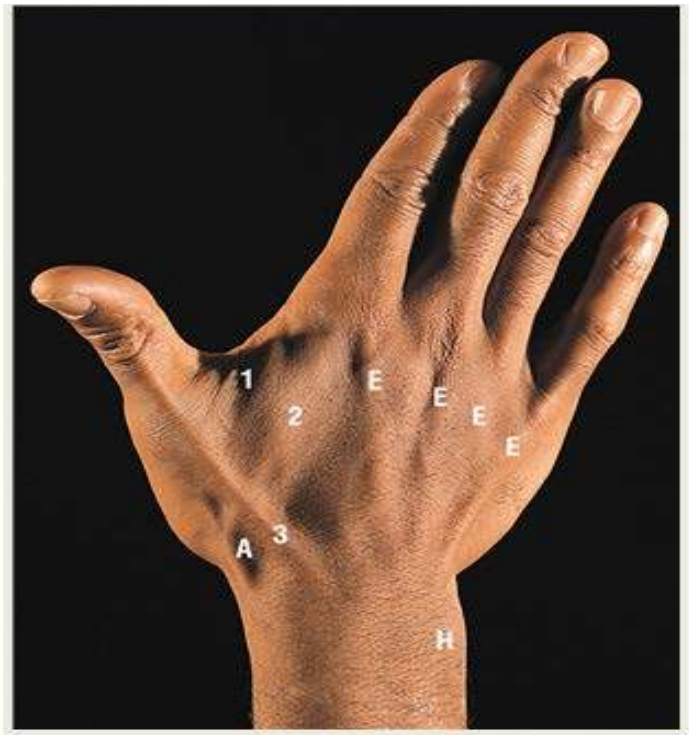
The Hand I Organization, Bones, Joints, Fascia and Spaces



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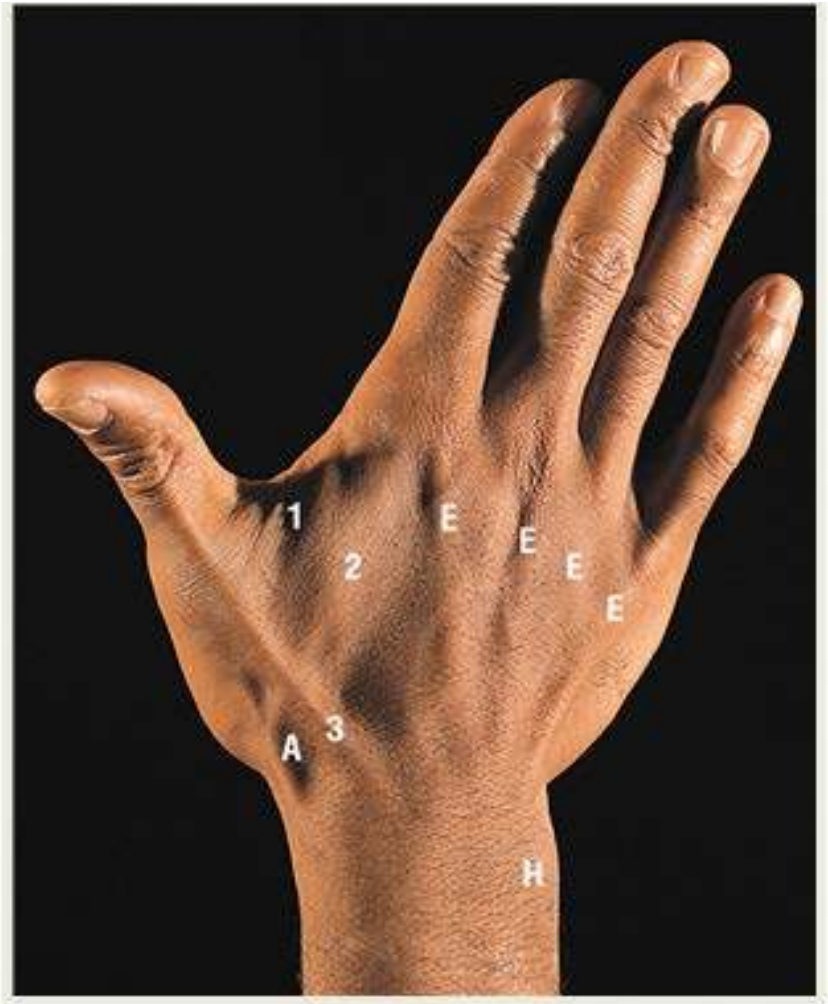
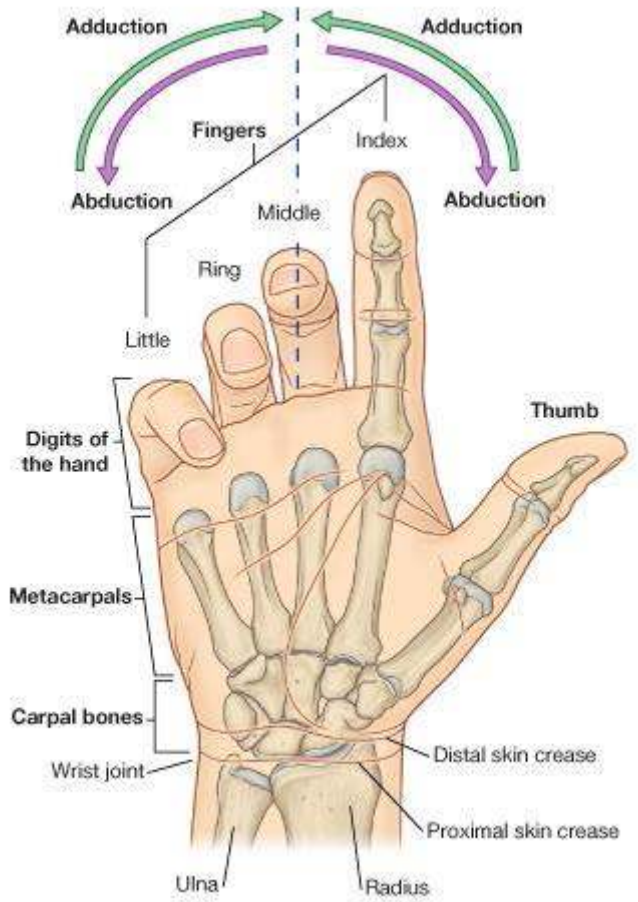
Introduction

- Part of the upper limb distal to the wrist joint
- Subdivided into three parts:
    i. The wrist
    ii. The metacarpus
    iii. The digits



Movements of the hand

Abduction and adduction of the fingers are defined with respect to the long axis of the middle finger



The Hand: Posture

In the normal resting position, the fingers form a flexed arcade, with the little finger flexed most, and the index finger; least

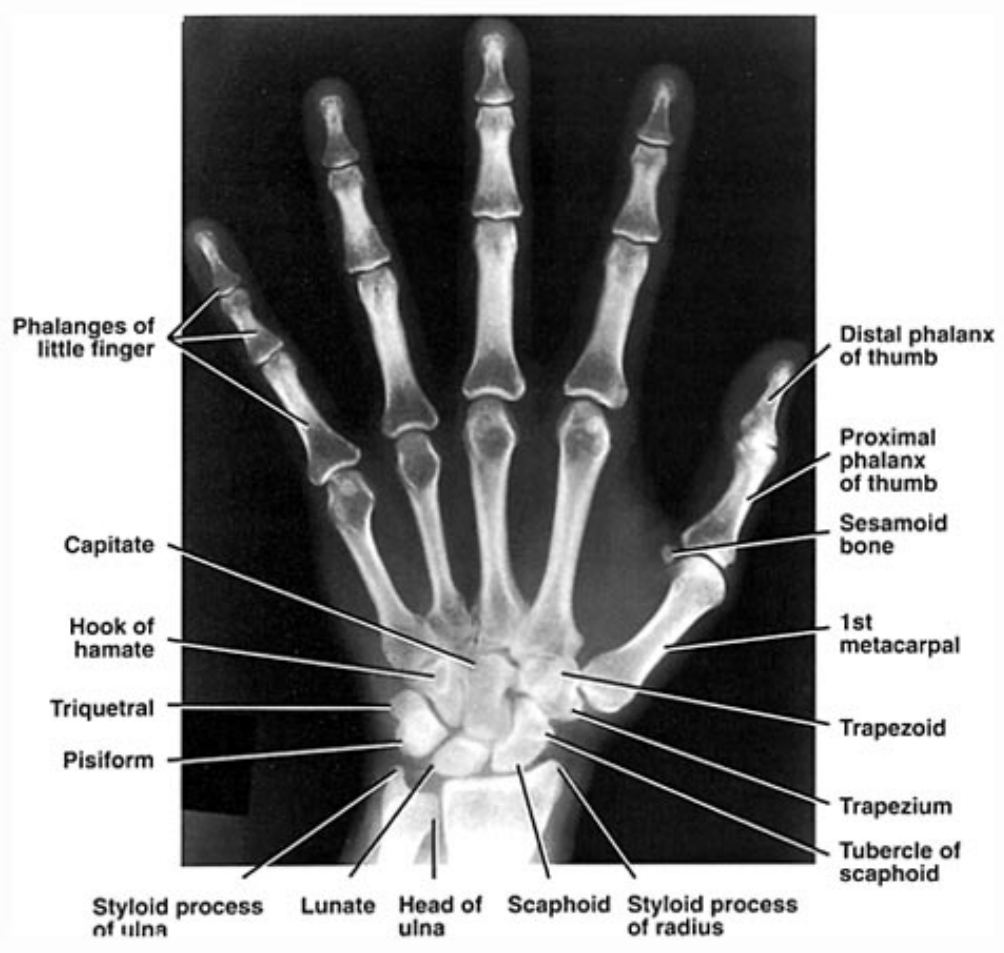
flexed

Skin of the hand

- Palmar skin is thick and cornified for enhanced grip.
- The dorsal skin on the other hand is thin, mobile and elastic to accommodate flexion. When this property is lost, for example, in patients with burns; there will be difficulty with flexing the fingers

The Hand: Bones

- Hand consist of 27 bones:
  - 14 Phalangeal bones
  - 5 Metacarpal bones
  - 8 Carpal bones



Carpal Bones: Anterior View

Pneumonics: *She Likes To Play*
Try To Catch Her

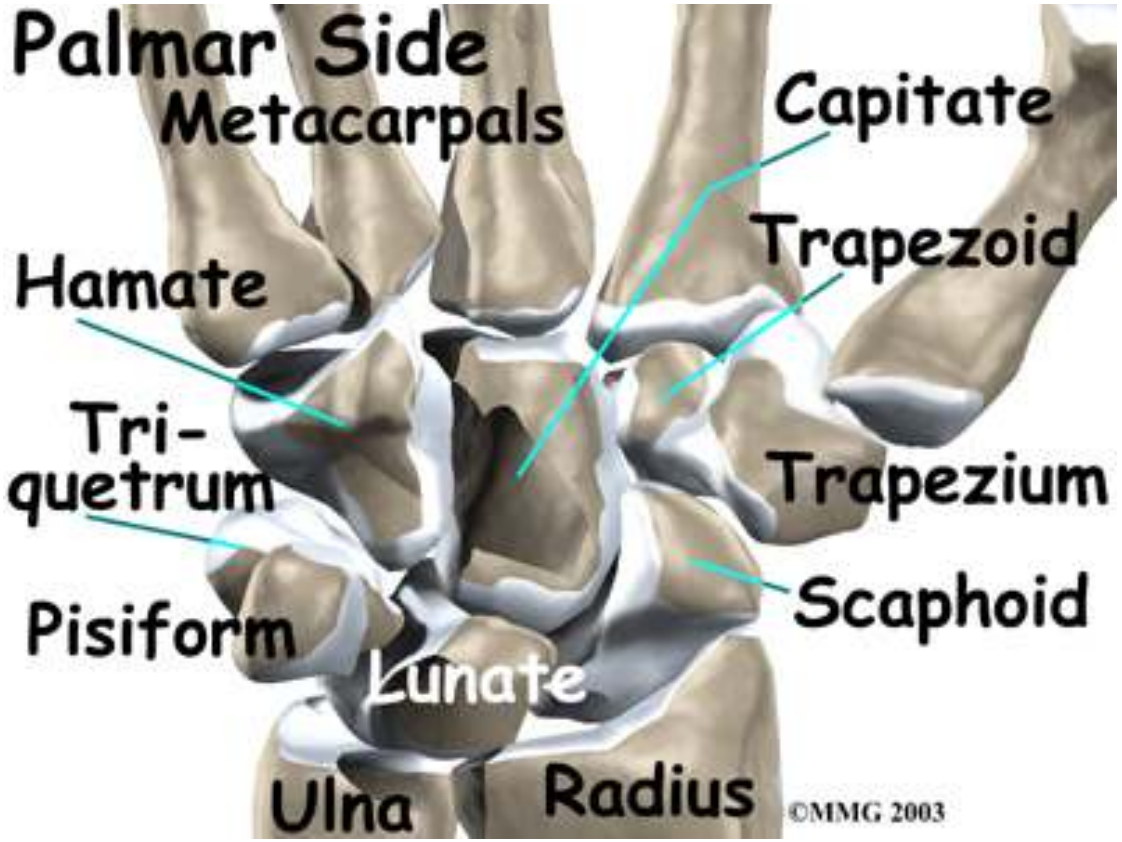
- Carpal bones: arranged in two rows with 4 bones each

1. Proximal row

i. **S**caphoid (**S**he)
ii. **L**unate (**L**ikes)
iii. **T**riquetrum (**T**o)
iv. **P**isiform (**P**lay)

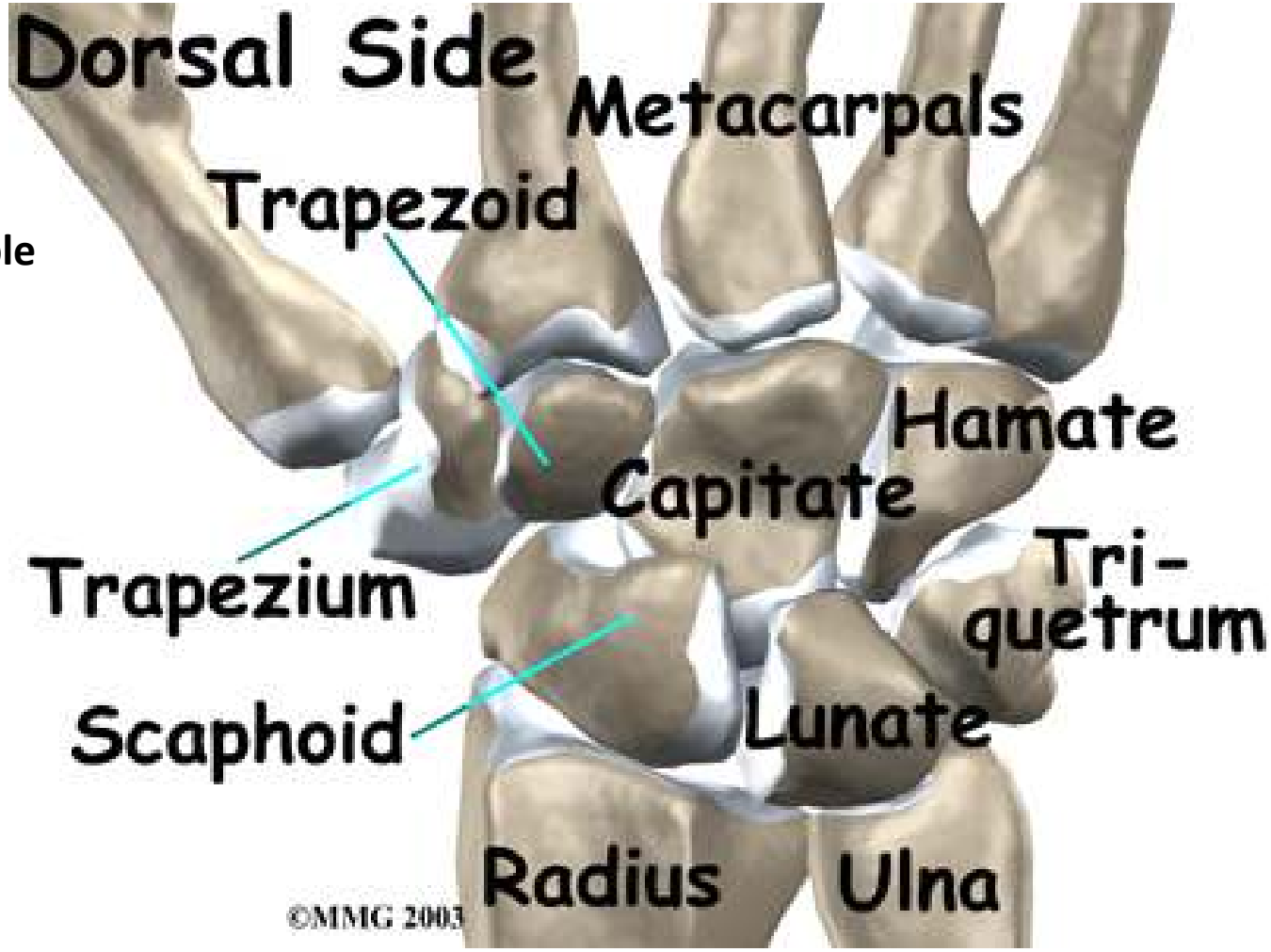
2. Distal row

i. **T**rapezium (**T**ry)
ii. **T**rapezoid (**T**o)
iii. **C**apitate (**C**atch)
iv. **H**amate (**H**er)



Carpal Bones: Posterior view

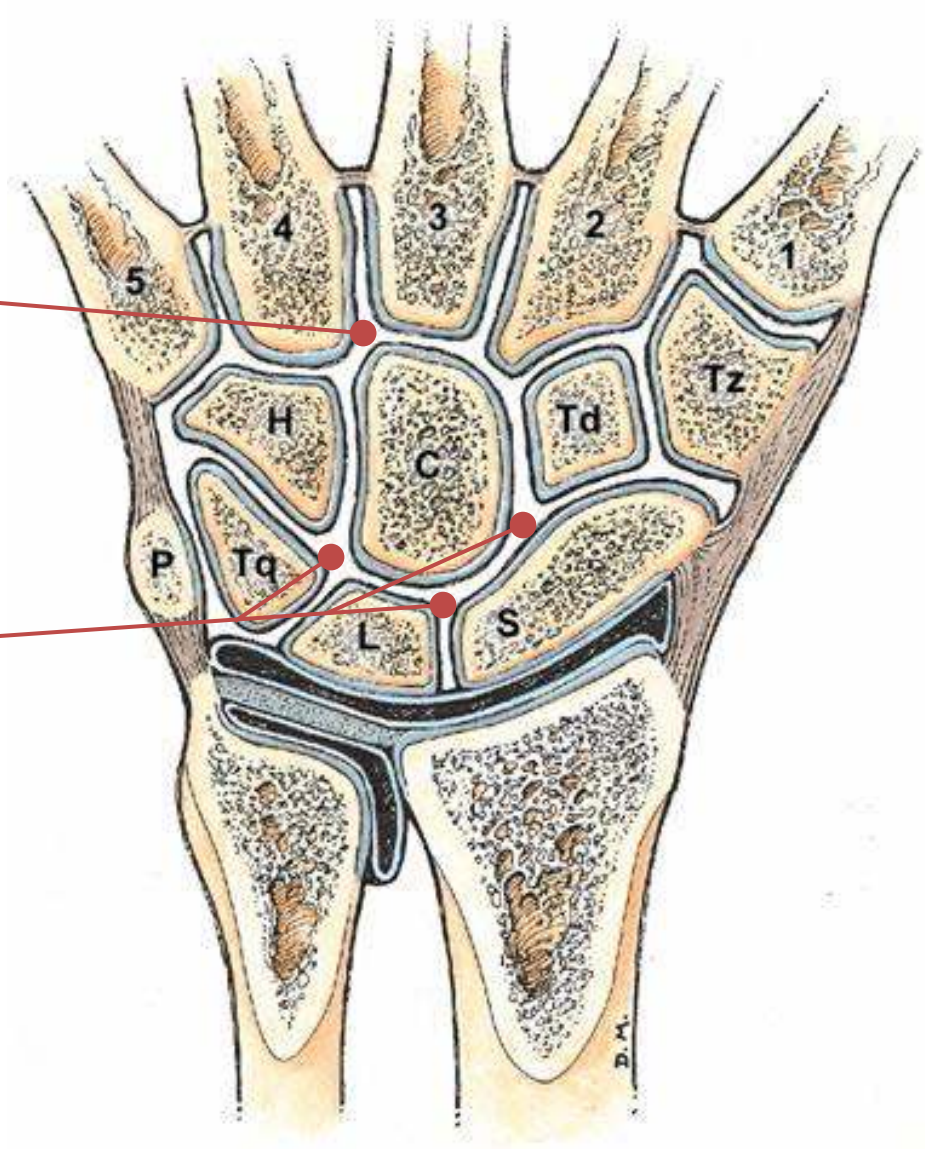
- The pisiform is not visible in this view
- It is obscured by the triquetrum



Another pneumonics: **S**ome **L**overs **T**ry **P**ositions **T**hat **T**hey **C**an't **H**andle

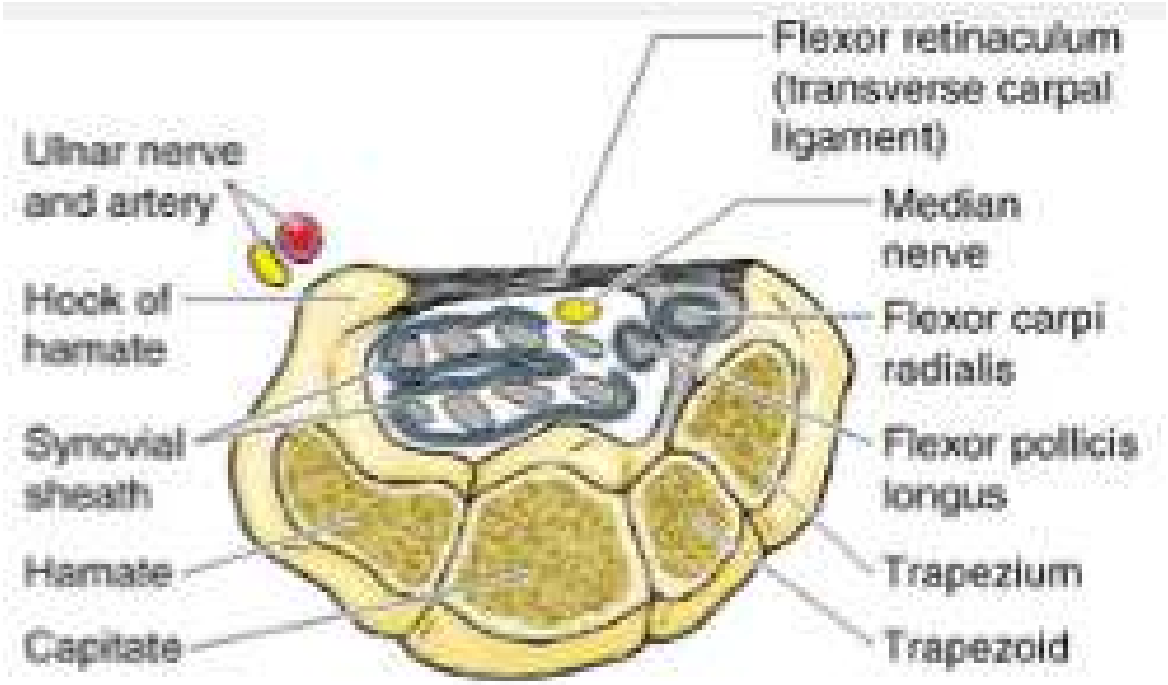
Carpal Bones

- Carpal bones in the distal row articulate with the metacarpals of the digits to form carpometacarpal joints.
- Carpal bones articulate with each other to form the intercarpal joints
- The bones are arranged in a bow shape fashion called the Carpal arch



Carpal Arch

- The lateral side of the arch is formed by the tubercles of the scaphoid and trapezium.
- The medial side by the pisiform and the hook of hamate
- The arch is converted to a tunnel called the carpal tunnel by the attachment of the flexor retinaculum

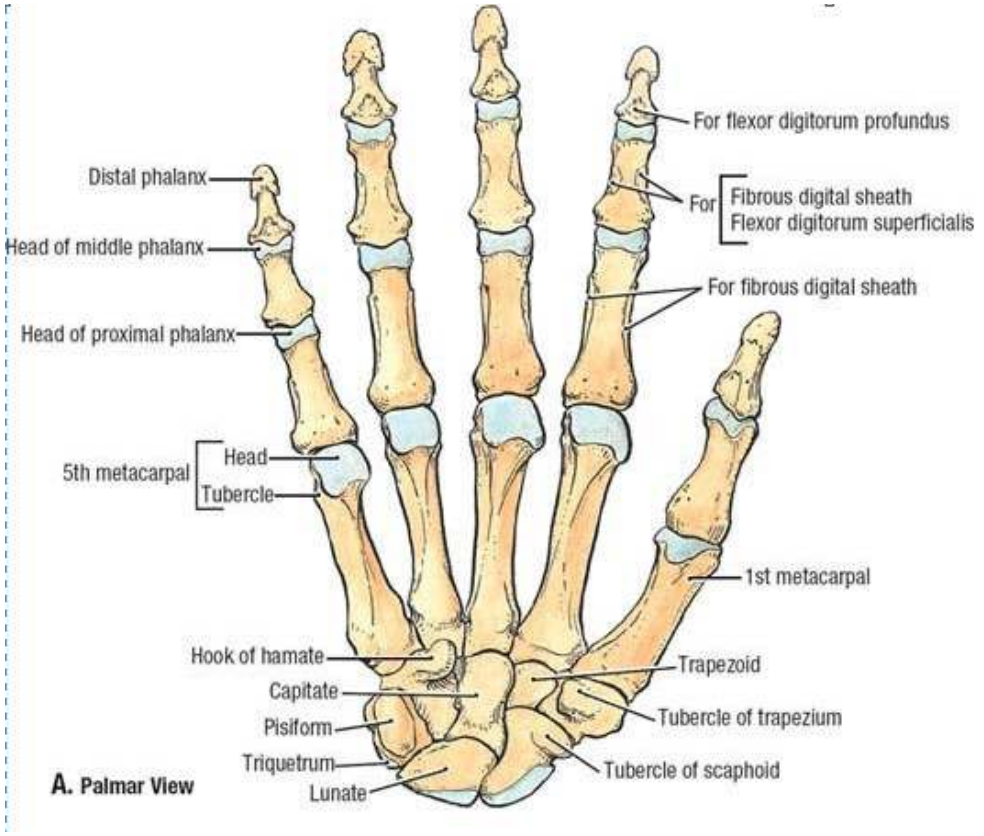


The Metacarpals

- Each of the five metacarpal bones is related to one digit
- First metacarpal is related to the thumb
- Metacarpals II to V are related to the index, middle, ring, and little fingers, respectively

The Metacarpals

- Each metacarpal consists of a **base,** a **shaft (body), and distally, a head.**
- The bases articulate with the carpal bones to form carpometacarpal joints.
- The sides of the bases of the metacarpal bones of the fingers (**Not the thumb!**) also articulate with each other.

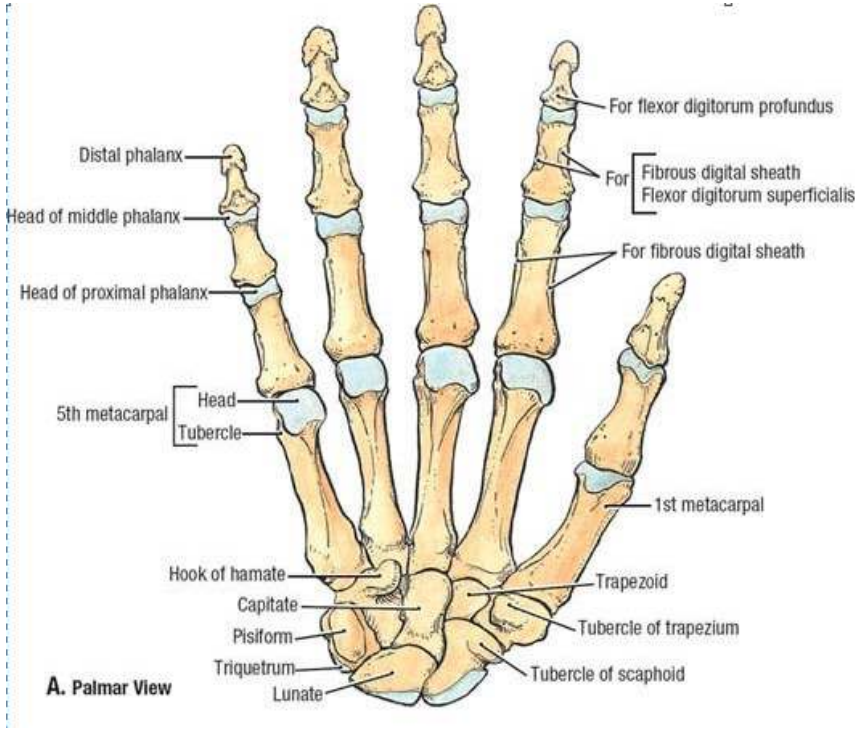


The Metacarpals

- The heads articulate with the proximal phalanges of the digits to form the metacarpophalangeal joints.
- The heads form the knuckles on the dorsal surface of the hand when the fingers are flexed.

The Phalanges

- The phalanges are the bones of the digits.
- The thumb has two:- a proximal and a distal phalanx
- The other digits have three:- a proximal, a middle, and a distal phalanx.



The Phalanges

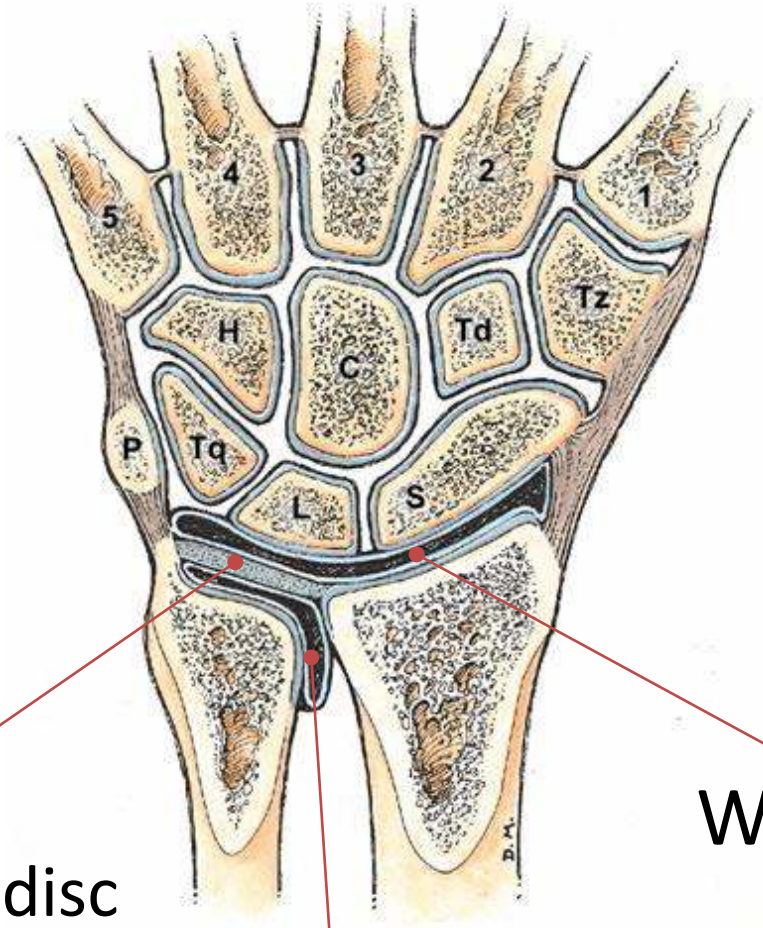
- Like the metacarpals, each phalanx has a base, a shaft (body), and distally, a head.
- The base of each proximal phalanx articulates with the head of the related metacarpal bone.
- The head of each proximal phalanx articulate with the base of the middle phalanx to form the proximal interphalangeal joint
- The head of each middle phalanx articulate with the base of the distal phalanx to form the distal interphalangeal joint
- The head of each distal phalanx is non-articular and flattened into a crescent-shaped palmar tuberosity, which lies under the palmar pad at the end of the digit.

Joints of the wrist and hand

i. Radiocarpal joint (Wrist)
ii. Intercarpal joints
iii. Carpometacarpal joints
iv. Metacarpophalangeal joints
v. Interphalangeal joints
    - Proximal Interphalangeal joints (PIP)
    - Distal Interphalangeal joints (DIP)

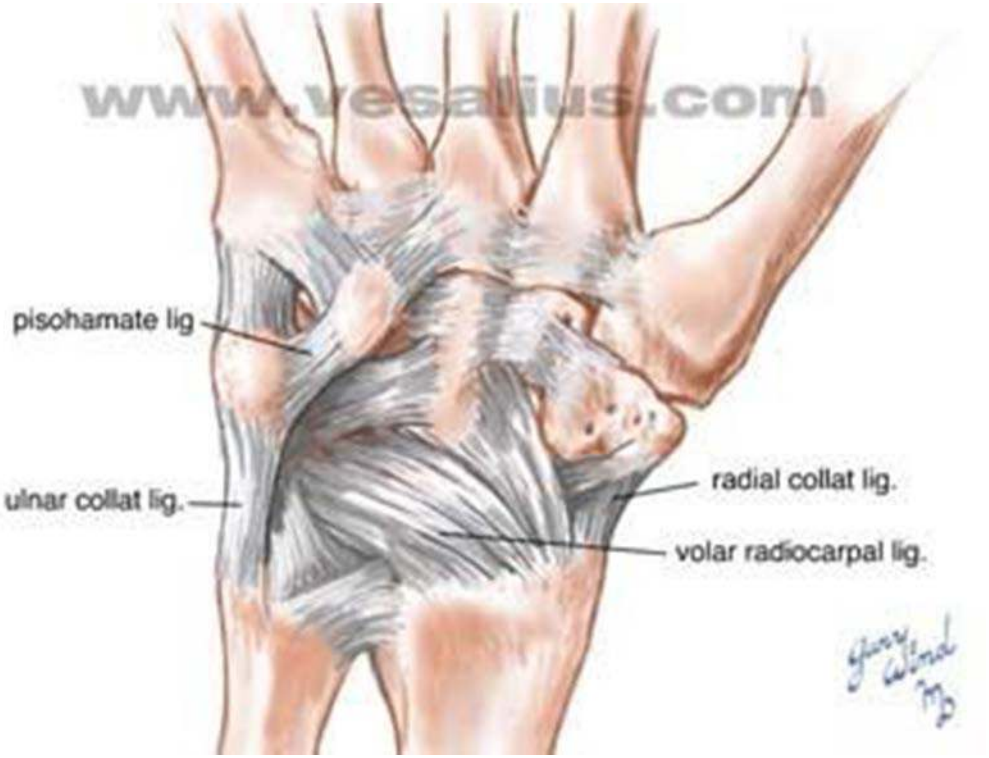
The Wrist (Radiocarpal) Joint

- Between radius proximally and the scaphoid and lunate bones distally
- It is a synovial joint
- The ulna does not articulate with carpal bones(i.e. does not contribute to the wrist joint)
- The joint between radius and ulna is the distal radioulnar (DRU) joint
- An articular disc is found between DRU and radiocarpal joints



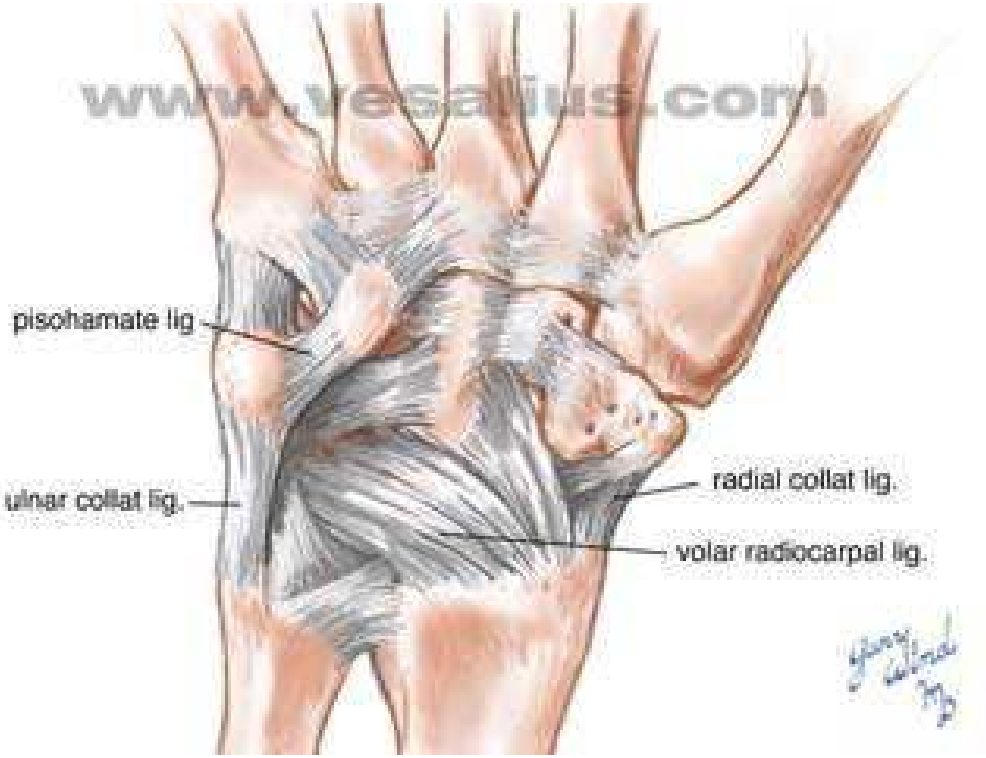
The Wrist joint

- **Ligaments**
  i. Radial collateral
  ii. Ulnar collateral
  iii. Palmar (volar) radiocarpal
  iv. Palmar (volar) ulnocarpal
  v. Dorsal radiocarpal



The Wrist joint

- Ligaments of wrist most highly developed on palmar side of wrist
- Palmar radiocarpal ligament originates laterally from radial styloid & directed in a distal ulnar direction.

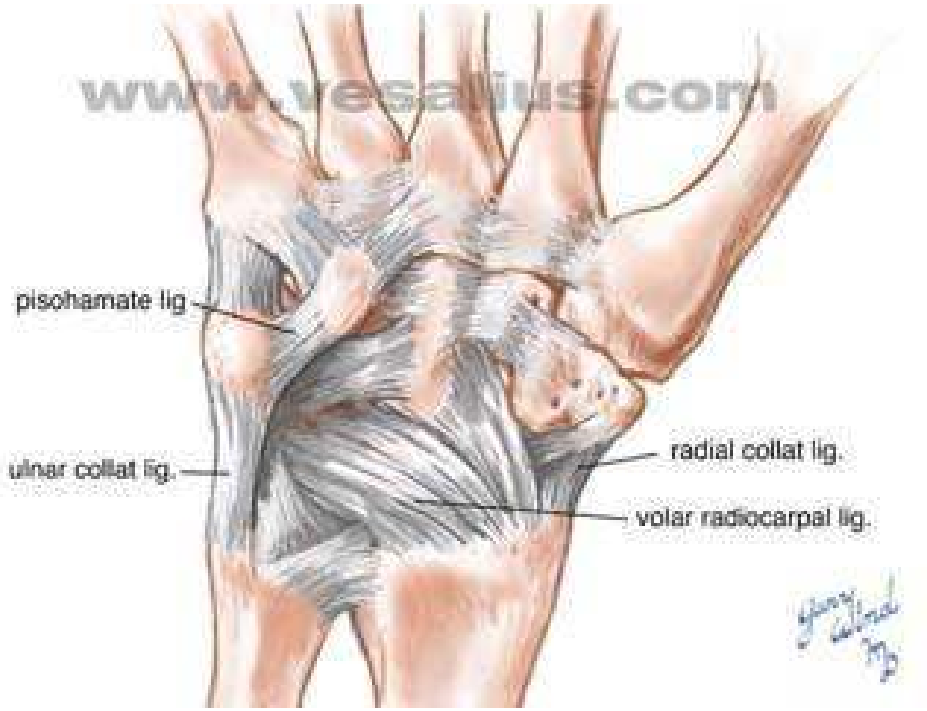


The Wrist joint

- Movement is in two axes.
  - abduction
  - adduction
  - flexion
  - Extension
- Adduction is greater than abduction
- Flexion is greater than extension

Intercarpal Joints

- Synovial joints between the carpal bones share a common articular cavity.
- The joint capsule of the joints is reinforced by numerous ligaments.
- Movement is limited

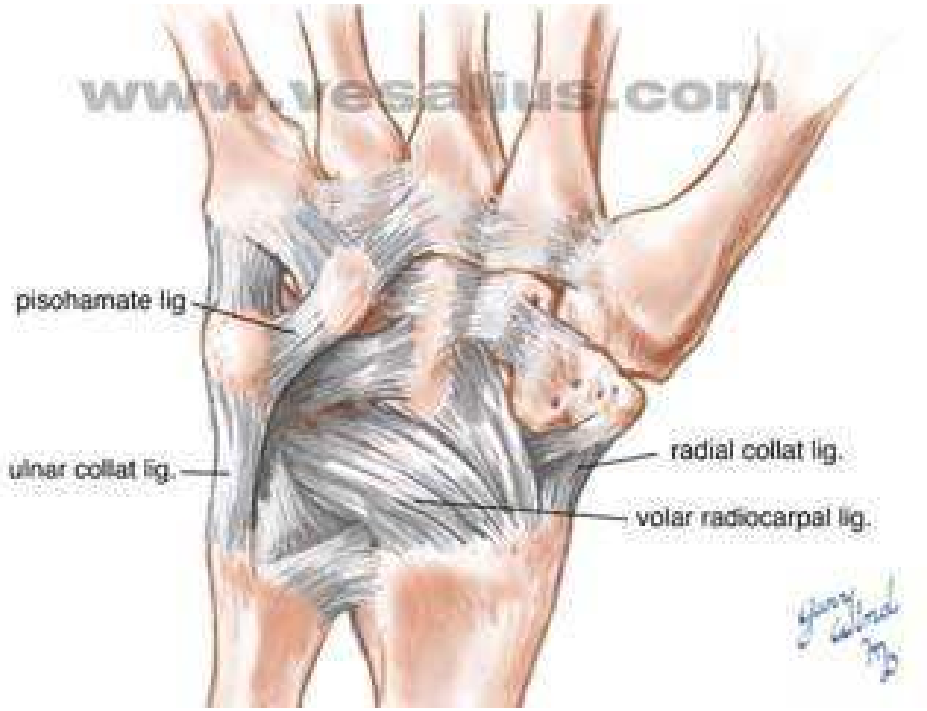


Intercarpal Joints: Ligamentous Anatomy

- Strong on the radial side to prevent carpals from translating ulnarly on medially angulated slope of distal radius
- Ligaments are mainly two types:

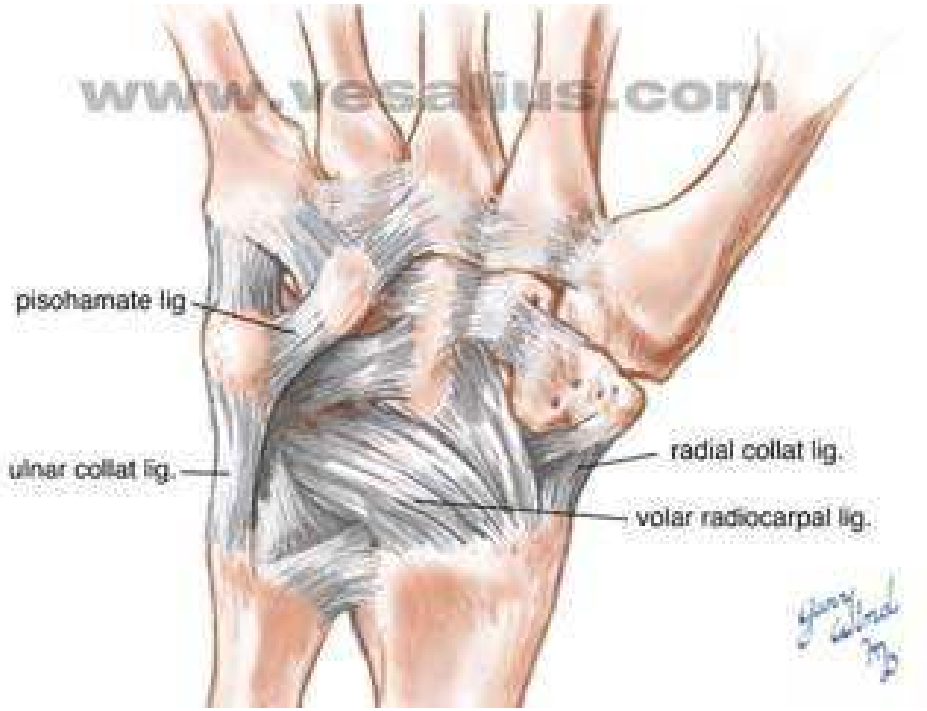
  i. Extrinsic

  ii. Intrinsic



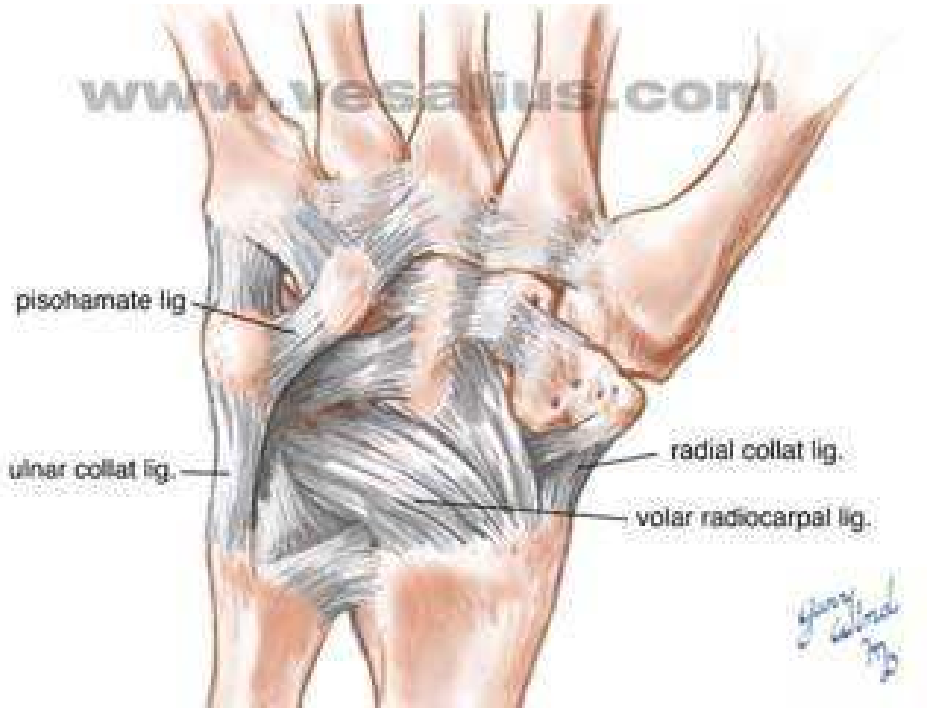
Extrinsic Ligamentous Anatomy

- Extrinsic ligaments are between carpal bones & radius or metacarpal
- Stronger/stiffer than intrinsic ligaments
- Radiocapitate (Part of radiocarpal ligaments complex) is the primary stabilizer of distal carpal row on proximal side



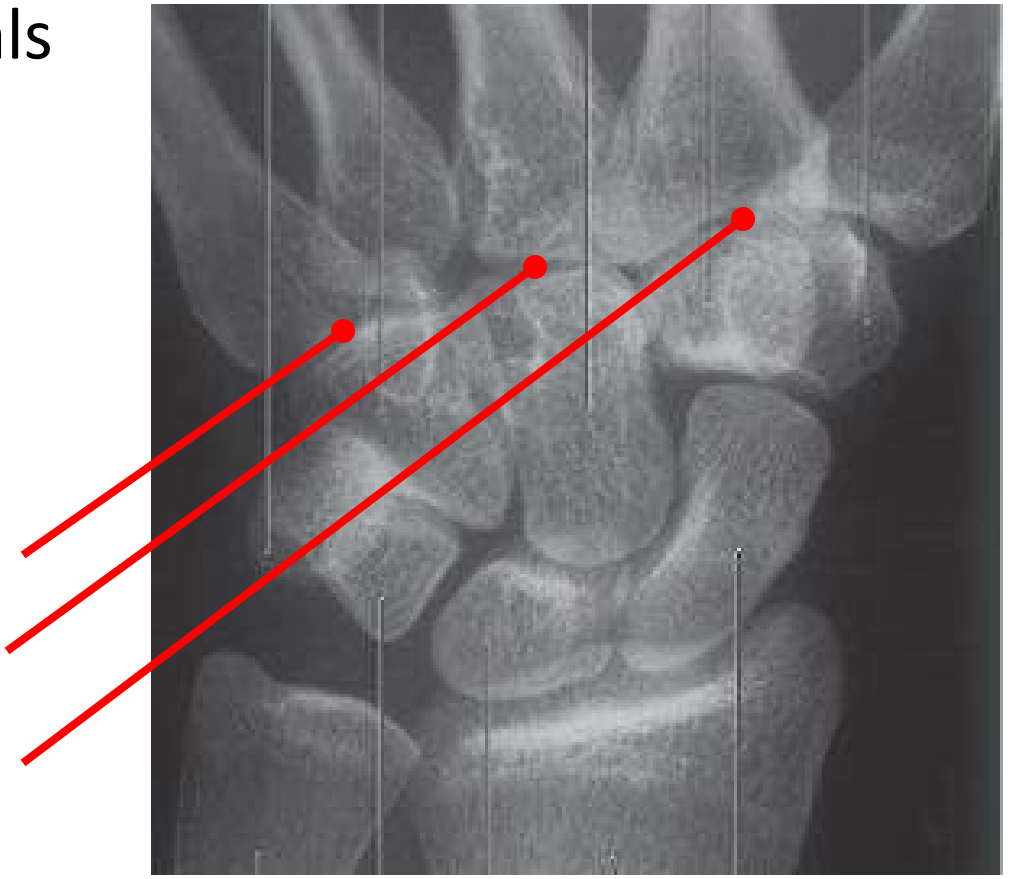
Intrinsic Ligamentous Anatomy

- Intrinsic ligaments originate and insert on the carpals
- Not as strong as extrinsic ligaments
- Capable of greater elongation than extrinsic ligaments



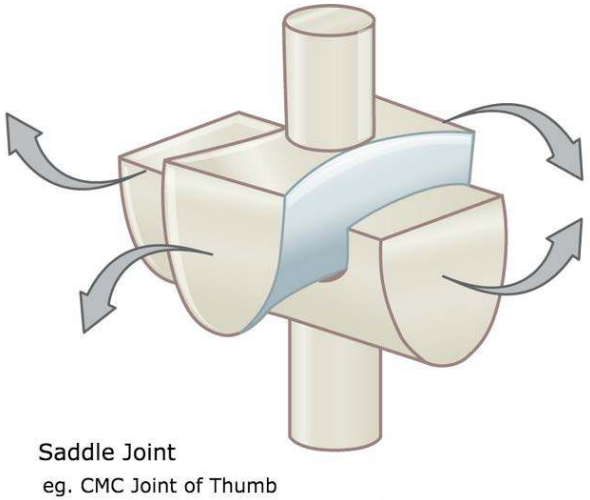
The Carpometacarpal Joints

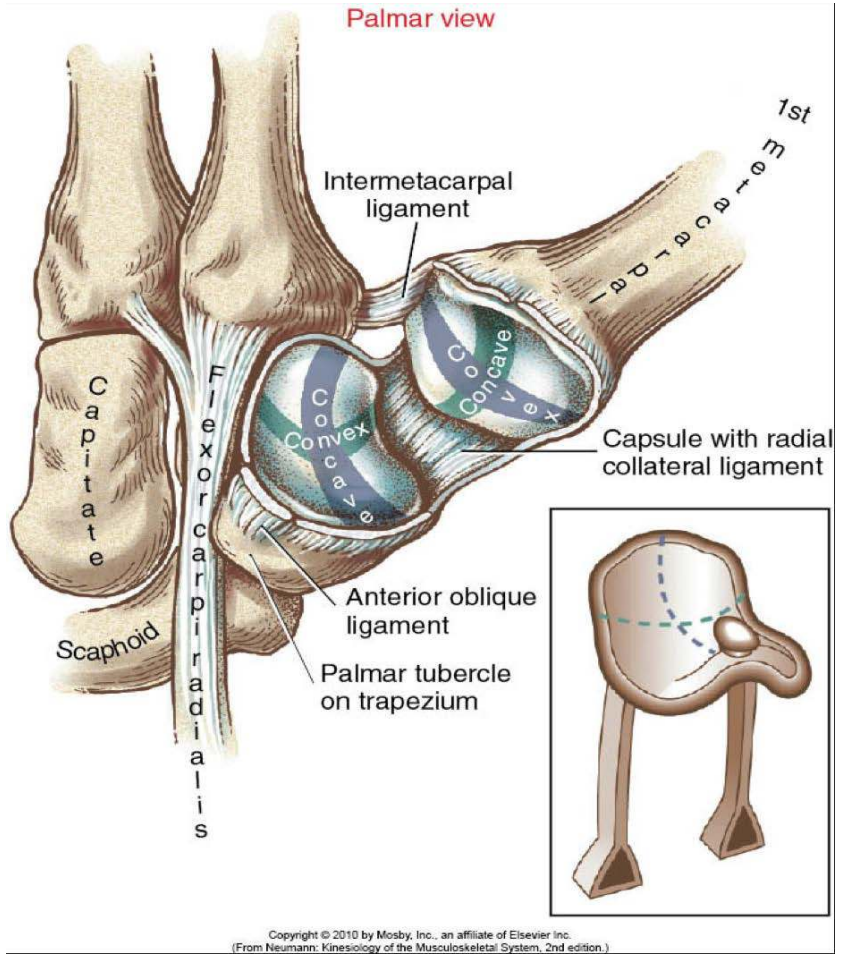
- Joints between the metacarpals and the related distal row of carpal bones
- Five in number
- First CMJ is radically different from the others



First Carpometacarpal Joint

- Also called trapeziometacarpal joint because it connects the trapezium to the 1st metacarpal
- Different from the others
- Saddle shaped synovial joint
- Movement is multiaxial:
  i. Flexion & extension
  ii. Abduction & adduction
  iii. Rotation and
  iv. Circumduction





Saddle joints

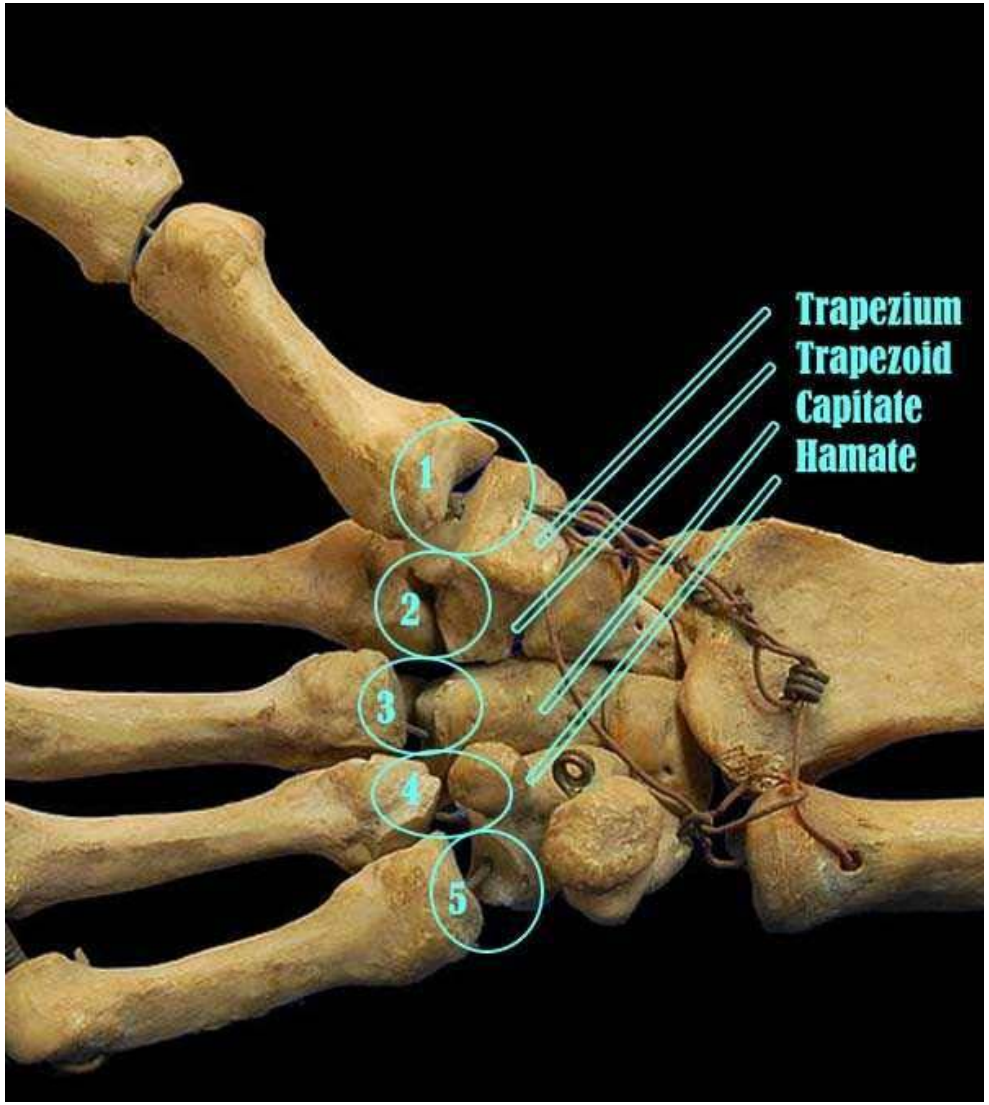
Saddle joints are a type of synovial joint that allow **articulation by reciprocal reception**. Both bones have concave-convex articular surfaces which interlock like two saddles opposed to one another.

Movements

- Saddle joints allow movement with **two degrees of freedom** much like condyloid joints. They allow flexion / extension, abduction / adduction and therefore also allow circumduction. Unlike ball and socket joints, saddle joints do not allow axial rotation.
    - flexion / extension
    - abduction / adduction
    - circumduction

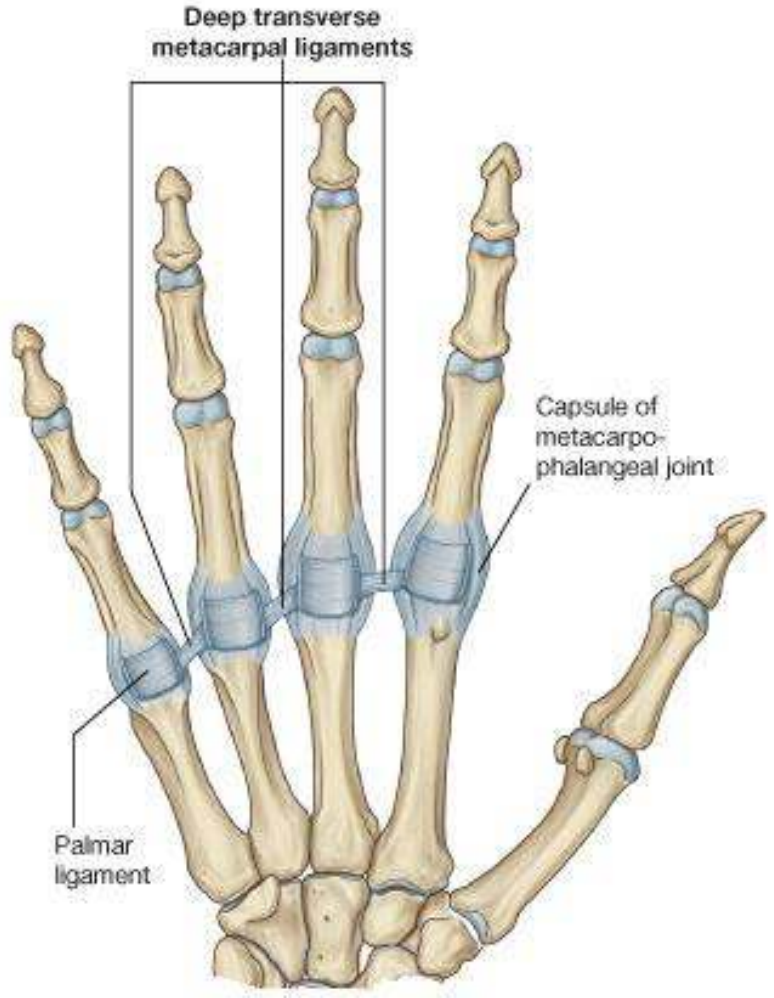
II-V Metacarpophalangeal Joints

- Joints between the distal heads of the metacarpals and the proximal phalanges of the digits
- Condyloid (Ellipsoidal) joints
- Forms a unified skeletal framework for the palm of the hand.
- Capsules are reinforced by the palmar ligament and by medial and lateral collateral ligaments.



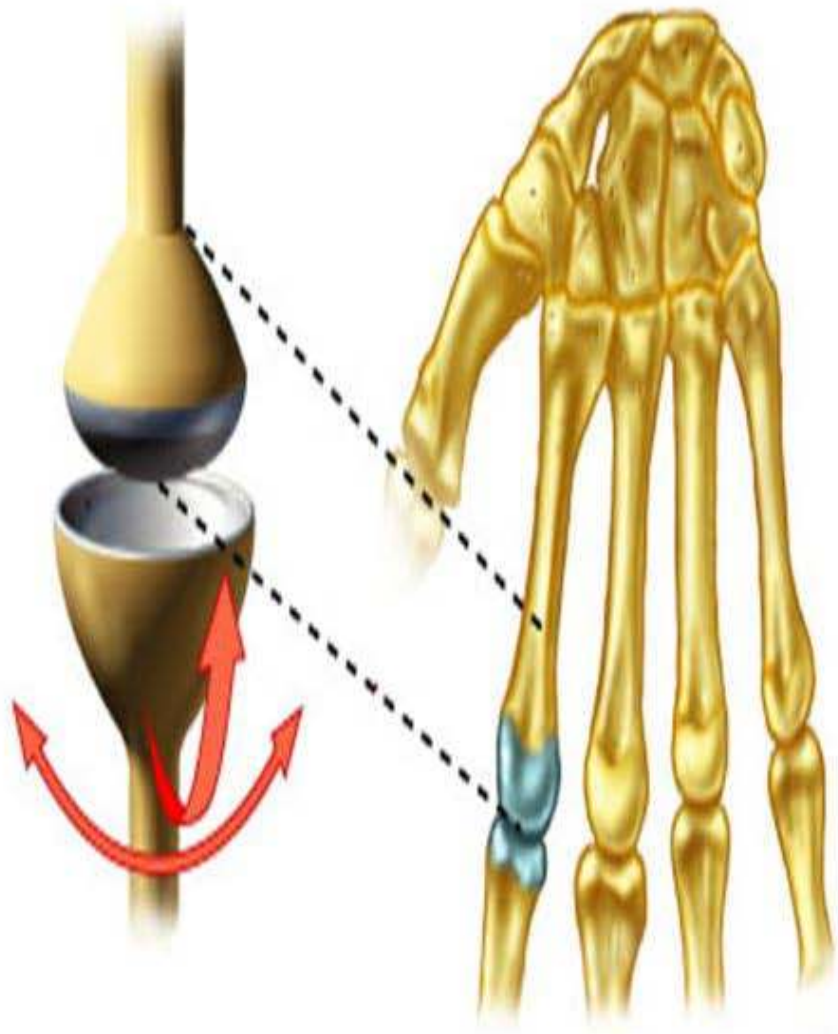
II-V Metacarpophalangeal Joints

- The three deep transverse metacarpal ligaments are thick bands of connective tissue connecting the palmar ligaments of the metacarpophalangeal joints of the fingers to each other
- Important because they restrict the movement of the bones relative to each other.
- Movements are flexion, extension, abduction, adduction, circumduction, and limited rotation



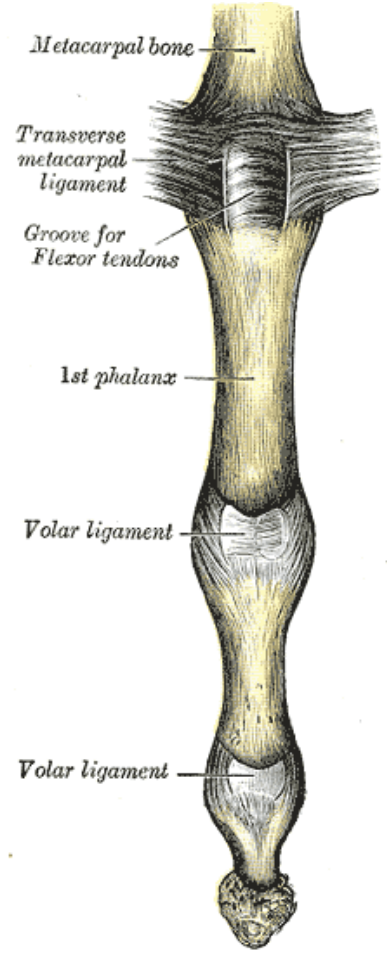
Condyloid (Ellipsoidal) Joints

- Oval articular surface of one bone fits into a complementary depression in another
- Both articular surfaces are oval
- Biaxial joints permit all angular motions
- Examples: radiocarpal (wrist) joints, and metacarpophalangeal (knuckle) joints



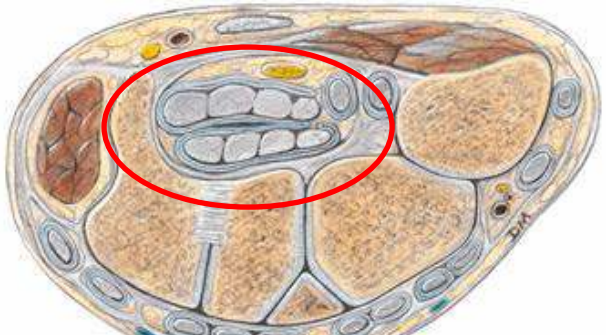
Interphalangeal joints

- Hinge joints
- Allow mainly flexion and extension.
- Reinforced by medial and lateral collateral ligaments and palmar ligaments.



Fascial structures of the hand

1. **Superficial fascia** (thick on palm, thin on dorsum)
2. **Flexor retinaculum**
   - Attaches to the pisiform and hamate medially
   - Attaches to the scaphoid and trapezium laterally
   - Forms the *carpal tunnel through which pass:*
     i. The tendon of *flexor carpi radialis in its own separate compartment*
     ii. The tendon of *flexor pollicis longus*
     iii. The 8 tendons of *flexor digitorum superficialis and flexor digitorum profundus*
     iv. The *median nerve*



Fascial structures of the hand

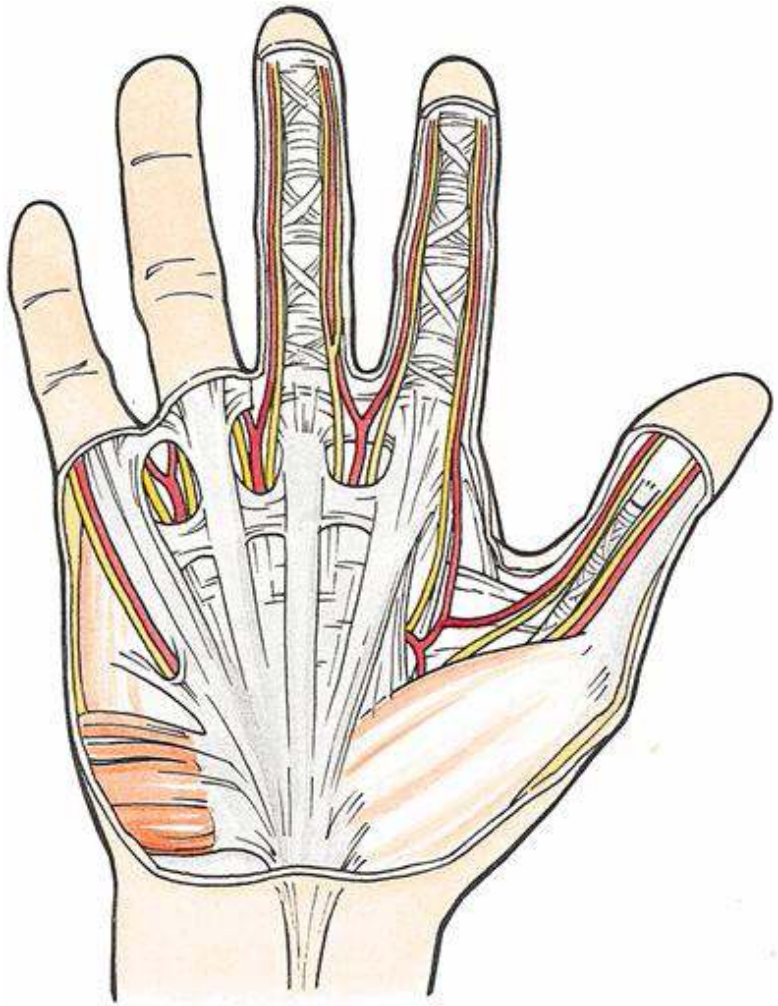
3. Extensor retinaculum

- Extensor tendons pass deep to the retinaculum in six separate compartments

Fascial structures of the hand

4. Palmar aponeurosis

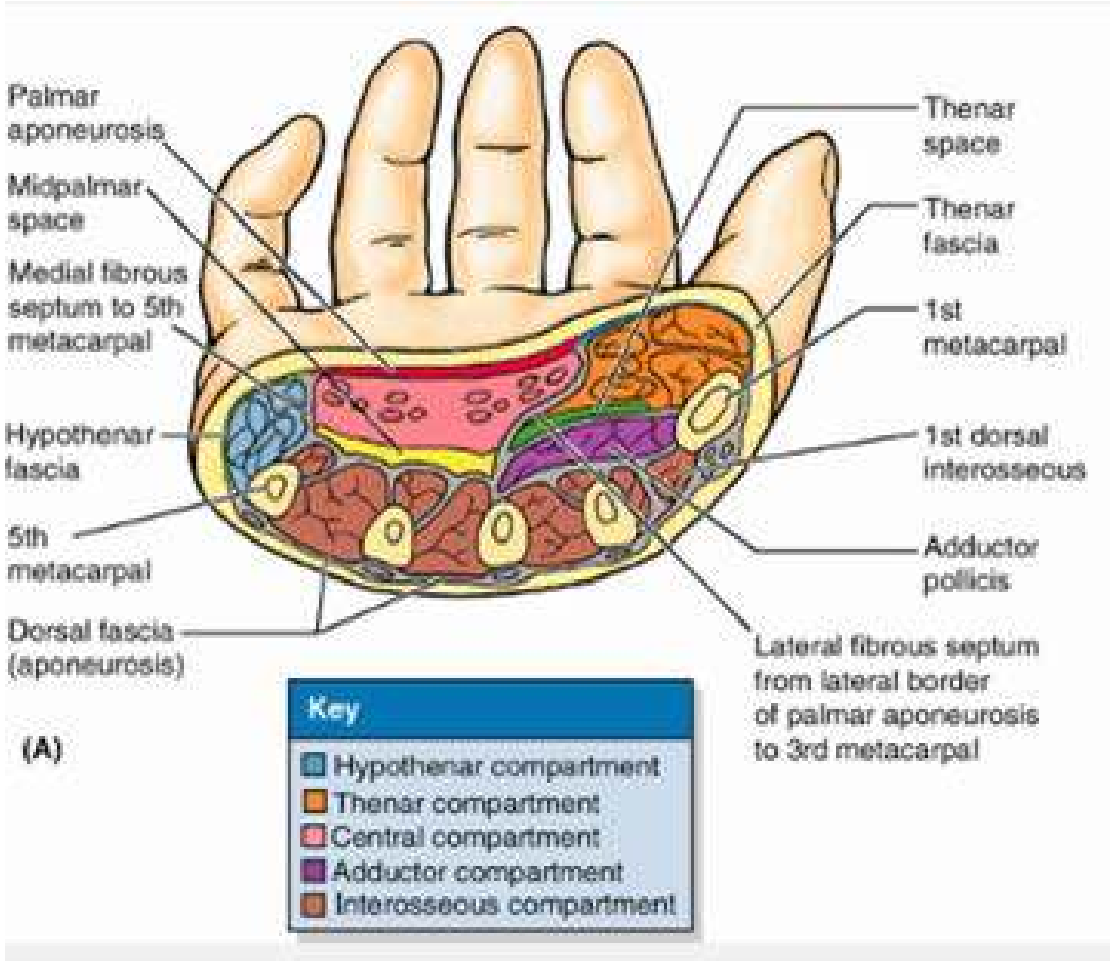
- Formed by the deep fascia
- Has four longitudinal thickenings passing to the four most medial digits. The thickenings are fasciculi of collagen fibers.
- The palmaris longus attaches to the aponeurosis



Fascial structures of the hand

5. Palmar fascial compartments

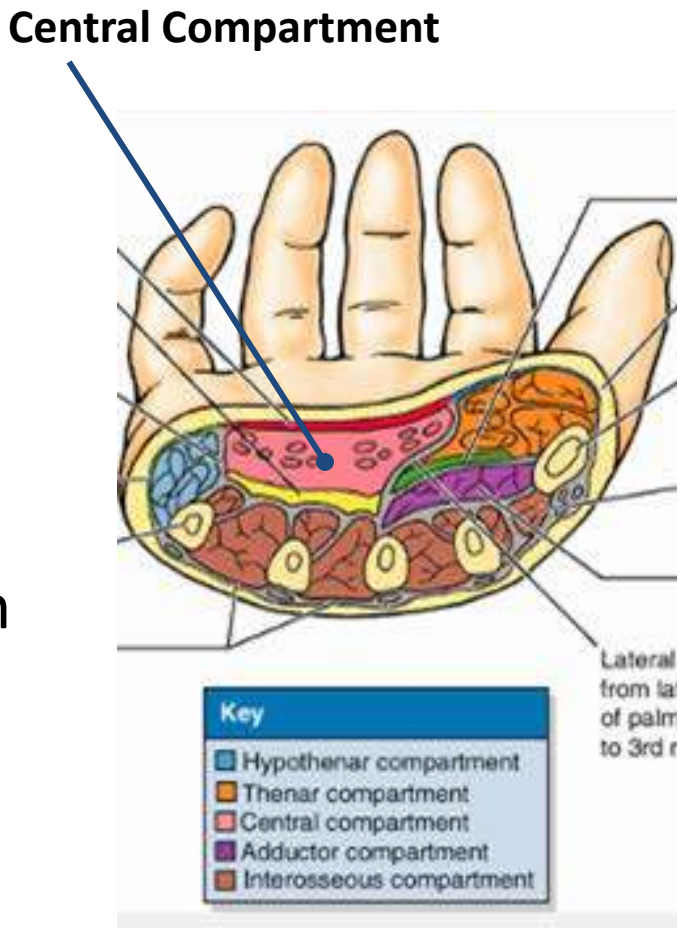
- Seven in number
- Separated from each other by connective tissue septa:
  - i. Central compartment
  - ii. Mid palmar space
  - iii. Thenar space
  - iv. Thenar compartment
  - v. Hypothenar Compartment
  - vi. Interosseous compartment
  - vii. Adductor compartment containing the adductor policis



Fascial structures of the hand

Central compartment

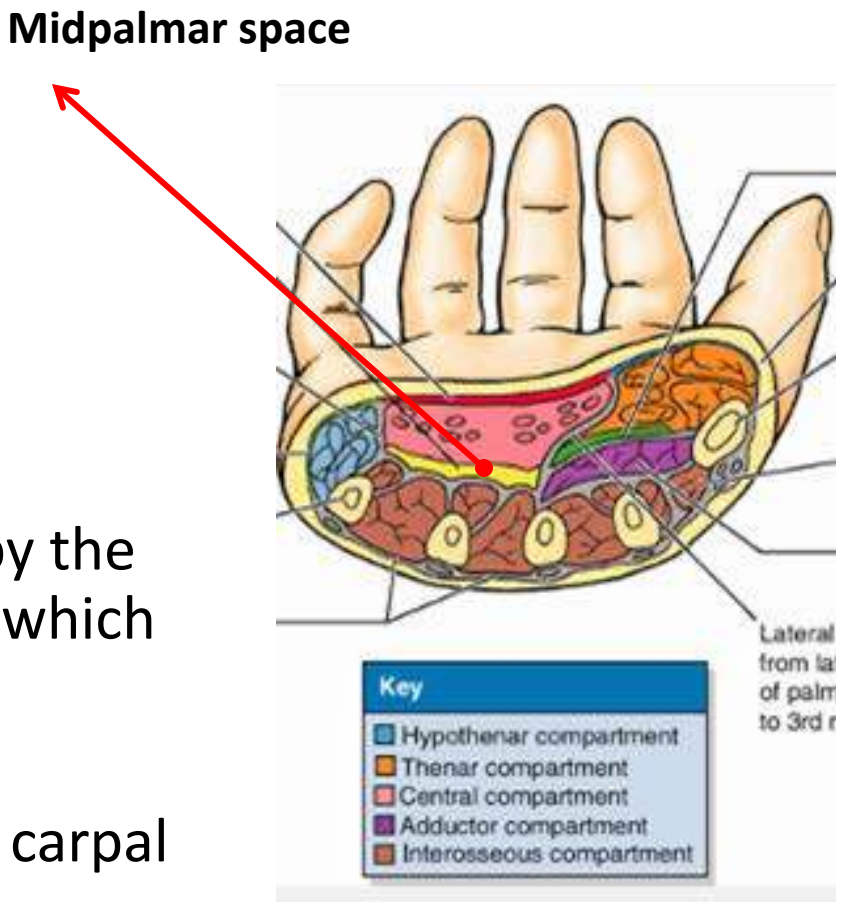
- Between the thenar and the hypothenar compartments
- Deep to palmar aponeurosis
- Superficial to the mid palmar space
- Separated from the thenar space by the lateral fibrous septum of the palm
- Contains:
  - flexor tendons
  - digital nerves
  - palmar arterial arches



Fascial structures of the hand

Mid Palmar space

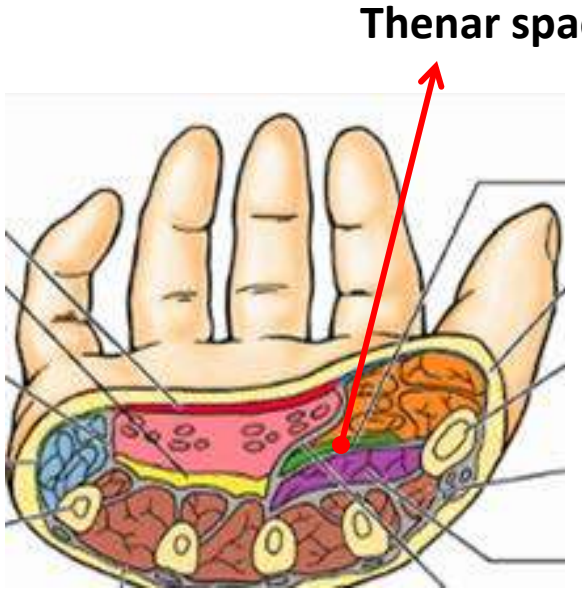
- This is a potential space
- Deep to the central compartment
- Superficial to the interosseous compartment containing the deep muscles of the palm
- Separated from the thenar space by the lateral fibrous septum of the palm which is strong and attached to the 3rd metacarpal
- Continues into the forearm via the carpal tunnel

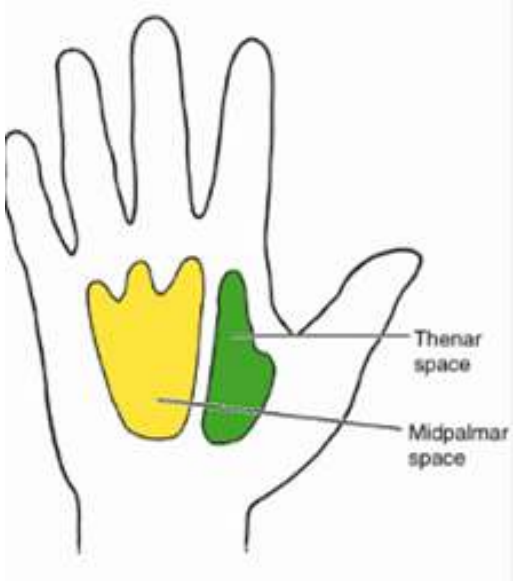


Fascial structures of the hand

Thenar Space

- This also, is a potential space
- Deep to the thenar compartment
- Superficial to adductor pollicis muscle in the adductor compartment
- Separated from both the midpalmar space and the central compartment by the lateral fibrous septum of the palm

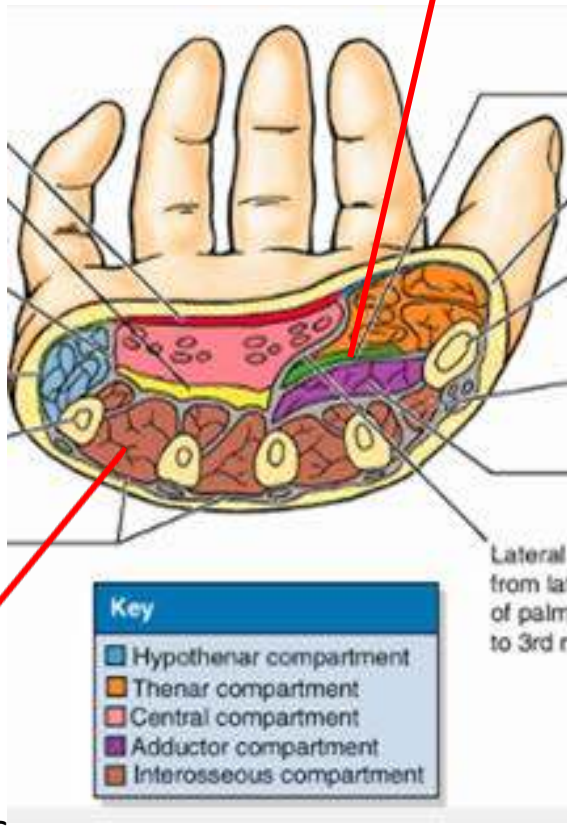




Fascial structures of the hand

The adductor compartment and the interosseus compartment

- Both spaces contain muscles only
- The interosseus compartment contains the interosseus muscles
- The adductor compartment contains the adductor pollicis

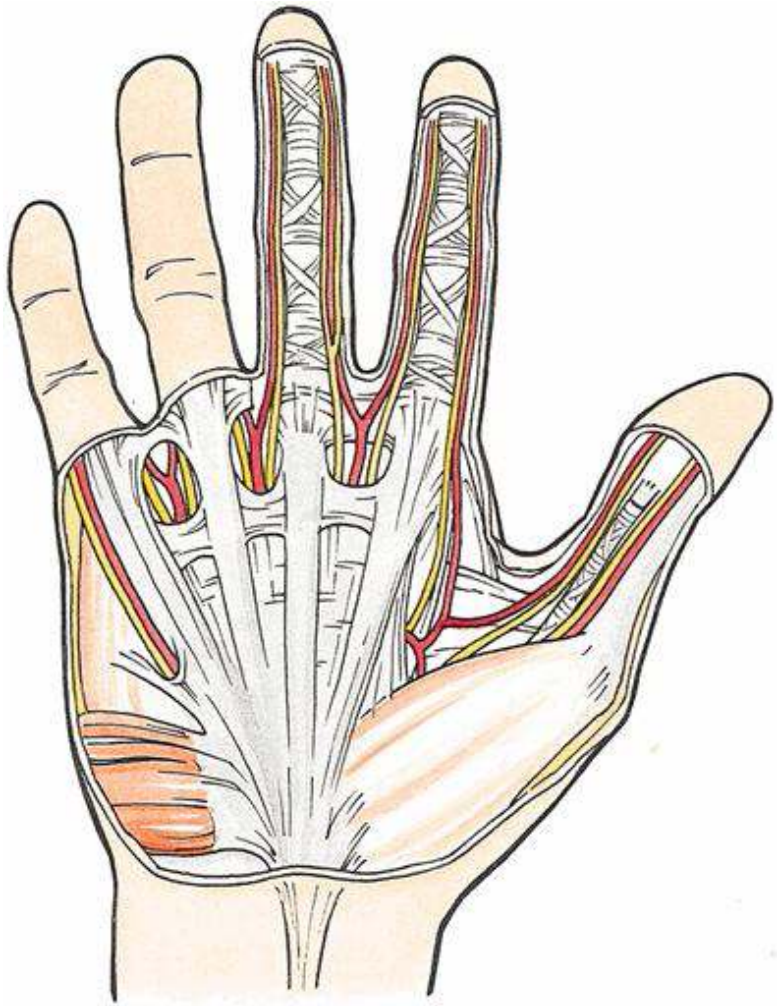


Adductor Compartment

Interosseus Compartment

Fascial structures of the hand

- **Thenar compartment**
  - Contents:
    - Thenar muscles
- **Hypothenar compartment**
  - Contents:
    - Hypothenar muscles



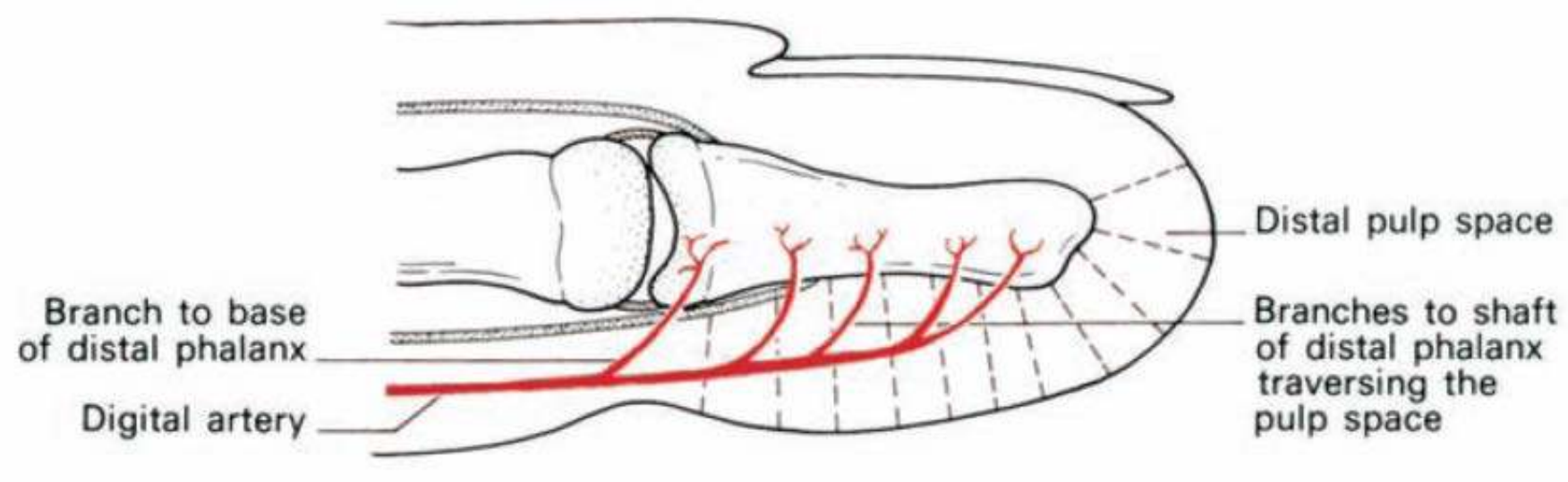
Fascial spaces of the hand

- Some of these spaces are potential
- Important because they may become infected and spread
- Six in number:
  i. The superficial pulp spaces of the fingers
  ii. The synovial tendon sheaths of the 2nd, 3rd and 4th fingers
  iii. The ulnar bursa
  iv. The radial bursa
  v. The midpalmar space
  vi. The thenar space

Fascial spaces of the hand

The superficial pulp spaces of the fingers

- A potential space filled with fatty tissue separated into septa by fibrous tissues passing from the skin to the periosteum of the distal phalanges of the digits
- When infected, pressure easily rises and leads to severe pain and thromboses of vessels



Fascial spaces of the hand

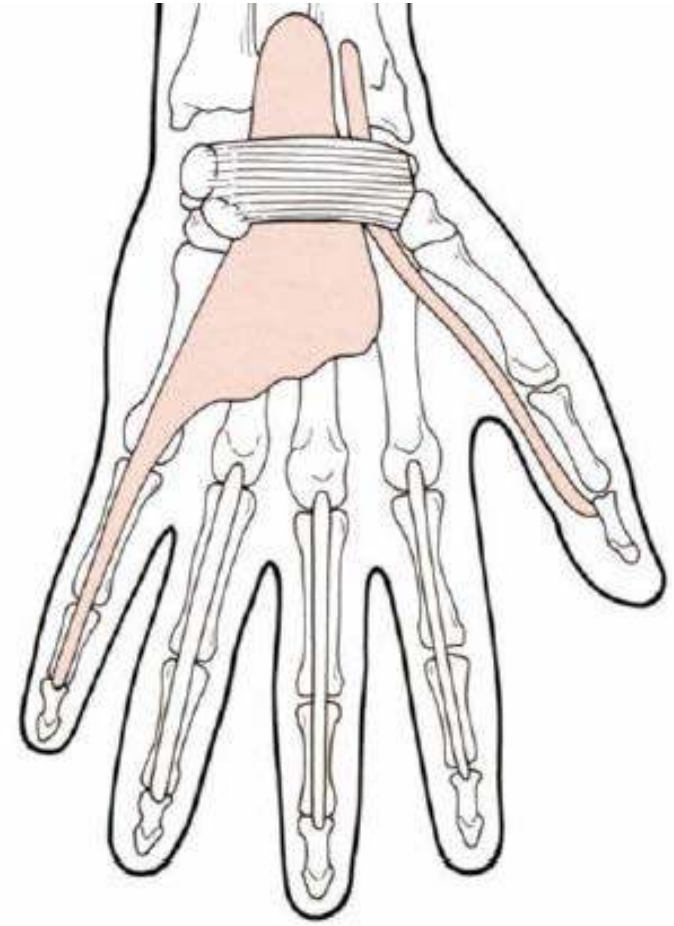
The synovial tendon sheaths of the 2nd, 3rd and 4th fingers

- The tendons of the 2nd, 3rd and 4th fingers have synovial sheaths which are closed off proximally at the metacarpal head

Fascial spaces of the hand

The Ulna and Radial bursa

- The radial bursa is the synovial sheath of the flexor pollicis longus which extends into the palm
- The ulnar bursa is the synovial sheath of the 5th finger which expands in the palm to enclose the tendons to the 2nd, 3rd, & 4th fingers.
- Both bursae communicates in about 50% of individuals. This may lead to spread of infections between them.
- Both extend proximally beneath the flexor retinaculum into the wrist and distal forearm



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