



Wrist and Hand Anatomy/Biomechanics

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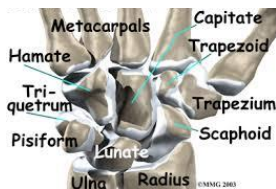
Anatomy - Hand

- The wrist
- The metacarpals
- The Phalanges
 - Digit 1 – thumb
 - Digit 5 – digiti minimi



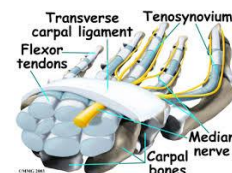
Osteology

- Proximal Row
 - Scaphoid
 - Tubercle – palpated on palmar surface
 - Lunate
 - Triquetrum (triangular bone)
 - *Pisiform
- Distal Row
 - Trapezium – Articulates w/ 1st MC
 - Trapezoid – Articulates w/ 2nd MC
 - Capitate – Articulates w/ 3rd MC
 - Hamate – Articulates w/ 4th & 5th MC
 - *Hook of Hamate



Carpal Arch

- The carpal bones form an arch, concave anteriorly
- The flexor retinaculum forms the roof of the carpal tunnel



Metacarpals

- Base
 - Articulate with carpals
 - Bases of MC bones of digits articulate with one another
- Body
- Head
 - Articulate with the proximal phalanges of the digits
- MC 1 - Thumb
- MC 2-5 – Associated with digits 2-5



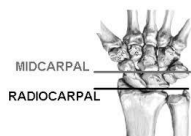
Phalanges

- Each Phalange
 - Base
 - Body
 - Head
- Proximal
- Middle
 - Thumb lacks a middle phalange
- Distal



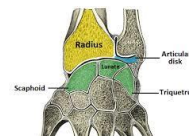
Joints of Wrist

- Radio-carpal
 - Proximal: distal surface of radius, radioulnar disc
 - Distal: scaphoid, lunate, triquetrum
- Mid-carpal
 - Proximal: 1st row of carpals - scaphoid, lunate, triquetrum
 - Distal: 2nd row of carpals - trapezium, trapezoid, capitate, hamate
 - Pisiform does not participate
- Inter-carpal
 - The synovial joints between the carpals
- The movements at these joints contribute to hand position



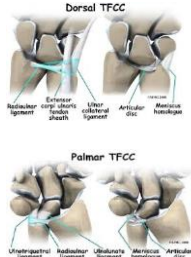
Radiocarpal Joint

- Classification
 - Synovial
 - Ellipsoidal/Modified Ovoid
 - Two degrees of movement
 - Flexion/Extension
 - Radial and ulnar deviation
 - Compound – more than one articular surface
 - Complex – due to presence of TFCC



TFCC

- **Triangular Fibrocartilage Complex (TFCC)**
 - Radioulnar disc
 - Connective Tissue Wedge
 - Attachments
 - Apex – On ulna, between styloid process and articular surface of the head
 - Base – Fans out, on radius, between ulnar notch and articular surface of the carpal bones
 - It expands the articular surface of the RC joint



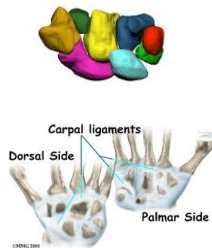
Midcarpal Joint

- **Classification**
 - Synovial
 - Modified ovoid – as a whole, convex on concave
 - Compound



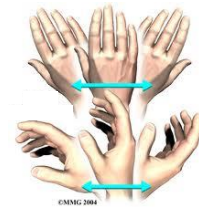
Intercarpal Joints

- **Classification**
 - Synovial
 - Modified ovoid
 - Planar
 - A lot of ligamentous support – not much movement
 - Assess/treat in volar/dorsal glide



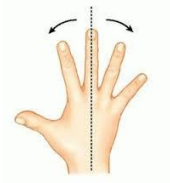
Wrist Motions

- **Frontal plane**
 - Radial deviation/abduction
 - Ulnar deviation/adduction
- **Sagittal plane**
 - Flexion
 - Extension



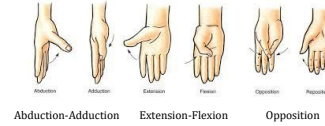
Finger Abduction/adducton

- Abduction and Adduction are defined using the long axis of the middle finger as a reference
- The 3rd digit only abducts (radial or ulnar)



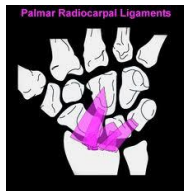
Thumb Movements

Movements of the thumb are at right angles to the movements of the other digits



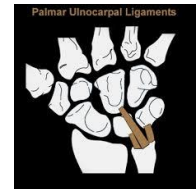
Wrist Ligaments (highlights)

- Palmar radiocarpal ligaments
 - Resist extension/palmar glide of carpals
 - To scaphoid, capitate, triquetral, lunate



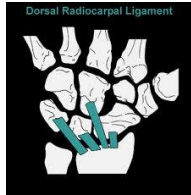
Wrist Ligaments

- Palmar Ulnocarpal ligaments
 - To lunate, triquetrum, and capitate



Wrist Ligaments

- Dorsal radiocarpal ligament
- Resists flexion/dorsal glide of carpals on the radius



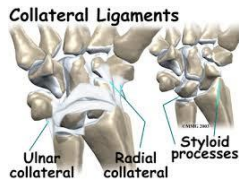
Wrist Ligaments

- Dorsal Intercarpal ligaments
- Palmar Intercarpal Ligaments



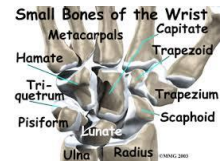
Wrist Ligaments

- Radial (lateral) collateral ligament
 - Resists varus stress to the wrist
- Ulnar (medial) collateral ligament
 - Resists valgus stress to the wrist



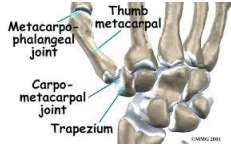
Carpometacarpal Joints (CMC)

- 5 CMC joints between the base of each MC and the distal carpal bones
- 1st CMC – 1st MC/Trapezium
- 2nd CMC – 2nd MC/Trapezoid
- 3rd CMC – 3rd MC/Capitate
- 4th CMC – 4th MC/Hamate
- 5th CMC – 5th MC/Hamate



1st CMC Joint

- Unique
- Synovial
- Saddle shape
- Unmodified sellar joint – allows 2 degrees of freedom
 - Sagittal plane – Abd/add. Convex MC on concave trapezium
 - Coronal plane – Flexion/extension. Concave 1st MC on convex trapezium
 - Combined Motion – opposition (circumduction)



1st Metacarpophalangeal Joint

- Synovial
- Modified ovoid
- Condylloid
- Compound
- 1 degree of freedom
 - Frontal plane: Flexion/Extension



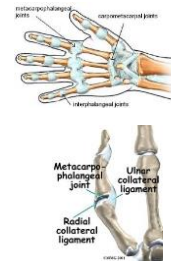
2nd-5th CMP Joints

- Synovial
- Ellipsoidal
- Modified ovoid
- Compound
- 2 Degrees of Freedom
 - Flexion/Ext
 - Abduction/Adduction



MCP Joints

- Palmar Ligament
- Medial Collateral Ligament
 - Resists valgus stress
- Lateral Collateral ligament
 - Resists varus stress



Interphalangeal (IP) Joints

- Synovial
- Modified ovoid
- Hinge joints
- 1 degree of freedom – Flex/ext
- 2nd degree – a little rotation in transverse plane in full fist



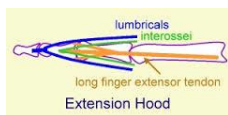
Palmar Fascia

- Deep fascia that covers the palm. Anchored to skin distally
- Apex is continuous w/ Palmaris longus tendon/flexor retinaculum
- Distal fibers to base of each digit
- Function: Protection of vessels, nerves, and tendons of the palm

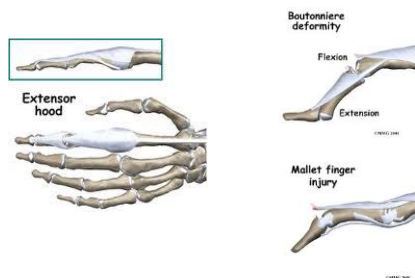


Extensor Hood

- Extensor digitorum extends and attaches to middle phalanx of each digit 2-5 by central tendon slip. If ruptured, lack of extension of proximal IP joint
- Medial and lateral wing tendons from intrinsics (lumbricals, interossei) of the hand extend dorsally to terminal tendon at distal phalanx. Rupture causes lack of ability to extend the DIP

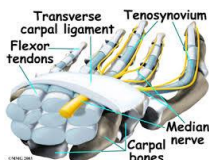


Extensor Hood



Carpal Tunnel

- Formed by the arch of the carpal bones and the flexor retinaculum (transverse carpal ligament)
- 4 tendons of the flexor digitorum profundus
- 4 tendons of the flexor digitorum superficialis
- Tendon of the flexor pollicis longus
- Median nerve



- Over the top of the tunnel
 - Ulnar artery
 - Ulnar nerve
 - Palmaris Longus tendon
 - Palmar cutaneous branch of median nerve



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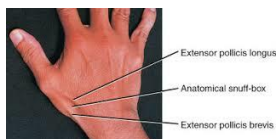
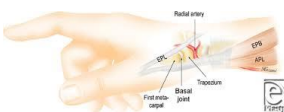


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Anatomical Snuff Box

- Base of triangle at the wrist and the apex in the thumb
- Lateral border – tendons of the abductor Pollicis Longus and the Extensor Pollicis Brevis
- Medial Border – tendons of the Extensor Pollicis Longus
- Floor Scaphoid and Trapezium – A great place to palpate these



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Muscles of the Hand Thenar Muscles

- Flexor pollicis brevis
- Abductor pollicis brevis
- Opponens pollicis
- Innervated by median n.
- Deep head of FPB also innervated by ulnar n.



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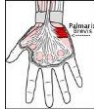


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Hypothenar Muscles

- Palmaris brevis
- Flexor digiti minimi brevis
- Abductor digiti minimi
- Opponens digiti minimi
- Innervated by ulnar n.



Intermediate Muscles

- Lumbricals
 - Dual innervation
 - 1,2: median n
 - 3,4: ulnar n
- Adductor pollicis
 - Ulnar n.



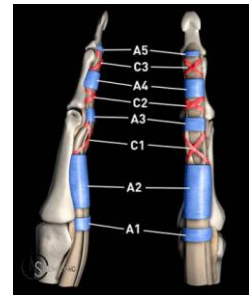
Deep Muscles

- Dorsal Interossei
 - 4 total
 - 3rd digit abducts medially and laterally
 - Thumb and 5th finger have separate abductors
- Palmar Interossei
 - 3 total
 - 3rd digit doesn't adductor
 - Thumb has it's own adductor



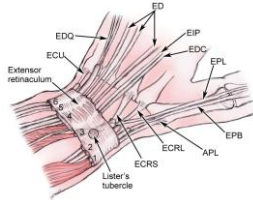
Flexor Tendon Pulleys

- A2 and A4 most important for finger function and prevent bowstringing
- A1 – Trigger Finger
- 9cm of flexor tendon excursion for wrist/finger flexion
- 2.5cm required for full finger flexion



Dorsal Compartments of Wrist/Hand

- I – APL/EPB
- II – ECRL/ECRB
- III – EPL
- IV – EI/EDC
- V – EDM
- VI – ECU



Biomechanics/Kinematics

- Flexion – 60% midcarpal, 40% radiocarpal
- Extension – 66% radiocarpal, 33% midcarpal
- Radial Deviation – Scaphoid/Lunate Volar Flexion
- Ulnar Deviation – Scaphoid/Lunate Palmer Flexion
- Distal row moves first, Proximal row follows
- Flexion – Distal row flexes and UD
- Extension – Distal row extends and RD
- RD – Distal row RD and extends, Proximal row UD and flexes
- UD – Distal row UD and flexes, Proximal row RD and extends



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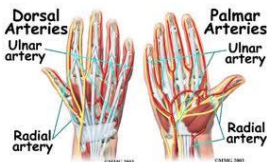


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Vasculature – Ulnar Artery

- Ulnar a/n enter the hand on the medial side of the wrist superficial to the flexor retinaculum
- Branches in the hand



Radial Artery

- Curves around the lateral side of the wrist
- Over the floor of the anatomical snuff box
- Between 2 heads of the 1st dorsal interossei
- Between the 2 heads of the adductor pollicis
- To the palm to form the deep palmar arch



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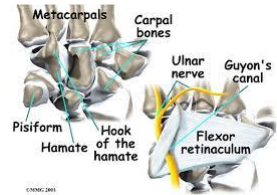
Veins

- Dorsal venous network drains the back of the hand
- Cephalic Vein – Radial side
- Basilic Vein – Medial side

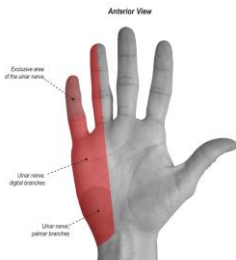


Innervation of the Hand – Ulnar Nerve

- Enters hand lateral to the pisiform with the ulnar a. in the Guyon's canal
- 2 branches
 - Superficial branch
 - Palmaris brevis
 - Cutaneous to palmar surface of the medial 1 ½ digits
 - Deep branch
 - Hypothenar muscles
 - DL, PL, AP and medial 2 lumbricals
 - Articular branches to the wrist

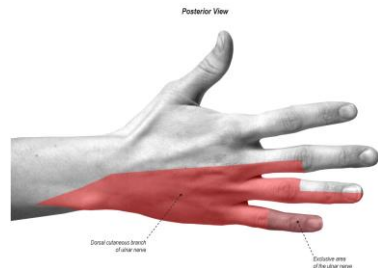


Cutaneous Distribution of Ulnar Nerve



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Cutaneous Distribution of Ulnar Nerve



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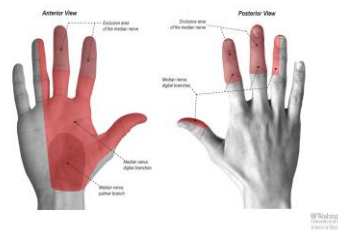
Median Nerve

- Enters hand through carpal tunnel
- 2 branches
 - Recurrent branch
 - Thenar muscles
 - Palmar digital branches
 - Skin on lateral 3 ½ digits on palmar surface and dorsal aspects of these digits distal to the DIP joints
- Innervates lateral 2 lumbricals



Radial Nerve – Superficial Branch

- Through anatomical snuffbox
- Innervates skin dorsal lateral 3 ½ digits distal to the DIP jts.



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