



Chapter 7 The Wrist and Hand Joints

Manual of Structural Kinesiology
R.T. Floyd, EdD, ATC, CSCS

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7-1

The Wrist & Hand Joints

- Many sports require precise functioning of wrist & hand
- Archery, bowling, golf, baseball, tennis, etc. require combined use of wrist & hand joints
- Relate functional anatomy to joint actions
 - flexion, extension, abduction, & adduction of wrist & hand
 - 29 bones
 - More than 25 joints
 - More than 30 muscles
 - 18 are intrinsic

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Bones

- 29 bones, including radius & ulna
 - 8 carpal bones in 2 rows of 4 bones form wrist
 - 5 metacarpal bones, numbered 1 to 5 from thumb to little finger, join the wrist bones
 - 14 phalanges (digits), 3 for each phalange except the thumb, which has only 2
 - Proximal, middle, & distal
 - Thumb has a sesamoid bone in its flexor tendon
 - Other sesamoids may occur in joints of fingers

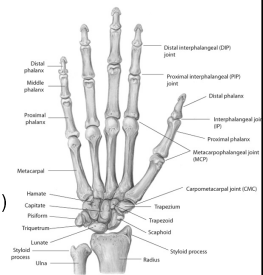
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Bones

Eight carpal bones

- Proximal row from radial to ulnar side
 - scaphoid (boat-shaped) or navicular
 - lunate (moon-shaped)
 - triquetrum (three-cornered)
 - pisiform (pea-shaped)



From Anthony CP, Kolthoff NF. *Textbook of anatomy and physiology*, ed 9. St Louis, 1975; Mosby.

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Bones

Eight carpal bones

- Distal row, from the radial to ulnar side
 - trapezium (greater multangular)
 - trapezoid (lesser multangular)
 - capitate (head-shaped)
 - hamate (hooked)

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Bones

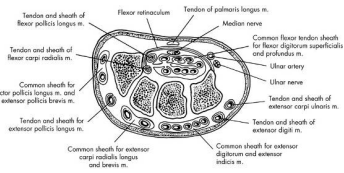
- Scaphoid most often injured
 - From falling on outstretched hand
 - Often dismissed as a sprain
 - Significant problem if not recognized & treated properly
 - Usually long period of precise immobilization or surgery

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Bones

- Carpal bones form a three-sided arch
 - concave on palmar side
 - bony arch is spanned by transverse carpal & volar carpal ligaments
 - creates the carpal tunnel
 - frequently a source of problems known as carpal tunnel syndrome

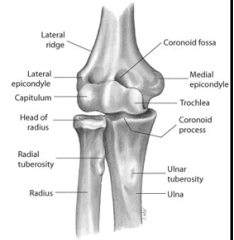


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Bones

- Medial epicondyle, medial condyloid ridge, & coronoid process - origin for many wrist & finger flexors
- Lateral epicondyle & lateral supracondylar ridge - origin for many wrist & finger extensors



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Bones

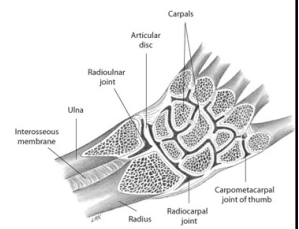
- Key distal bony landmarks for muscles involved in wrist motion
 - base of 2nd, 3rd, & 5th metacarpals, pisiform, & hamate
- Key bony landmarks for finger muscles
 - base of proximal, middle, & distal phalanxes
 - base of 1st metacarpal, proximal & distal phalanxes of thumb

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Joints

- Wrist joint
 - condyloid-type joint
 - allows flexion, extension, abduction, & adduction
 - motion occurs primarily between distal radius & proximal carpal row (scaphoid, lunate, & triquetrum)

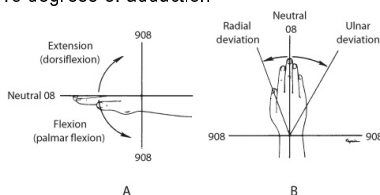


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Joints

- Wrist joint
 - 70 to 90 degrees of flexion
 - 65 to 85 degrees of extension
 - 15 to 25 degrees of abduction
 - 25 to 40 degrees of adduction

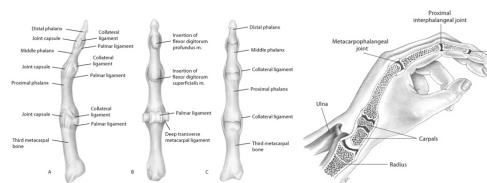


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Joints

- Each finger has 3 joints
 - Metacarpophalangeal (MCP) joints
 - Proximal interphalangeal (PIP) joints
 - Distal interphalangeal (DIP) joints



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Joints

- Each finger has 3 joints
 - Metacarpophalangeal (MCP) joints
 - Condylloid
 - 0 to 40 degrees of extension
 - 85 to 100 degrees of flexion

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Joints

- Each finger has 3 joints
 - Proximal interphalangeal (PIP) joints
 - Ginglymus
 - Full extension to 90 to 120 degrees of flexion

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Joints

- Each finger has 3 joints
 - Distal interphalangeal (DIP) joints
 - Ginglymus
 - Flex 80 to 90 degrees from full extension

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Joints

- Thumb has 2 joints
 - Metacarpophalangeal (MCP) joint
 - Full extension into 40 to 90 degrees of flexion
 - Ginglymus

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Joints

- Thumb has 2 joints
 - Interphalangeal (IP) joint
 - Flex 80 to 90 degrees
 - Ginglymus

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Joints

- Thumb has 2 joints
 - Carpometacarpal (CMC) joint of thumb
 - Unique saddle-type joint
 - 50 to 70 degrees of abduction
 - Flex 15 to 45 degrees & extend 0 to 20 degrees

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Movements

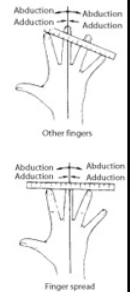
- Wrist
 - Flexion & extension
 - Abduction & adduction
- Fingers
 - Flex & extend
 - MCP joints also abduct & adduct

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Movements

- Middle phalange is reference point to differentiate abduction & adduction
 - Thumb, index & middle fingers abduct when they move laterally toward radial side of hand
 - Ring & little fingers adduction when they move medially toward ulnar side of hand
 - Medial movement of thumb, index & middle fingers toward ulnar side of hand is adduction
 - Lateral movement of ring & little finger toward radial side of hand is abduction

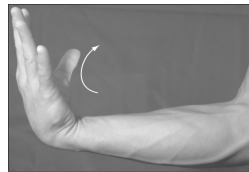


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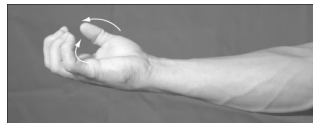
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Movements

- Flexion
 - movement of palm of hand and/or phalanges toward anterior or volar aspect of forearm



Wrist flexion



Flexion of fingers and thumb, opposition

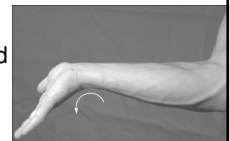
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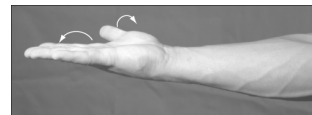
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Movements

- Extension
 - movement of back of hand and/or phalanges toward posterior or dorsal aspect of forearm



Wrist extension



Extension of fingers and thumb, reposition

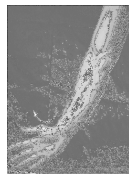
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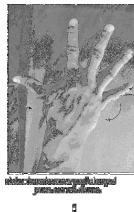
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Movements

- Abduction (radial flexion)
 - movement of thumb side of hand toward lateral aspect or radial side of forearm
 - Also, movement of fingers away from middle finger



Wrist abduction (radial deviation)



Abduction of fingers

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Movements

- Adduction (ulnar flexion)
 - movement of little finger side of hand toward medial aspect or ulnar side of forearm
 - Also, movement of fingers toward middle finger



Wrist adduction (ulnar deviation)



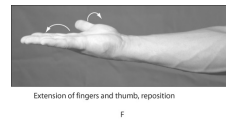
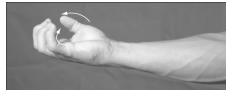
Adduction of fingers

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Movements

- **Opposition**
 - movement of thumb across palmar aspect to oppose any or all of the phalanges
- **Reposition**
 - movement of thumb as it returns to anatomical position from opposition with hand and/or fingers



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Muscles

Extrinsic muscles of wrist & hand grouped according to function & location

- 6 muscles move wrist but not fingers & thumb
 - 3 wrist flexors
 - flexor carpi radialis
 - flexor carpi ulnaris
 - palmaris longus
 - 3 wrist extensors
 - extensor carpi radialis longus
 - extensor carpi radialis brevis
 - extensor carpi ulnaris

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Muscles

- 9 muscles primary movers of phalanges
 - Also involved in wrist joint actions
 - Generally weaker in their wrist actions
 - Flexors
 - Flexor digitorum superficialis
 - Flexor digitorum profundus
 - Flexor pollicis longus (thumb flexor)

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Muscles

- Extensors
 - Extensor digitorum
 - Extensor indicis
 - Extensor digiti minimi
 - Extensor pollicis longus (thumb extensor)
 - Extensor pollicis brevis (thumb extensor)
- Abductor of thumb & wrist
 - Abductor pollicis longus

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Muscles

- All wrist flexors generally have their origins on anteromedial aspect of proximal forearm and medial epicondyle of humerus with insertions on anterior aspect of wrist & hand
- Median nerve & all flexor tendons except flexor carpi ulnaris & palmaris longus pass through carpal tunnel

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Muscles

- **Carpal tunnel syndrome**
 - Swelling & inflammation can cause increased pressure in carpal tunnel resulting in decreased function of median nerve leading to reduced motor & sensation function in its distribution
 - particularly common with repetitive use of the hand and wrist in manual labor and clerical work such as typing and keyboarding
 - Often, slight modifications in work habits and hand & wrist positions during these activities can be preventative
 - Flexibility exercises for the wrist & finger flexors may be helpful

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Muscles

- Wrist extensors generally have their origins on posterolateral aspect of proximal forearm & lateral humeral epicondyle with insertions located on posterior aspect of wrist & hand
- Flexor & extensor tendons immediately proximal to wrist are held in place on palmar & dorsal aspects by transverse bands of tissue known as flexor & extensor retinaculum to prevent the tendons from bowstringing during flexion & extension

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Muscles

- Wrist abductors
 - Generally cross wrist joint anterolaterally & posterolaterally to insert on radial side of hand
 - Flexor carpi radialis
 - Extensor carpi radialis longus
 - Extensor carpi radialis brevis
 - Abductor pollicis longus
 - Extensor pollicis longus
 - Extensor pollicis brevis

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Muscles

- Wrist adductors
 - cross wrist joint anteromedially & posteromedially to insert on ulnar side of hand
 - Flexor carpi ulnaris
 - Extensor carpi ulnaris

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Muscles

- Intrinsic hand muscles have origins & insertions on bones of hand
 - Radial side - four muscles of thumb
 - opponens pollicis
 - abductor pollicis brevis
 - flexor pollicis brevis
 - adductor pollicis
 - Ulnar side - three muscles of little finger
 - opponens digiti minimi
 - abductor digiti minimi
 - flexor digiti minimi brevis

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Muscles

- Intrinsic hand muscles
 - Remainder of hand - 11 different muscles
 - 4 lumbricals
 - 3 palmar interossei
 - 4 dorsal interossei

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Muscles

- Anteromedially at elbow & forearm and anterior at hand
 - Primarily wrist flexion
 - Flexor carpi radialis
 - Flexor carpi ulnaris
 - Palmaris longus

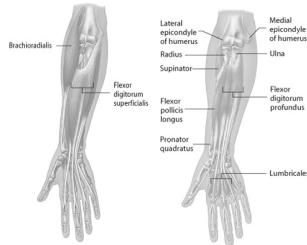


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Muscles

- Anteromedially at elbow & forearm and anterior at hand
 - Primarily wrist & phalangeal flexion
 - Flexor digitorum superficialis
 - Flexor digitorum profundus
 - Flexor pollicis longus

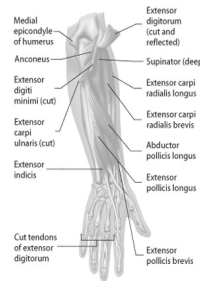


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Muscles

- Posterolaterally at elbow & forearm and posterior at hand
 - Primarily wrist extension
 - Extensor carpi radialis longus
 - Extensor carpi radialis brevis
 - Extensor carpi ulnaris

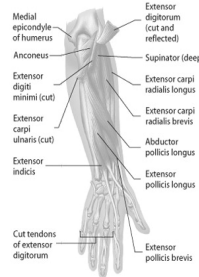


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Muscles

- Posterolaterally at elbow & forearm and posterior at hand
 - Primarily wrist & phalangeal extension
 - Extensor digitorum
 - Extensor indicis
 - Extensor digiti minimi
 - Extensor pollicis longus
 - Extensor pollicis brevis
 - Abductor pollicis longus

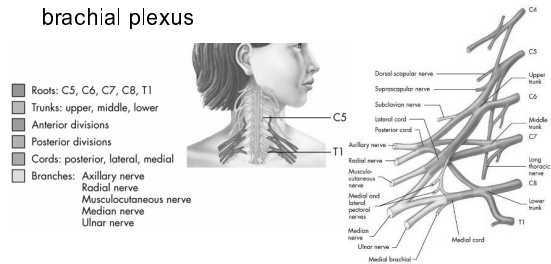


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Nerves

- All wrist & hand muscles are innervated from the radial, median, & ulnar nerves of the brachial plexus



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Nerves

- Radial nerve from C6, C7, & C8
 - Extensor carpi radialis brevis
 - Extensor carpi radialis longus
- Posterior interosseous nerve from radial nerve
 - Extensor carpi ulnaris
 - Extensor digitorum
 - Extensor digiti minimi
 - Abductor pollicis longus
 - Extensor pollicis longus
 - Extensor pollicis brevis
 - Extensor indicis

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Nerves

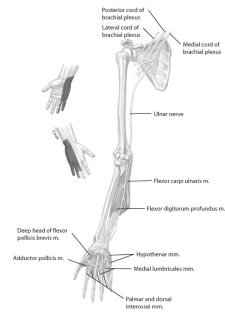
- Median nerve - arising from C6, C7, C8, & T1
 - Flexor carpi radialis
 - Palmaris longus
 - Flexor digitorum superficialis
- Anterior interosseous nerve from median nerve
 - Flexor digitorum profundus for index & long finger
 - Flexor pollicis longus
 - Intrinsic muscles
 - abductor pollicis brevis, flexor pollicis brevis (superficial head), opponens pollicis, and 1st & 2nd lumbrical

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Nerves

- Ulnar nerve - branching from C8 & T1
 - Flexor digitorum profundus for 4th & 5th fingers
 - Flexor carpi ulnaris

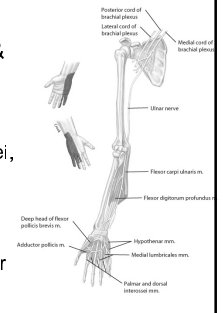


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Nerves

- Ulnar nerve - branching from C8 & T1
 - Remaining intrinsic muscles
 - flexor pollicis brevis (deep head), adductor pollicis, palmar interossei, dorsal interossei, 3rd & 4th lumbrical, opponens digiti minimi, abductor digiti minimi, & flexor digiti minimi brevis
 - Sensation to ulnar side of hand, ulnar one-half of ring finger & entire little finger

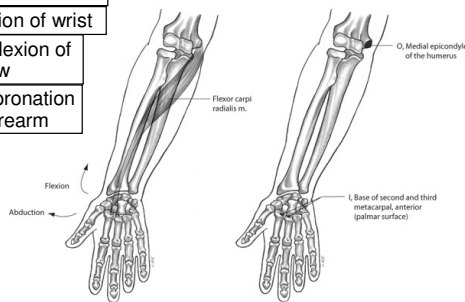


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Flexor Carpi Radialis Muscle

- Flexion of wrist
- Abduction of wrist
- Weak flexion of elbow
- Weak pronation of forearm

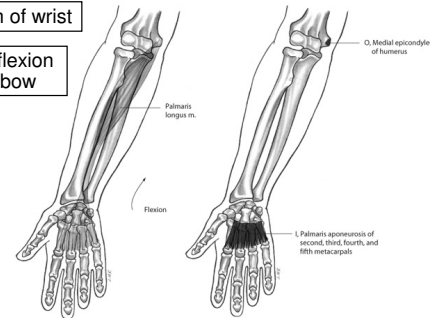


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Palmaris Longus Muscle

- Flexion of wrist
- Weak flexion of elbow

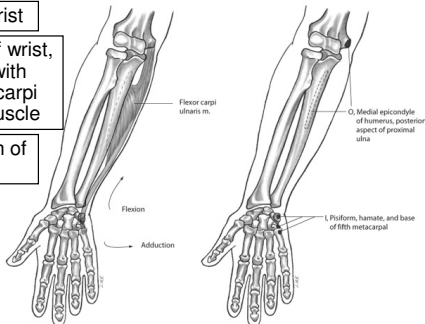


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Flexor Carpi Ulnaris Muscle

- Flexion of wrist
- Adduction of wrist, together with extensor carpi ulnaris muscle
- Weak flexion of elbow

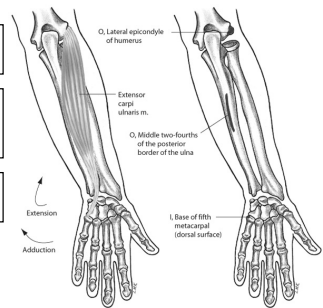


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Extensor Carpi Ulnaris Muscle

- Extension of wrist
- Adduction of wrist together with flexor carpi ulnaris muscle
- Weak extension of elbow



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Extensor Carpi Radialis Brevis Muscle

Extension of wrist

Abduction of wrist

Weak flexion of elbow

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Extensor Carpi Radialis Longus Muscle

Extension of wrist

Abduction of wrist

Weak flexion of elbow

Weak pronation to neutral from a fully supinated position

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Flexor Digitorum Superficialis Muscle

Flexion of fingers at metacarpophalangeal & proximal interphalangeal joints

Flexion of wrist

Weak flexion of elbow

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Flexor Digitorum Profundus Muscle

Flexion of 4 fingers at metacarpophalangeal, proximal interphalangeal, & distal interphalangeal joints

Flexion of wrist

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Flexor Pollicis Longus Muscle

Flexion of thumb carpometacarpal, metacarpophalangeal, & interphalangeal joints

Flexion of wrist

Abduction of wrist

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Extensor Digitorum Muscle

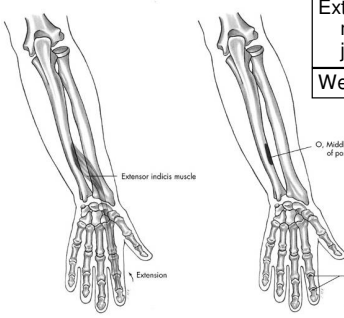
Extension of 2nd, 3rd, 4th, & 5th phalanges at metacarpophalangeal joints

Extension of wrist

Weak extension of elbow

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Extensor Indicis Muscle



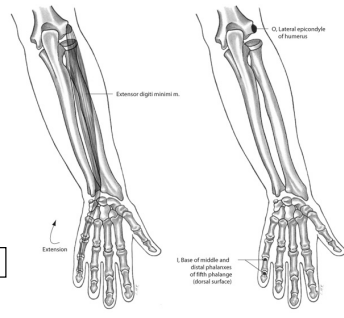
Extension of index finger at metacarpophalangeal joint

Weak wrist extension

Weak supination of forearm from a pronated position

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Extensor Digiti Minimi Muscle



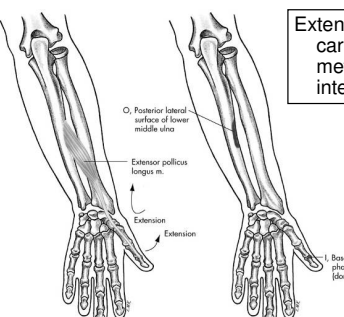
Extension of little finger at metacarpophalangeal joint

Weak wrist extension

Weak elbow extension

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Extensor Pollicis Longus Muscle



Extension of thumb at carpometacarpal, metacarpophalangeal, & interphalangeal joint

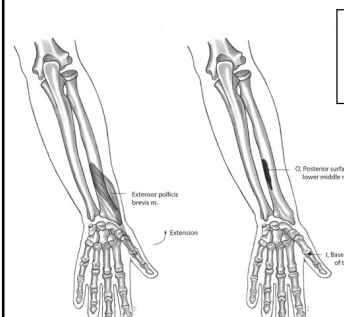
Extension of wrist

Abduction of wrist

Weak supination of forearm from a pronated position

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Extensor Pollicis Brevis Muscle



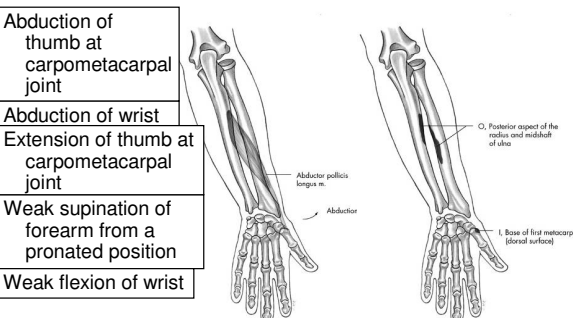
Extension of thumb at carpometacarpal & metacarpophalangeal joints

Weak wrist extension

Wrist abduction

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Abductor Pollicis Longus Muscle



Abduction of thumb at carpometacarpal joint

Abduction of wrist

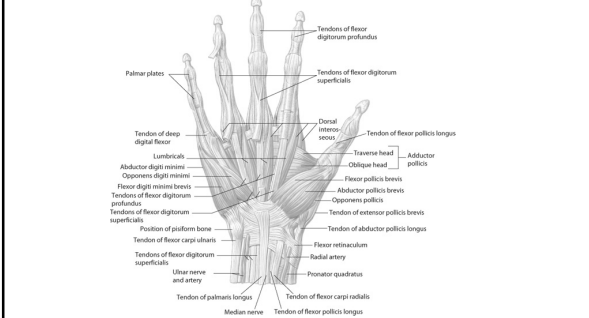
Extension of thumb at carpometacarpal joint

Weak supination of forearm from a pronated position

Weak flexion of wrist

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Intrinsic Muscles of the Hand



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Intrinsic Muscles of the Hand

- Thenar eminence - muscular pad on palmar surface of 1st metacarpal
 - abductor pollicis brevis
 - opponens pollicis
 - flexor pollicis brevis
 - adductor pollicis

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Intrinsic Muscles of the Hand

- Hypothenar eminence - muscular pad that forms ulnar border on palmar surface
 - abductor digiti minimi
 - flexor digiti minimi brevis
 - opponens digiti minimi
- Intermediate muscles
 - three palmar interossei
 - four dorsal interossei
 - four lumbrical muscles

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Intrinsic Muscles of the Hand

- Four muscles act on CMC of thumb
 - opponens pollicis - opposition in thumb metacarpal
 - abductor pollicis brevis & flexor pollicis brevis abduct thumb metacarpal
 - flexor pollicis brevis flexes thumb metacarpal
 - adductor pollicis adducts thumb metacarpal
 - flexor pollicis brevis & adductor pollicis flex proximal phalanx of thumb

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Intrinsic Muscles of the Hand

- Three palmar interossei
 - adduct the 2nd, 4th, & 5th phalanges
- Four dorsal interossei
 - flex & abduct index, middle, & ring proximal phalanges
 - assist with extension of middle & distal phalanges of index, middle, & ring fingers
- Third dorsal interossei
 - adducts middle finger

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Intrinsic Muscles of the Hand

- Four lumbricales
 - flex index, middle, ring, & little proximal phalanges
 - extend middle & distal phalanges of index, middle, ring, & little fingers.
- Three muscles act on little finger
 - opponens digiti minimi causes opposition of little finger metacarpal
 - abductor digiti minimi abducts 5th metacarpal
 - flexor digiti minimi brevis flexes 5th metacarpal

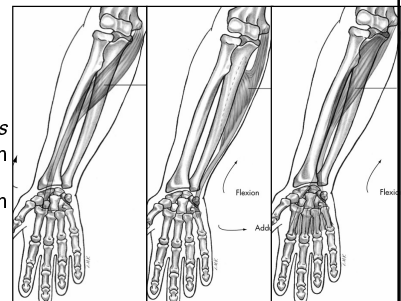
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7-65

Wrist Flexion

• Agonists

- *Flexor carpi radialis*
- *Flexor carpi ulnaris*
- *Palmaris longus*
- *Flexor digitorum superficialis*
- *Flexor digitorum profundus*
- *Flexor pollicis longus*



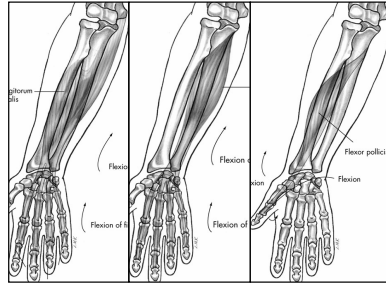
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7-66

Wrist Flexion

• Agonists

- Flexor carpi radialis
- Flexor carpi ulnaris
- Palmaris longus
- Flexor digitorum superficialis
- Flexor digitorum profundus
- Flexor pollicis longus



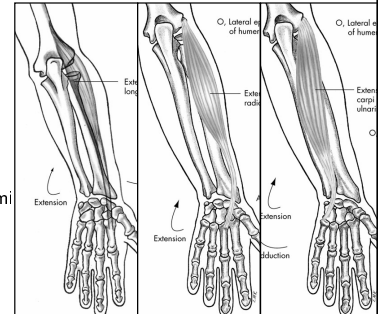
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Wrist Extension

• Agonists

- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor carpi ulnaris
- Extensor digitorum
- Extensor indicis
- Extensor digiti minimi
- Extensor pollicis longus
- Extensor pollicis brevis



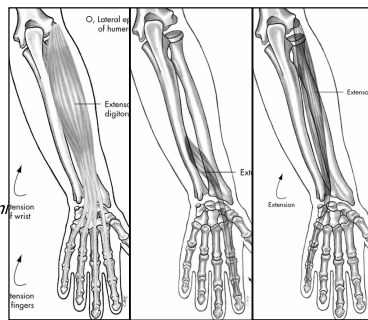
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Wrist Extension

• Agonists

- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor carpi ulnaris
- Extensor digitorum
- Extensor indicis
- Extensor digiti minimi
- Extensor pollicis longus
- Extensor pollicis brevis



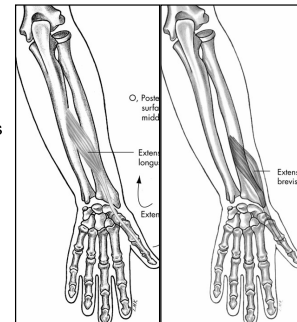
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Wrist Extension

• Agonists

- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor carpi ulnaris
- Extensor digitorum
- Extensor indicis
- Extensor digiti minimi
- Extensor pollicis longus
- Extensor pollicis brevis



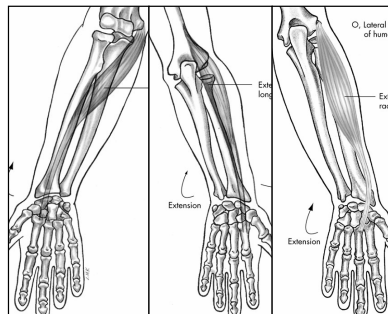
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Wrist Abduction

• Agonists

- Flexor carpi radialis
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Abductor pollicis longus
- Extensor pollicis longus
- Extensor pollicis brevis



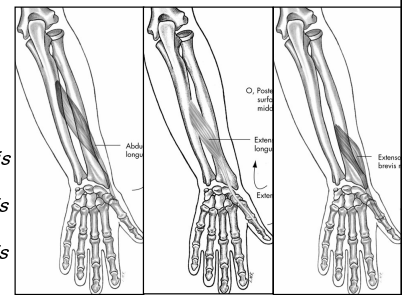
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Wrist Abduction

• Agonists

- Flexor carpi radialis
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Abductor pollicis longus
- Extensor pollicis longus
- Extensor pollicis brevis

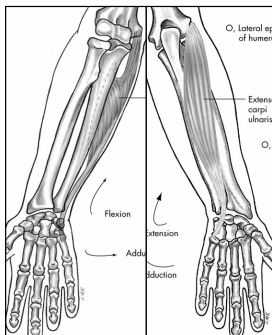


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Wrist Adduction

- Agonists
 - Flexor carpi ulnaris
 - Extensor carpi ulnaris

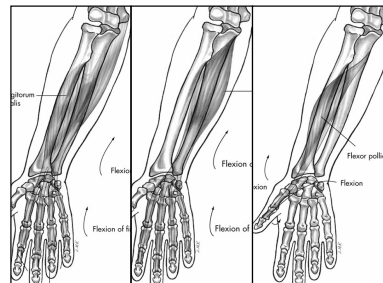


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Phalangeal Flexion

- Agonists
 - Flexor digitorum superficialis
 - Flexor digitorum profundus
 - Flexor pollicis longus

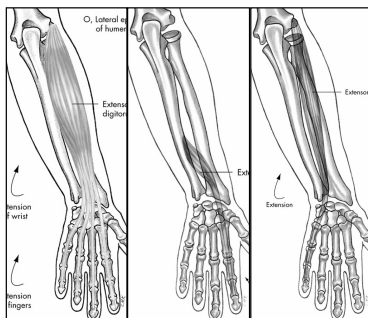


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Phalangeal Extension

- Agonists
 - Extensor digitorum
 - Extensor indicis
 - Extensor digiti minimi
 - Extensor pollicis longus
 - Extensor pollicis brevis

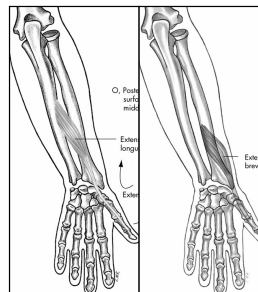


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Phalangeal Extension

- Agonists
 - Extensor digitorum
 - Extensor indicis
 - Extensor digiti minimi
 - Extensor pollicis longus
 - Extensor pollicis brevis



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Web Sites

Radiologic Anatomy Browser

<http://radlinux1.usuf1.usuhs.mil/rad/iong/index.html>
 – This site has numerous radiological views of the musculoskeletal system.

University of Arkansas Medical School Gross Anatomy for Medical Students

<http://anatomy.uams.edu/anatomyhtml/grossresources.html>
 – Dissections, anatomy tables, atlas images, links, etc.

Loyola University Medical Center: Structure of the Human Body

www.meddean.luc.edu/lumen/MedEd/GrossAnatomy/GA.html
 – An excellent site with many slides, dissections, tutorials, etc., for the study of human anatomy

Wheeless' Textbook of Orthopaedics

www.wheelessonline.com/
 – This site has an extensive index of links to the fractures, joints, muscles, nerves, trauma, medications, medical topics, lab tests, and links to orthopedic journals and other orthopedic and medical news.

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Web Sites

Arthroscopy.Com

www.arthroscopy.com/sports.htm
 – Patient information on various musculoskeletal problems of the upper and lower extremity

Premiere Medical Search Engine

<http://www.medsite.com/Default.asp?bhcp=1>
 – This site allows the reader to enter any medical condition and it will search the net to find relevant articles.

Virtual Hospital

www.vh.org
 – Numerous slides, patient information, etc.

Medical Multimedia Group

www.healthpages.org/AHP/LIBRARY/HLTHTOP/CTD/
 – A Patient's Guide to Cumulative Trauma Disorder(CTD)

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Web Sites

Medical Multimedia Group

www.healthpages.org/AHP/LIBRARY/HLHTOP/CTS/ctsndx.htm
– A Patient's Guide to Carpal Tunnel Syndrome

Physioroom.com

www.physioroom.com/injuries/arm/index.shtml
– Articles on hand and wrist injuries

Dartmouth Medical School

www.dartmouth.edu/~anatomy/wrist-hand/muscles/
– Muscles of the wrist and hand

American Academy of Orthopaedic Surgeons

<http://orthoinfo.aaos.org/category.cfm?topcategory=Arm>
– Patient Education Library on the Hand

MayoClinic.com

www.mayoclinic.com/invoke.cfm?id=AR00030
– Hand exercises for people with arthritis

Web Sites

American Society for Surgery of the Hand

http://www.assh.org/Content/NavigationMenu/PatientsPublic/HandConditions/ExtensorTendonInjuries/Extensor_Tendon_Inj.htm
– Extensor Tendon Injuries