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

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

Eight carpal bones

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

Eight carpal bones

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

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
Bones

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

Joints

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

Joints

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

Joints

- 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

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

Joints

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

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

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

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

- Interphalangeal (IP) joint
  - Flex 80 to 90 degrees
  - Ginglymus

- 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

Movements

- Wrist
  - Flexion & extension
  - Abduction & adduction

- Fingers
  - Flex & extend
  - MCP joints also abduct & adduct
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 abduction 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 adduction

Movements

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

Movements

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

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

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

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
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

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)

Muscles
– Extensors
  • Extensor digitorum
  • Extensor indicis
  • Extensor digit minimi
  • Extensor pollicis longus (thumb extensor)
  • Extensor pollicis brevis (thumb extensor)
– Abductor of thumb & wrist
  – Abductor pollicis longus

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
• 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

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

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
Muscles

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

- **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

- **Intrinsic hand muscles** have origins & insertions on bones of hand
  - **Radial side** - four muscles of thumb
    - Flexor carpi radialis
    - Flexor carpi ulnaris
    - Palmaris longus
  - **Anteromedially at elbow & forearm and anterior at hand**
    - Primarily wrist flexion
      - Flexor digitorum superficialis
      - Flexor digitorum profundus
      - Flexor pollicis longus
  - **Posterolaterally at elbow & forearm and posterior at hand**
    - Primarily wrist extension
      - Extensor carpi radialis longus
      - Extensor carpi radialis brevis
      - Extensor carpi ulnaris
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

Nerves

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

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

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

Nerves

• Ulnar nerve - branching from C8 & T1
  - Flexor digitorum profundus for 4th & 5th fingers
  - Flexor carpi ulnaris
• 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, & flexor digiti minimi brevis
  - Sensation to ulnar side of hand, ulnar one-half of ring finger & entire little finger
Flexor Carpi Radialis Muscle

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

Palmaris Longus Muscle

- Flexion of wrist
- Weak flexion of elbow

Flexor Carpi Ulnaris Muscle

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

Extensor Carpi Ulnaris Muscle

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

Extensor Carpi Radialis Brevis Muscle

- Extension of wrist
- Abduction of wrist
- Weak extension of elbow

Extensor Carpi Radialis Longus Muscle

- Extension of wrist
- Abduction of wrist
- Weak extension of elbow
Flexor Digitorum Superficialis Muscle
- Flexion of fingers at metacarpophalangeal & proximal interphalangeal joints
- Flexion of wrist
- Weak flexion of elbow

Flexor Digitorum Profundus Muscle
- Flexion of 4 fingers at metacarpophalangeal, proximal interphalangeal, & distal interphalangeal joints
- Flexion of wrist

Flexor Pollicis Longus Muscle
- Flexion of thumb carpometacarpal, metacarpophalangeal, & interphalangeal joints
- Flexion of wrist

Extensor Digitorum Muscle
- Extension of 2nd, 3rd, 4th, & 5th phalanges at metacarpophalangeal joints
- Extension of wrist
- Weak extension of elbow

Extensor Indicis Muscle
- Extension of index finger at metacarpophalangeal joint
- Weak wrist extension

Extensor Digiti Minimi Muscle
- Extension of little finger at metacarpophalangeal joint
- Weak wrist extension
Extensor Pollicis Longus Muscle
- Extension of wrist
- Extension of thumb

Extensor Pollicis Brevis Muscle
- Extension of thumb at metacarpophalangeal joint
- Weak wrist extension

Abductor Pollicis Longus Muscle
- Abduction of thumb at carpometacarpal joint
- Abduction of wrist

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

- 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
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

Intrinsic Muscles of the Hand

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

Intrinsic Muscles of the Hand

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

Wrist Flexion

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

Wrist Extension

- Agonists
  - Extensor carpi radialis longus
  - Extensor carpi radialis brevis
  - Extensor carpi ulnaris
  - Extensor digitorum
  - Extensor indicis
  - Extensor digitii minimi
  - Extensor pollicis longus
  - Extensor pollicis brevis
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

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

Wrist Abduction

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

Wrist Abduction

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

Wrist Adduction

- Agonists
  - Flexor carpi ulnaris
  - Extensor carpi ulnaris

Phalangeal Flexion

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

• Agonists
  – Extensor digitorum
  – Extensor indicis
  – Extensor digiti minimi
  – Extensor pollicis longus
  – Extensor pollicis brevis

Web Sites

Anatomy & Physiology Tutorials
www.gwc.maricopa.edu/class/bio201/index.htm
Radiologic Anatomy Browser
http://radlinux1.usuhs.mil/radiong/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/htmlpages/anatomy.html/gross.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 study of human anatomy.

Web Sites

Wheeless’ Textbook of Orthopaedics
www.ortho-u.net/
  – This site has an extensive index of links to the fractures, joints, muscles, nerves, trauma, medications, medical topics, lab tests as well as links to orthopaedic journals, other orthopaedic, and medical news.
Arthroscopy.Com
www.arthroscopy.com/sports.htm
  – Patient information on various musculoskeletal problems of the upper and lower extremity.
Electronic Textbook of Hand Surgery
www.e-hand.com/default.htm
  – Slides and illustrations of Upper Extremity Musculoskeletal Anatomy