

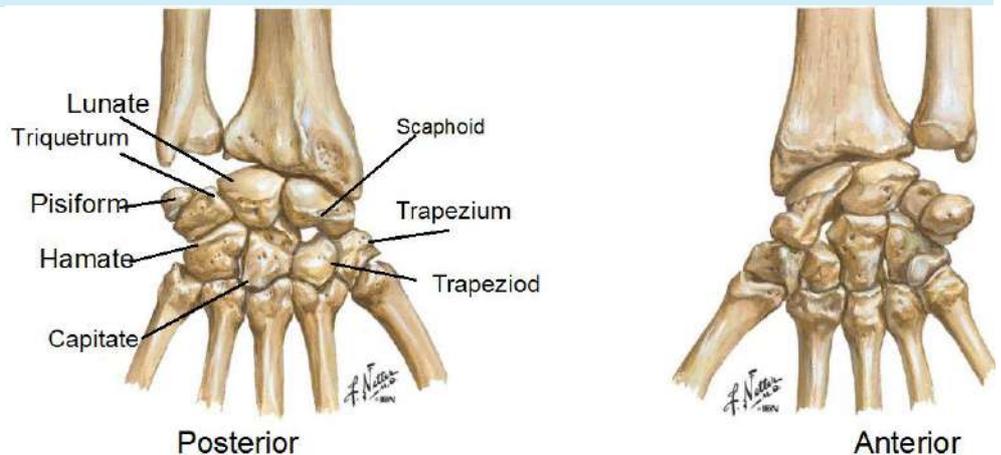
LECTURE 8 HANDS: BONES AND MUSCLES

WRIST AND HAND

- Human hand can do power grip and precision grip
- Thumb is 90° to the rest of the hand – can do fine actions
- Often able to do power actions
 - o Take tools and manipulate them using fingers and thumb

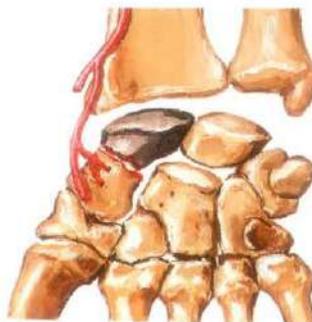
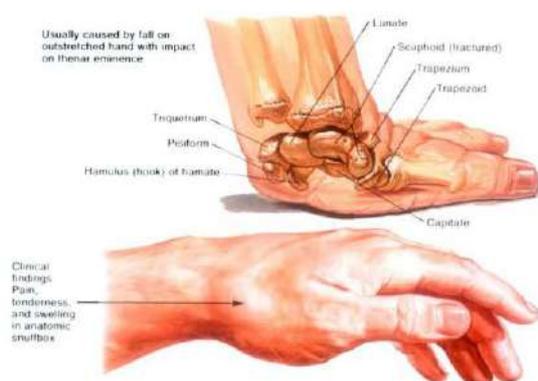
CARPAL BONES

- 8 carpal bones arranged in 2 rows
- on the anterior side, bridged by flexor retinaculum
- on posterior side – bridged by extensor retinaculum
- proximal row: closer to radius and ulna
- distal row – makes contact with finger/ metacarpals
- **proximal row:** from lateral to medial on anterior side; scaphoid, lunate, triquetrum, and a small sesamoid bone called the pisiform
- scaphoid and lunate makes contact with the radius
- the triquetrum doesn't make contact with ulna – separated by a ligament that stops direct contact between ulna and triquetrum
- sitting on triquetrum – pisiform bone (sesamoid bone) sits within the tendon of the FCU (flexor carpi ulnaris)
- **scaphoid:** sits on the thumb side, close to radius; has a constriction in the middle – neck of the scaphoid;
- distal row
 - o **trapezium:** makes contact with 1st metacarpal; forms the **saddle joint with thumb**; reciprocally concave and convex, which allows flexion and extension, abduction and adduction, and opposition
 - o trapezoid: triangular, wedge shaped
 - o capitate: large with rounded head
 - o **hamate:** medial side on distal row; on the anterior side, the hamate has a hook – called **hook of hamate**; important because it has a ligament that connects the hook to the pisiform bone; forms a ligament called the piso-hamate ligament; the **ulnar nerve and artery** goes underneath the piso-hamate ligament
- scaphoid trapezium and hamate likely to be injured



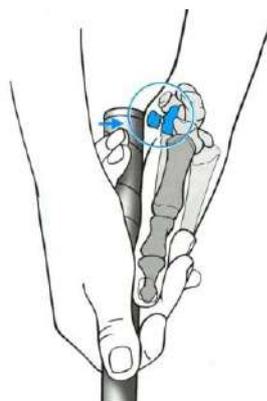
SCAPHOID FRACTURE

- scaphoid is most commonly fractured of carpal bones
- fractured commonly during fall on outstretched hand; when arm is pronated, dorsiflexed and abducted, fall onto radius, on the lateral side, the scaphoid takes most of the impact
- the weakest part of scaphoid = the constriction, thus fracture happens at the neck
- the blood supply for scaphoid is from the distal end of the scaphoid; radial artery penetrates the distal end of the scaphoid first. If there is fracture, then the proximal end of the scaphoid becomes necrotic



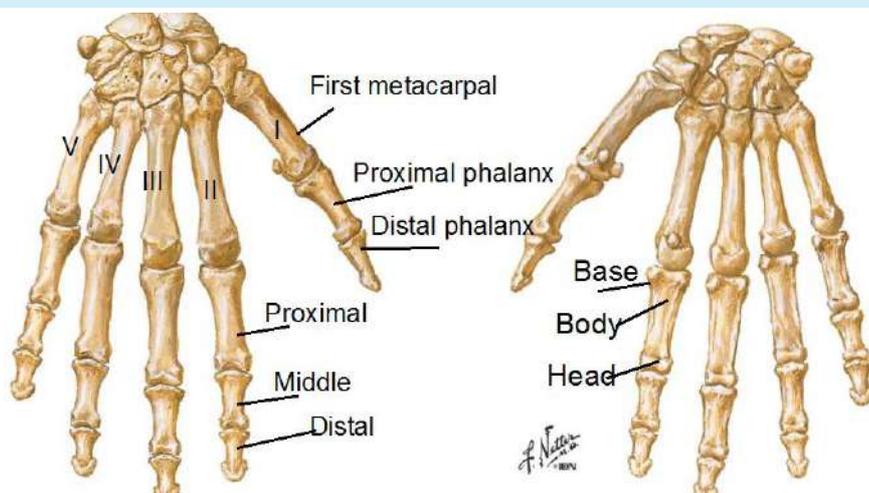
FRACTURE OF HOOK OF HAMATE

- the hook of hamate is palpable from the surface anteriorly; very sub cutaneous thus very easily damaged
- damage is caused by constant pressure on the hook – e.g. when gripping bicycle handle, thus called handlebar neuropathy
- the ulnar nerve and artery travel under the pisi-hamate ligament, thus the ulnar nerve and artery is commonly injured
- ulnar nerve and artery are largely responsible for innervation and bloody supply for intrinsic muscles of the hand
- the median nerve = forearm; hand = ulnar nerve
- in handlebar neuropathy – intrinsic muscles of hand are compromised



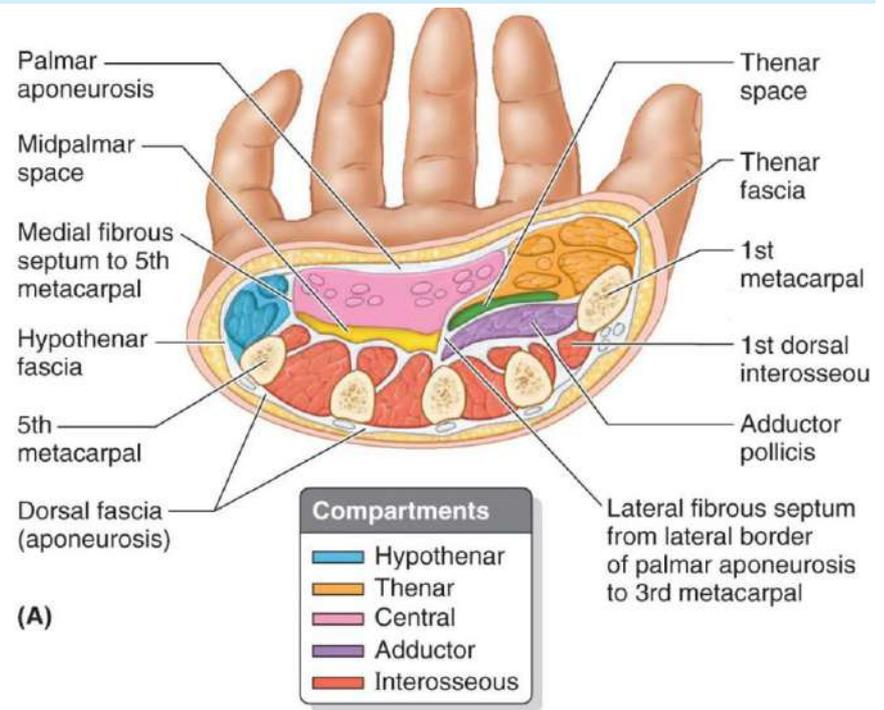
METACARPAL BONES

- not easily seen because they lie in your palm
- 1st metacarpal = thumb: short and robust
 - o during fracture of scaphoid and trapezium, 1st metacarpal can be endangered
- the base of a metacarpal is where it attaches to a carpal bone
- shaft = body
- condylar bit = the head
- phalanges attach to the head of the metacarpals
- thumb = 2 phalanges
- other fingers = 3 phalanges (proximal middle distal)
- proximal = base, shaft = body, distal = head
- there are sesamoid bones embedded in tendons = allow smooth motion
- number of sesamoid bones is variable – not in all tendons



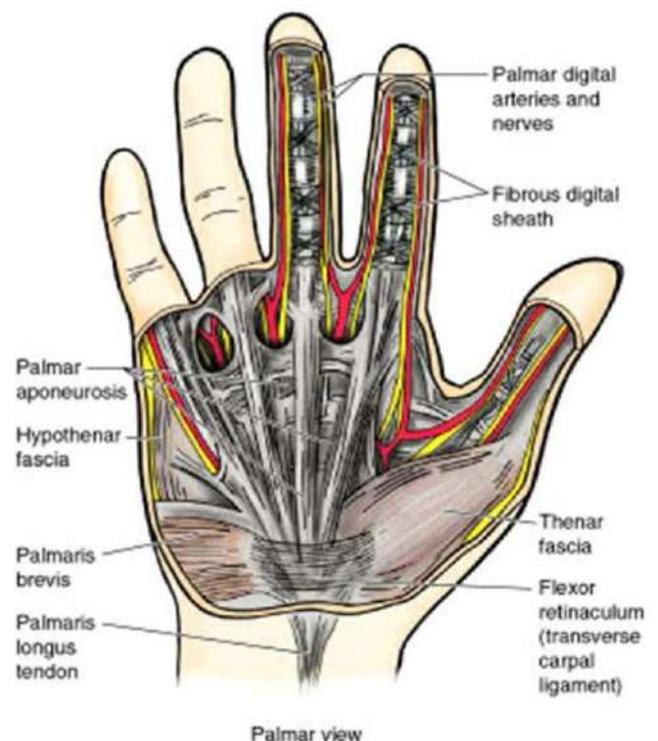
FASCIAL COMPARTMENTS

- when the antebrachial fascia goes to the wrist, it forms retinaculum
- flexor retinaculum on anterior side, extensor retinaculum = posterior
- as deep fascia proceeds further to palm of the hand, forms triangular shaped structure, a thick aponeurotic structure called the palmar aponeurosis
- apex of palmar aponeurosis – end of the wrist; where the palmar aponeurosis inserts
- the palmar aponeurosis forms tight fascia in the hand
- the hand is designed to grip – the fascia helps this by providing strengthening



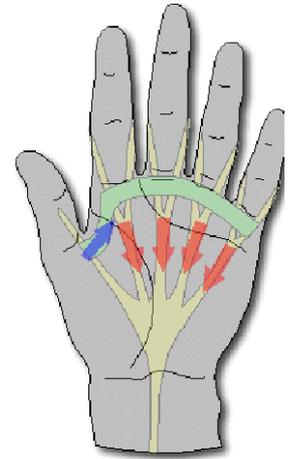
(A)

- allows skin to tightly attach to aponeurosis; pulling skin from palmar aponeurosis is difficult
- as it radiates to digits, the fibrous tissue separates and forms fibrous digital sheaths which enclose tendons travelling to digits e.g. FDS and FDP
- the tendons then have a tunnel in which to move; fibrous sheaths makes sure that the tendons don't stick out and cause bow stringing
- on the lateral border of aponeurosis, connective tissue goes deep and inserts into the body of the third metacarpal
- on medial border, there is a septum where the connective tissue pierces and inserts into the 5th metacarpal
- the 2 septums divides the hand into 3 compartments
- on the thumb side: the thenar compartment; demarcated by the lateral border of septum
- compartment on the medial side, demarcated by the 5th metacarpal: the hypothenar compartment
- between the two compartments = the central compartment
- there are lots of muscles that works on the thumb and on the little finger which allows the opposition of thumb and little finger
- palmar aponeurosis is most superficial part of deep fascia
- there is a tiny muscle that takes origin on palmar aponeurosis = **palmaris brevis**
 - o it has very fine fibers on anterior side
 - o goes cross ways from palmar aponeurosis and insert onto the skin itself
 - o small subcutaneous muscle
 - o helps to collect palm together



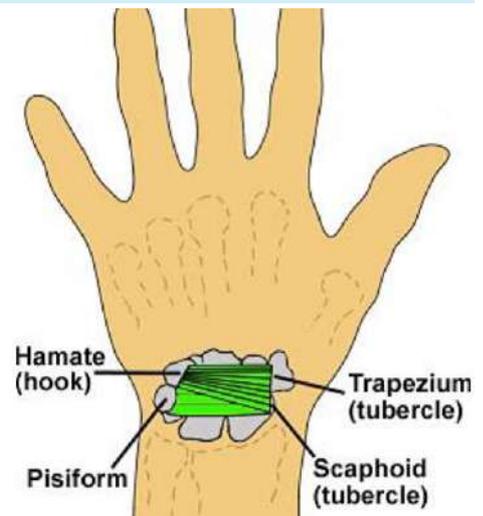
DUPUYTREN'S CONTRACTURE OF PALMAR APONEUROSIS

- sometimes, the palmar aponeurosis can cause contracture – called Dupuytren's contraction
 - o there is thickening and shrinking of the palmar aponeurosis
 - o this causes fingers to flex, particularly ring and little finger
 - o no known aetiology, may be inherited, usually in older people
 - o has to be relieved by cutting the fascia to relieve tension



FLEXOR RETINACULUM = TRANSVERSE CARPAL LIGAMENT

- origin from lateral side, from the scaphoid tubercle, to tubercle of trapezium then crosses to medial side
- on the medial side, at the distal end attaches to hook of hamate and the pisiform bone
- forms fibro-osseous roof of carpal tunnel
- **S**capoid **T**rapezium hook **O**f hamate **P**isiform

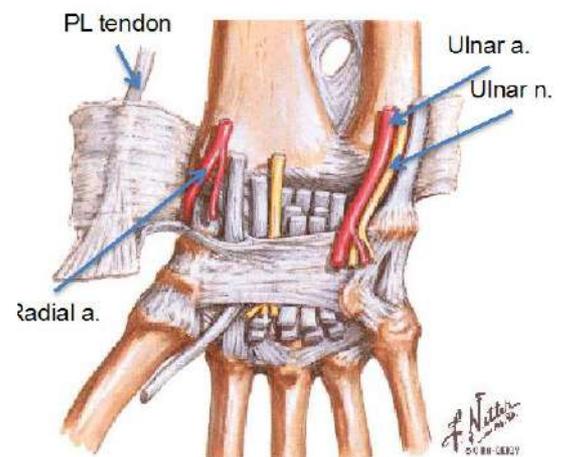


CARPAL TUNNEL

- Roof of carpal tunnel = flexor retinaculum
- Floor = carpal bones
- Can see carpal tunnel at the distal wrist crease – flexor retinaculum is close to the hand
- Contents
 - o Flexor tendons
 - o Synovial sheaths that cover tendons
 - o Median nerve; when impinged – causes carpal tunnel syndrome

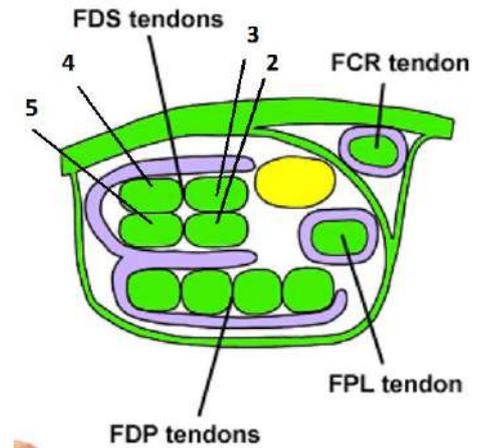
SUPERFICIAL TO FLEXOR RETINACULUM

- Not affected by carpal tunnel syndrome
- PL (palmaris longus) tendon – variably present in the population (when it is present, forms apex of palmar aponeurosis)
- ulnar artery and ulnar nerve - go on the medial side, under the hamate-pisiform ligament; but superficial to carpal tunnel
 - o during carpal tunnel syndrome, there is no deficit on the ulnar side
- superficial branch of radial artery – to locate the radial artery, then you locate the tendon of FCR; lateral to this is the radial artery; radial artery goes on lateral side over carpal tunnel and into the anatomical snuff box
- median nerve goes through the carpal tunnel, but before doing so, gives off a branch
- palmar cutaneous branch of median nerve – superficial to the carpal tunnel
- FCU tendon lies well medial to flexor retinaculum – first inserts onto the pisiform and the hamate, and then inserts onto the base of 5th metacarpal



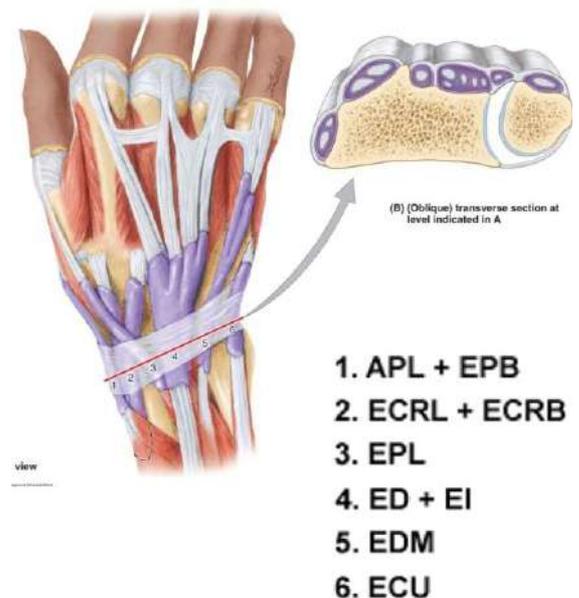
DEEP TO FR

- 9 tendons lie centrally in the carpal tunnel
 - o FDS(x4tendons) (superficially placed under the FR)
- They are placed in two rows
- The tends going to the 4th and 3rd digit lie superficial to the tendons going to the 2nd and 5th digit
- Starts from the forearm, through the carpal tunnel; as it goes to digits, it splits and inserts into the base of the middle phalanges of digits 2-4, on either side of each digit
 - o FDP(x4tendons) – goes deeper to FDS
- In a straight row
- The tendons of FDP goes deeper to the FDS, and goes under the split of the FDS tendon and attaches onto the base of the distal phalanges
- There is a synovial sheath encircling FDS and FDP because they do lots of repetitive action – thus synovial sheath also goes in the carpal tunnel
- FPL + associated synovial sheath
- Median nerve – lies just deep to the palmaris longus tendon
 - o Has already given off the cutaneous branch, and continues under the tunnel
 - o After it passes the carpal tunnel, gives off another branch - recurrent thenar branch – provides nerve supply to muscles of the thumb (thenar compartment muscles)
 - o median nerve then splits - lateral & medial branches that go to the digits
- FCR (within roof of carpal tunnel) – point where you find radial artery
 - o when the flexor retinaculum goes to the lateral side, it splits, before attaching on either side of the trapezium
 - o Going through the split is the tendon of FCR
 - o Will still be affected by carpal tunnel syndrome
- Synovial sheaths



EXTENSOR RETINACULUM – ON POSTERIOR SIDE

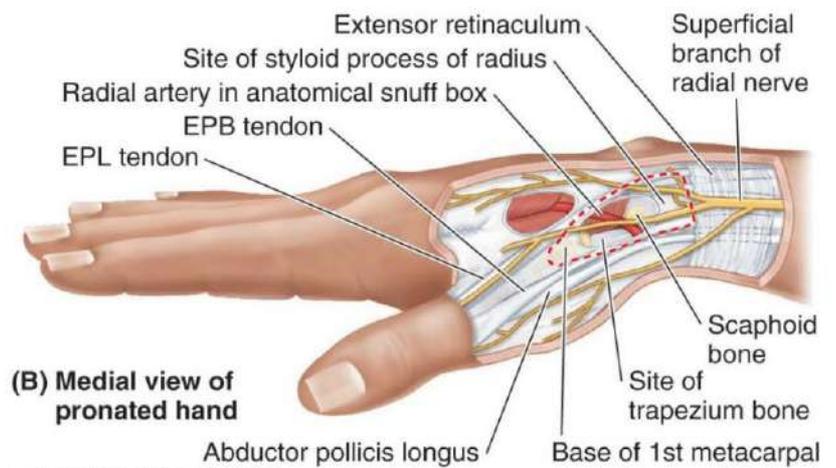
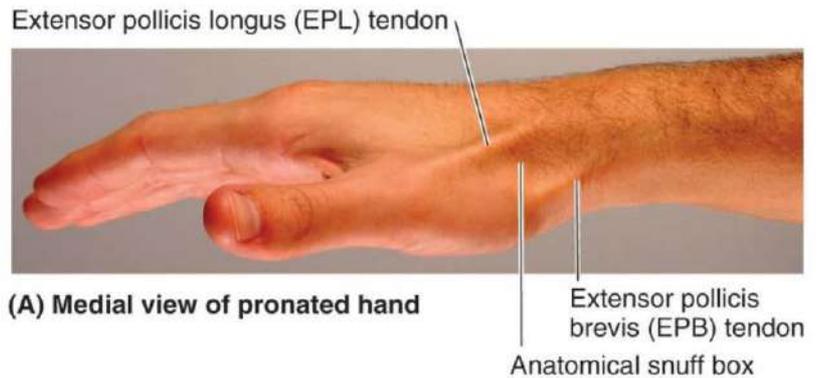
- Attachments:
- Origin: Radius laterally
- Insertion: Triquetrum, pisiform on medial side
- FCU tendon lies medially to the extensor retinaculum
- Not clinically as relevant
- Contents:
 - o Six tunnels in which nine tendons travel
 - o Includes 9/11 of the tendons of forearm
- tendons are covered by Synovial sheaths
- tendons that don't go through extensor retinaculum
 - o the brachioradialis (from posterior compartment but goes to the anterior side) – doesn't cross the wrist; works as a flexor even though it received innervation from the radial nerve
 - o supinator – works to supinate the elbow joint; doesn't cross the wrist
- going from lateral to medial (thumb to pink)



- **1. APL (abductor pollicis longus) + EPB (extensor pollicis brevis)** – work on the thumb; travel together on lateral side; they start deeper from the radius, ulna and interosseous membrane but cross the tendons of ECRL and ECRB to end up more superficial and insert and work on the thumb; referred to as outcropping tendons
- 2. ECRL + ECRB: more medial to APL + EPB
- 3. EPL – another one that works on thumb
- 4. ED (extensor digitorum) (go to all 4 digits minus thumb) + EI (extensor indicis) (tendon for index finger)
- 5. EDM (Extensor digiti minimi) (little finger)
- 6. ECU – extensor carpi ulnaris most medial

ANATOMICAL SNUFFBOX

- Boundaries:
 - o Laterally: tendons of APL and EPB
 - o Medially: tendon of EPL (most prominent)
- All work on the thumb; APL and EPB are outcropping tendons
- The thumb has rotated 90° to rest of the hand
- Abduction of thumb = 90°; the snuffbox tendons aren't so visible
- Extension of thumb = splaying of hands – when the snuff box is most visible
- Roof:
 - o Skin,
 - o subcutaneous tissue, cephalic vein (one of two veins that provides superficial venous supply for upper limb – on the lateral side of the arm, in the roof of the snuffbox),
 - o radial nerve superficial branch
- Floor (deep)
 - o Scaphoid – most commonly fractured; palpating anatomical snuff box helps to identify this fracture
 - o trapezium
- in the anatomical snuffbox (between the floor and the roof): Radial artery, on the lateral side, doesn't go in the carpal tunnel; provides blood supply to scaphoid bone; can be endangered during fracture



Copyright © 2014 Wolters Kluwer Health | Lippincott Williams & Wilkins

MUSCLES OF THE HAND

- The aponeurosis is divided into three compartments (thenar, hypothenar and middle)
- there are 4 layers

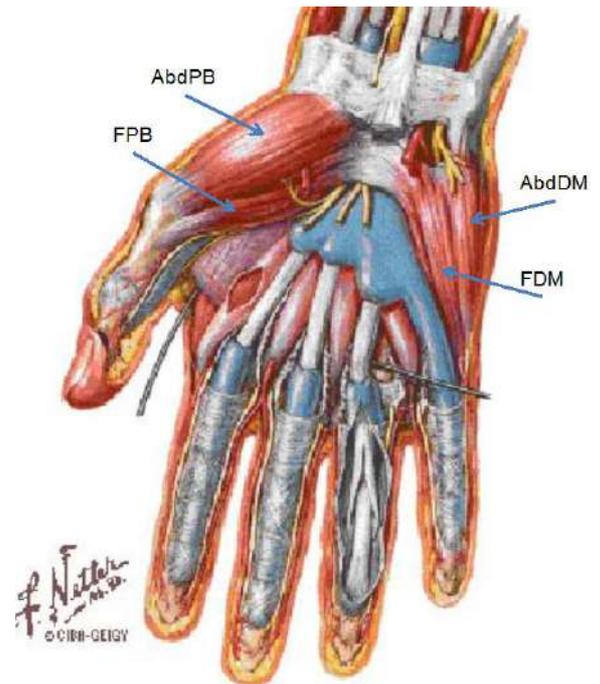
LAYER 1: HYPOTHENAR + THENAR

A) thenar muscles

- o abductor pollicis brevis (AbdPB)
- o flexor pollicis brevis (FPB)
- insert onto the base of the proximal phalanx of thumb
- abduction + flexion
- form the thenar eminence

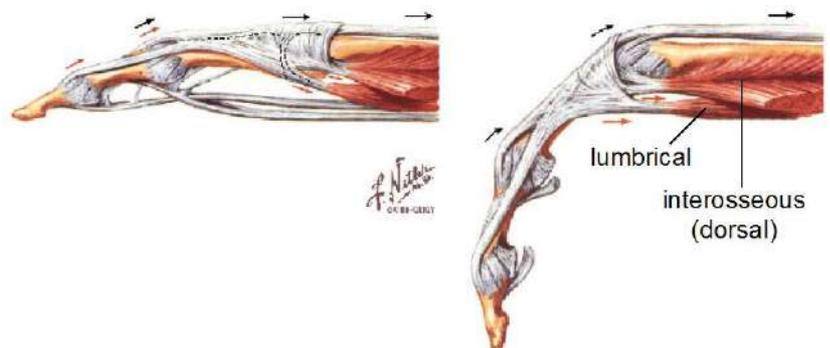
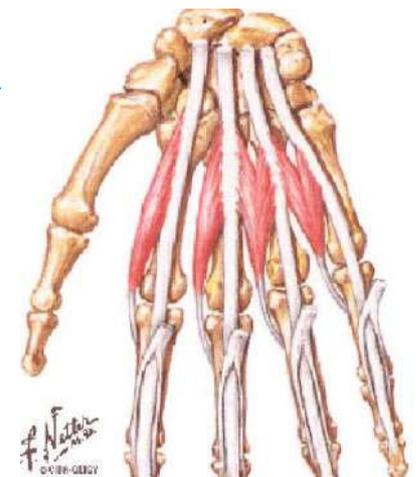
B) Hypothenar muscles

- abductor digiti minimi (AbdDM)
- flexor digiti minimi (FDM)
 - o insert onto the base of the proximal phalanx of fifth digit
- all arise from edges of flexor retinaculum



LAYER 2: MIDDLE FINGERS

- **lumbricals x 4**
- originate from tendons of FDP, not bone
- don't insert onto bone – insert onto extensor expansions
- come off from the anterior side of the hand, go through the digits, and insert onto extensor expansions of digits 2-5
- there are 2 uni pennate and 2 bi pennate muscles
- lumbricals work with FDP; FDP inserts onto the distal phalanx and helps you to do a complete fist
- the lumbricals insert onto the extensor expansions (Which start on the middle phalanx)
- lumbricals work on the metacarpal-phalangeal joints and help flex them
- but because they also insert onto the extensor expansions, also extend the interphalangeal joints
- flex proximal joints; extend distal joints

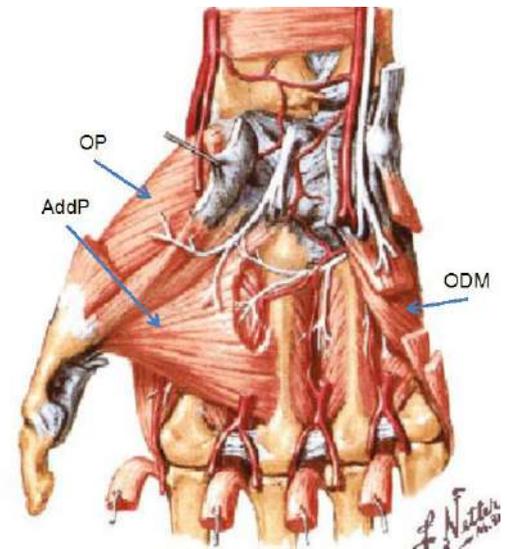


LAYER 3: THENAR + HYPOTHENAR

A. Thenar muscles:

- opponens pollicis (OP)
- adductor pollicis (AddP)
 - o lie deeper to the abductors and flexors of the thumb in the first layer

- the adductor pollicis is a fan shaped muscle with two heads, an oblique head that starts at the base of the 2nd and 3rd metacarpal, and a transverse head that starts on the shaft of the third metacarpal; both heads insert into the base of the proximal phalanx of the thumb
- allows adduction of thumb
- opponens and adduction allows rotation of thumb together



B. Hypothenar muscles:

- o opponens digiti minimi (ODM)
- there is an opponens muscle on both the hypothenar and the thenar side
- the adductor muscle is only on the thenar side
- for the **opponens**
 - o both start off from the edges of the flexor retinaculum and insert along the borders of the metacarpal on either the thenar or the hypothenar side

LAYER 4: MIDDLE FINGERS

- Interosse
 - o 3 palmar (adduct; pAd)
 - o 4 dorsal (abduct; dAb)
- lie between the metacarpals; arise from shaft of MC's
- insert into extensor expansion (digits 1-4)
- lie in two layers – 3 on palmar side, and 4 on dorsal side
- palmar side
 - o start from metacarpal and insert onto the extensor expansion of the same metacarpal
 - o don't insert onto the 3rd metacarpal – thus 3rd finger acts as axis around which the movement takes place
 - o pAd – adduct the hand (bring them together)
 - o these work on the digits; the AddP works on the thumb
- dorsal side
 - o there are 4 of them
 - o work relative to midline axis
 - o bipennate muscles – move digits away from the midline
 - o Dab (abduct) – splay out hand
 - o Arise from the MC, pass through the lateral side of the digit, and insert onto the extensor expansion

NERVE SUPPLY OF INTRINSIC HAND

- the median nerve has a recurrent branch after it goes through the carpal tunnel
- this provides the nerve supply to AbdPB, the FPB and OP
- the lateral branch of median nerve supplies 1st and 2nd lumbrical
- apart from these muscles, the rest are innervated by the ulnar nerve
 - o all of the 7 interossei
 - o 2 lumbricals (3rd and 4th)

Median nerve:

- Recurrent branch
 - AbdPB
 - FPB
 - OP
- Lateral branch
 - 1st and 2nd lumbrical



Ulnar nerve:

- Deep branch
 - AbdDM
 - FDM
 - ODM
 - AddP
 - 3rd and 4th Lumbrical
 - Interossei



- AddP
- ODM
- FDM
- AbdDM

- Hook of hamate damage = ulnar nerve damage – large loss of intrinsic muscles of the hand