphoid & trapezium) EXCEPT adductor pollicis (transverse head: 3rd metacarpal bone, oblique head: 2nd & 3rd metacarpal + 2nd & 3rd carpal bones: trapezoid & capitate)
2. Have general insertion (proximal phalanx of thumb) EXCEPT opponens pollicis (1st metacarpal)

HYPOTHENAR MUSCLES
1. Have general origin (medial side of flexor retinaculum & medial 2 carpal bones: pisiform & hamate
2. Have general insertion (proximal phalanx of little finger) EXCEPT opponens digiti minimi (5th metacarpal bone)
INTRINSIC MUSCLES

**LUMBRICALS**
Origin: tendons of FDP
Insertion: tendons of ED

**PALMAR INTEROSSEI**
Origin: metacarpal bone
Insertion: proximal phalanx

**DORSAL INTEROSSEI**
Origin: adjoining sides of 2 metacarpal bone
Insertion: proximal phalanx

**PALMARIS BREVIS**
Origin: Palmar aponeurosis
Insertion: skin of medial border of hand
Palmaris Brevis

- The palmaris brevis is a small muscle
- It arises from the flexor retinaculum and palmar aponeurosis
- Is inserted into the skin of the palm
- Is supplied by the superficial branch of the ulnar nerve
- It corrugate the skin at the base of the hypothenar eminence and so improve the grip of the palm in holding a rounded object
Lumbricals

- 4 in number
- **Origin:** Tendons of flexor digitorum profundus
- **Insertion:** Extensor expansion of medial four fingers
- **Nerve supply:** First and second from median nerve; third and fourth from deep branch of ulnar nerve
- **Action:** Flex metacarpophalangeal joints and extend interphalangeal joints of fingers except thumb
Interossei

- 8 in number, 4 palmar and 4 dorsal

**Palmar**

- **Origin:** First arises from base of first metacarpal; remaining three from anterior surface of shafts of second, fourth, and fifth metacarpals.
- **Insertion:** Proximal phalanges of thumb and index, ring, and little fingers and dorsal extensor expansion of each finger.
- **Nerve Supply:** Deep branch of ulnar nerve.
- **Action:** Adduct fingers toward center of third finger.
Interossei

Dorsal

- **Origin**: Contiguous sides of shafts of metacarpal bones

- **Insertion**: Proximal phalanges of index, middle, and ring fingers and dorsal extensor expansion

- **Nerve supply**: Deep branch of ulnar nerve

- **Action**: Abduct shafts of metacarpal fingers from center of third finger; both palmar and dorsal flex metacarpophalangeal joints and extend interphalangeal joints
Abductor Pollicis Brevis

- **Origin**: Scaphoid, trapezium and flexor retinaculum
- **Insertion**: Base of proximal phalanx of thumb
- **Nerve supply**: Median nerve
- **Action**: Abduction of thumb

*abductor pollicis brevis = intrinsic muscle*
Flexor Pollicis Brevis

- **Origin:** Flexor retinaculum
- **Insertion:** Base of proximal phalanx of thumb
- **Nerve supply:** Median nerve
- **Action:** Flexes metacarpophalangeal joint of thumb
Opponens Pollicis

- Origin: Flexor retinaculum
- Insertion: Shaft of metacarpal bone of thumb
- Nerve supply: Median nerve
- Action: Pulls thumb medially and forward across palm
Adductor Pollicis

- **Origin:** Oblique head; second and third metacarpal bones; transverse head; third metacarpal bone
- **Insertion:** Base of proximal phalanx of thumb
- **Nerve supply:** Deep branch of ulnar nerve
- **Action:** Adduction of thumb
Pronator quadratus muscle
Radial artery and palmar carpal branch
Palmar carpal arterial arch
Ulnar nerve
Radius
Superficial palmar branch of radial artery
Flexor retinaculum (reflected)
Median nerve
Deep palmar branches of ulnar artery and
Opponens pollicis muscle
Abductor pollicis brevis muscle (cut)
Branches of median nerve to thenar muscles and to 1st and 2nd lumbrical muscles
Flexor pollicis brevis muscle
Adductor pollicis muscle
Palmar metacarpal arteries
1st dorsal interosseous muscle
Lumbrical muscles (reflected)
Ulnar artery and palmar carpal branch
Flexor carpi ulnaris tendon
Pisiform bone
Abductor digiti minimi muscle (cut)
Deep palmar arterial arch
Flexor digiti minimi brevis muscle (cut)
Branches from deep branch of ulnar nerve to 3rd and 4th lumbrical muscles and to all interosseous muscles
Opponens digiti minimi muscle
Common palmar digital arteries
Deep transverse metacarpal ligaments
Abductor Digiti Minimi

- **Origin:** Pisiform bone
- **Insertion:** Base of proximal phalanx of little finger
- **Nerve supply:** Deep branch of ulnar nerve
- **Action:** Abducts little finger
Flexor Digiti Minimi

- Origin: Flexor retinaculum
- Insertion: Base of proximal phalanx of little finger
- Nerve supply: Deep branch of ulnar nerve
- Action: Flexes little finger
Opponens Digiti Minimi

- **Origin**: Flexor retinaculum
- **Insertion**: Medial border of fifth metacarpal bone
- **Nerve supply**: Deep branch of ulnar nerve
- **Action**: Pulls fifth metacarpal forward as in cupping the palm
ARTERIAL ARCHES IN HAND

- SUPERFICIAL PALMAR ARCH
- DEEP PALMAR ARCH

1. Formation
2. Site
3. Surface anatomy
4. Branches
SUPERFICIAL PALMAR ARCH

FORMATION:
1. Direct continuation of ulnar artery (mainly)
2. Superficial branch of radial artery

SITE:
between palmar aponeurosis & long flexor tendons

SURFACE ANATOMY:
level with the distal border of the fully extended thumb

BRANCHES:
digital branches to the medial three & half fingers

N.B.: Radial artery gives 2 branches that supplies the lateral one & half fingers:
1. Radialis indicis: supplies lateral side of index
2. Princeps pollicis: supplies both sides of thumb
DEEP PALMAR ARCH

FORMATION:
1. Direct continuation of radial artery (mainly)
2. Deep branch of ulnar artery

SITE:
between long flexor tendons & metacarpal bones

SURFACE ANATOMY:
lies one inch proximal to superficial palmar arch

BRANCHES:
1. Branches sharing in anastomosis around wrist joint
2. Articular & muscular branches
<table>
<thead>
<tr>
<th>Artery</th>
<th>Origin</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial palmar arch</td>
<td>Direct continuation of ulnar artery; arch is completed on lateral side by superficial branch of radial artery or another of its branches</td>
<td>Curves laterally deep to palmar aponeurosis and superficial to long flexor tendons; curve of arch lies across palm at level of distal border of extended thumb</td>
</tr>
<tr>
<td>Deep palmar arch</td>
<td>Direct continuation of radial artery; arch is completed on medial side by deep branch of ulnar artery</td>
<td>Curves medially, deep to long flexor tendons and is in contact with bases of metacarpals</td>
</tr>
<tr>
<td>Common palmar digital</td>
<td>Superficial palmar arch</td>
<td>Pass directly on lumbricales to webbings of digits</td>
</tr>
<tr>
<td>Proper palmar digital</td>
<td>Common palmar digital arteries</td>
<td>Run along sides of digits 2–5</td>
</tr>
<tr>
<td>Princeps pollicis</td>
<td>Radial artery as it turns into palm</td>
<td>Descends on palmar aspect of first metacarpal and divides at the base of proximal phalanx into two branches that run along sides of thumb</td>
</tr>
<tr>
<td>Radialis indicis</td>
<td>Radial artery, but may arise from princeps pollicis artery</td>
<td>Passes along lateral side of index finger to its distal end</td>
</tr>
<tr>
<td>Dorsal carpal arch</td>
<td>Radial and ulnar arteries</td>
<td>Arches within fascia on dorsum of hand</td>
</tr>
</tbody>
</table>
Dorsal venous arch of the hand

- **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.
The deep veins ascend in the forearm along the sides of the corresponding arteries. Deep veins communicate with the superficial veins. The deep interosseous veins, which accompany the interosseous arteries, unite with the accompanying veins of the radial and ulnar arteries. In the cubital fossa the deep veins are connected to the median cubital vein, a superficial vein. These deep cubital veins also unite with the accompanying veins of the brachial artery.
Cutaneous upper limb

ANT

POST
NERVES IN HAND
Cutaneous innervation
NERVES IN HAND
Muscular innervation

ULNAR NERVE:

SUPERFICIAL BRANCH:
1. Palmaris brevis

DEEP BRANCH:
1. Adductor pollicis
2. Hypothenar muscles
3. Interossei
4. Medial two lumbricals
NERVES IN HAND

Muscular innervation

MEDIAN NERVE:

1. Abductor pollicis brevis
2. Flexor pollicis brevis
3. Opponens pollicis
4. Lateral two lumbricals
Upper Brachial Plexus Injuries

Injury to the superior trunk of the plexus is apparent by the characteristic position of the limb (“waiter's tip position”), in which the limb hangs by the side in medial rotation. Upper brachial plexus injuries can also occur in a newborn when excessive stretching of the neck occurs during delivery.

As a result of injuries to the superior parts of the brachial plexus (Erb-Duchenne palsy), paralysis of the muscles of the shoulder and arm supplied by the C5 and C6 spinal nerves occurs: deltoid, biceps, and brachialis. The usual clinical appearance is an upper limb with an adducted shoulder, medially rotated arm, and extended elbow.
### TABLE 9.3.4 Muscles affected by a lower brachial plexus injury.

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Nerve</th>
<th>Spinal levels</th>
<th>Action(s) impaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexor carpi ulnaris</td>
<td>Ulnar</td>
<td>C7, C8</td>
<td>Wrist flexion and adduction (ulnar deviation)</td>
</tr>
<tr>
<td>Flexor digitorum superficialis</td>
<td>Median</td>
<td>C7, C8, T1</td>
<td>Wrist and finger flexion (MP and PIP joints)</td>
</tr>
<tr>
<td>Flexor digitorum profundus</td>
<td>Median</td>
<td>C8, T1</td>
<td>Wrist and finger flexion (MP, PIP, and DIP joints)</td>
</tr>
<tr>
<td>Pronator quadratus</td>
<td>Median (anterior interosseous)</td>
<td>C8, T1</td>
<td>Pronation</td>
</tr>
<tr>
<td>Extensor digitorum</td>
<td>Radial</td>
<td>C7, C8</td>
<td>Extensor digitorum</td>
</tr>
<tr>
<td>Extensor indicis</td>
<td>Radial (posterior interosseous)</td>
<td>C7, C8</td>
<td>Extensor indicis</td>
</tr>
<tr>
<td>Thenar muscles</td>
<td>Median (recurrent branch)</td>
<td>C8, T1</td>
<td>Thumb movements</td>
</tr>
<tr>
<td>Adductor pollicis</td>
<td>Ulnar (deep)</td>
<td>C8, T1</td>
<td>Thumb adduction</td>
</tr>
<tr>
<td>Hypothenar muscles</td>
<td>Ulnar (deep)</td>
<td>C8, T1</td>
<td>Little finger movements</td>
</tr>
<tr>
<td>Dorsal interossei</td>
<td>Ulnar (deep)</td>
<td>C8, T1</td>
<td>Finger abduction</td>
</tr>
<tr>
<td>Palmar interossei</td>
<td>Ulnar (deep)</td>
<td>C8, T1</td>
<td>Finger abduction</td>
</tr>
<tr>
<td>Lumbricals</td>
<td>Median</td>
<td>C8, T1</td>
<td>Flexion of MP joint, extension of IP joints</td>
</tr>
</tbody>
</table>

**Figure 9.3.4** Clinical signs of lower brachial plexus injury are related principally to ulnar nerve damage. They include "claw hand" (A: palmar view) and wasting of intrinsic hand muscles (B: dorsal view). Abbreviations: DIP, distal interphalangeal; PIP, proximal interphalangeal; MP, metacarpophalangeal.
Median Nerve Injury

When the median nerve is severed in the elbow region:

• Flexion of the proximal interphalangeal joints of the 1st—3rd fingers is lost, and
• Flexion of the 4th and 5th fingers is weakened.
• Flexion of the distal interphalangeal joints of the 2nd and 3rd fingers is also lost.

• Flexion of the distal interphalangeal joints of the 4th and 5th fingers is not affected because the medial part of the FDP, which produces these movements, is supplied by the ulnar nerve. Thus, when the **person attempts to make a fist**, the 2nd and 3rd fingers remain partially extended “hand of benediction”.

(Hand of Benediction)
Upper limb nerve lesions & deformities (Cont’d)

Proximal Median Nerve Compression

Compression at the elbow is the second most common site of median nerve entrapment, after the wrist (carpal tunnel).

**Pronator syndrome:**
a nerve entrapment syndrome, is caused by compression of the median nerve near the elbow. The nerve may be compressed between the heads of the pronator teres as a result of trauma, muscular hypertrophy, or fibrous bands. Individuals with this syndrome are first seen clinically with pain and tenderness in the proximal aspect of the anterior forearm and hypesthesia of palmar aspects of the radial three and half digits and adjacent palm. Symptoms often follow activities that involve repeated pronation.
Axillary N. Lesion:
Leads to paralysis of deltoid m. As the deltoid atrophies, the rounded contour of the shoulder disappears. This gives the shoulder a flattened appearance and produces a slight hollow inferior to the acromion. In addition to atrophy of the deltoid, a loss of sensation may occur over the lateral side of the proximal part of the arm, the area supplied by the superior lateral cutaneous nerve of the arm.

Right winged scapula:
Long thoracic N. lesion: paralysis of serratus anterior m.
Upper limb nerve lesions & deformities (Cont’d)
Shoulder Region Neuropathy

<table>
<thead>
<tr>
<th>INVOLVED NERVE</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suprascapular</td>
<td>Posterolateral shoulder pain, which may radiate to arm and neck; weakness in shoulder rotation</td>
</tr>
<tr>
<td>Musculocutaneous</td>
<td>Coracobrachialis compression and weakened flexion at the elbow, with hypesthesia of lateral forearm; weakened supination</td>
</tr>
<tr>
<td>Long thoracic</td>
<td>Injury at level of neck caused by stretching during lateral flexion of neck to opposite side; winged scapula</td>
</tr>
<tr>
<td>Axillary</td>
<td>Rare condition (quadrangular space syndrome) (not shown in illustration); can produce weakness of deltoid muscle and abduction</td>
</tr>
</tbody>
</table>

Compressesion of suprascapular nerve may cause lateral shoulder pain and atrophy of supraspinatus and infraspinatus muscles.

Musculocutaneous nerve compression within coracobrachialis muscle causes hypesthesia in lateral forearm and weakness of elbow flexion.

Winging of scapula

FIGURE 7-33  Shoulder Region Neuropathy
Upper limb nerve lesions & deformities (Cont’d)

Spinal accessory N. lesion

Unilateral paralysis of the trapezius is evident by:

- The patient's inability to elevate and retract the shoulder,
- Difficulty in elevating the upper limb superior to the horizontal level.
- The normal prominence in the neck produced by the trapezius is also reduced.
- Drooping of the shoulder.
Radial Nerve Compression

The characteristic clinical sign of radial nerve injury is **wrist-drop**—inability to extend the wrist and the fingers at the metacarpophalangeal joints; instead, the relaxed wrist assumes a partly flexed position owing to unopposed tonus of flexor muscles and gravity.
Upper limb nerve lesions & deformities (Cont’d)

Ulnar Nerve Compression

Ulnar nerve injuries usually occur in four places:
(1) most commonly where the nerve passes posterior to the medial epicondyle of the humerus
(2) in the cubital tunnel
(3) at the wrist
(4) in the hand

Cubital tunnel syndrome:
• Results from compression of the ulnar nerve as it passes beneath the ulnar collateral ligament and between the two heads of the flexor carpi ulnaris muscle.
• The tunnel space is significantly reduced with elbow flexion.
• The metacarpophalangeal joints become hyperextended, and inability to flex the 4th and 5th fingers at the distal interphalangeal joints when trying to make a fist (claw hand).
• In lesions of the ulnar nerve at the elbow, function of the flexor carpi ulnaris muscle and flexor digitorum profundus to the medial two digits is lost.
**Ulnar Nerve Compression** (Cont'd)

**Ulnar Tunnel Syndrome**

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. *Claw hand* may be present if the motor component:

**Ulnar Paradox**

Clawing of the hand, particularly of the little and ring fingers, is worse with lesions of the ulnar nerve at the wrist than at the elbow because interruption of the nerve at the elbow paralyzes the ulnar half of the flexor digitorum profundus, which leads to lack of flexion at the distal interphalangeal joints in these fingers.

**Claw hand**

The metacarpophalangeal joints of the fingers are hyperextended and the interphalangeal joints are flexed because the function of most of the intrinsic muscles of the hand is lost. Clawing is most pronounced in the medial fingers because the function of all intrinsic muscles of these digits is lost while in the lateral two digits, the lumbricals are innervated by the median nerve.
**Ulnar Nerve Lesion** (Cont’d)

**FIGURE 9.5.8** Palmar (A) and dorsal (B) views of the hand with severe ulnar nerve lesion. Abbreviations: DIP, distal interphalangeal; PIP, proximal interphalangeal; MP, metacarpophalangeal.
Compression injury to the radial, median, and ulnar nerves may occur at several sites along each of their courses down the arm and forearm. A review of the applied anatomy and clinical presentation of several common neuropathies is shown in this illustration.
References:

• Gray's Anatomy for Students- Second edition
• Clinically Oriented Anatomy, Keith L. Moore- Sixth edition
• Netter’s Clinical Anatomy, Second edition