The Hand

http://www.youtube.com/watch?v=iDXUwErttJA&feature=related
Clarification of Terms

- The hand is made up of the thumb, metacarpals, and phalanges
- The digits are numbered (with the thumb being #1 and the small finger being #5)
- The digits can also be referred to as: thumb, index (or pointer), long, ring and small

Lippert, p171
Osteology of the Hand (Bones)

- The thumb and fingers have essentially the same bone structure, however the thumb has only 2 phalanges and the fingers have 3.
- The hand, made up of the thumb and 4 fingers, has:
  - 5 metacarpals
  - 5 proximal phalanges
  - 4 middle phalanges
  - 5 distal phalanges
- There are no significant bony landmarks on these bones.
- The proximal end of the metacarpals and phalanges is called the base, and the distal end is called the head.
- [http://www.youtube.com/watch?v=Z6jUzWUGcOs&feature=related](http://www.youtube.com/watch?v=Z6jUzWUGcOs&feature=related)
Osteology of the Hand (Bones)
Hand: Joint Structure

- Each of the 5 digits contains 1 metacarpal and a group of phalanges
- A **ray** = one metacarpal and its associated phalanges
- **Carpometacarpal (CMC) joints** = articulation between proximal end of a metacarpal and the distal row of carpal bones
- **Metacarpophalangeal (MCP) joints** = articulation between the distal ends of the metacarpals and the proximal phalanges
- Each finger has 2 **interphalangeal (IP) joints** = a proximal interphalangeal (PIP) and a distal interphalangeal joint (DIP)
- The thumb has only 2 phalanges and therefore only one interphalangeal joint (IP joint)

Mansfield, p146
Hand: Joint Structure...cont

- Distal Interphalangeal Joints (DIP)
- Interphalangeal Joints (IP)
- Proximal Interphalangeal Joints (PIP)
- Metacarpophalangeal Joints (MCP)
- Carpometacarpal Joints (CMC)
Hand: Joint Structure...cont

- **Arches of the hand:**
  - Observe the natural arched curvature of the palmar surface of your relaxed hand
  - Control of this concavity allows the human hand to securely hold and manipulate objects
  - This palmar concavity is supported by 3 integrated arch systems:
    - Proximal and distal transverse arches
    - Longitudinal arch

Mansfield, p148
Thumb: Joint Structure

- The first digit, the thumb, has 3 joints:
  - The carpometacarpal (CMC) joint
    - Articulation between the trapezium and the base of the first metacarpal
    - Saddle joint: each articular surface is concave in one direction and convex in the other (much like a pringles potato chip)
  - The metacarpophalangeal (MCP) joint
  - The interphalangeal (IP) joint

Lippert, p171
Thumb: Joint Movement

- **Osteokinematics:**
  - CMC: flexion & extension, abduction & adduction, opposition & reposition
  - MCP: flexion and extension
  - IP: flexion and extension

- **Arthrokinematics:**
Thumb: Joint Movement...cont

- **CMC osteokinematics review:**
  - **Flexion / Extension**
    - Occur in a plane // to the palm (frontal plane)
  - **Abduction / Adduction**
    - Occur in a plan perpendicular to the palm (sagittal plane)
  - **Opposition / Reposition**
    - Opposition is a combination of flexion and abduction, with accessory rotation
    - Reposition is the return to anatomical position

Lippert, p172
Fingers: Joint Structure

- The second, third, fourth and fifth digits (index, long, ring, and small fingers) each have 4 digits:
  - CMC
  - MCP
  - PIP
  - DIP

Lippert, p173
Fingers: Joint Structure...cont

- **CMC Joints:**
  - Nonaxial plane (irregular) synovial joints
  - Provide more stability than mobility
  - Articulation between:
    - Trapezium & base of 1\textsuperscript{st} metacarpal (thumb)
    - Trapezoid & base of 2\textsuperscript{nd} metacarpal (index)
    - Capitate & base of 3\textsuperscript{rd} metacarpal (long)
    - Hamate & base of the 4\textsuperscript{th} metacarpal (ring)
    - Hamate & base of the 5\textsuperscript{th} metacarpal (small)

Lippert, p173
Fingers: Joint Structure...cont

- **MCP Joints:**
  - Layman’s term = knuckles
  - Biaxial condyloid joints
  - Convex heads of metacarpals articulate with the base of the proximal phalanges, which have a concave shape

- **Two IP Joints:**
  - PIP and DIP are uniaxial hinge joints

Lippert, p173
Fingers: Joint Movement

- **Osteokinematics:**
  - **CMC**: 2\textsuperscript{nd} and 3\textsuperscript{rd} CMC are not mobile, 4\textsuperscript{th} CMC slightly mobile, 5\textsuperscript{th} CMC allows for a small amount of small finger opposition (but nearly as much as the 1\textsuperscript{st} CMC of the thumb)
  - **MCP**: flexion, extension, hyperextension, abduction and adduction
  - **IP (PIP & DIP)**: flexion and extension

- **Arthrokinematics:**
  - **MCP**: convex moving on concave
  - **IP**: convex moving on concave

Lippert, p173
Fingers: Joint Movement...cont

- **Osteokinematics of the MCP joints:**
  - The middle finger is the point of reference for abduction and adduction.
  - **Abduction** occurs when the 2\(^{nd}\), 4\(^{th}\) and 5\(^{th}\) fingers move *away from* the 3\(^{rd}\) finger.
  - **Abduction** also occurs when the 3\(^{rd}\) finger moves in either direction.
  - **Adduction** occurs when the 2\(^{nd}\), 4\(^{th}\), and 5\(^{th}\) fingers return from abduction and move toward the 3\(^{rd}\) finger.
  - There is no adduction of the middle (3\(^{rd}\)) finger, only abduction occurring in either direction.

Lippert, p173
Hand: Supporting Structures

- **Wrist**
  - **Flexor Retinaculum**: ligament spanning the entire anterior surface of the wrist, holds flexor tendons close to the wrist when the wrist flexes. It also acts as a “tie beam” preventing the carpal bones from spreading apart.
  - **Extensor Retinaculum**: ligament spanning the posterior aspect of the wrist, holding the wrist extensor tendons close to the wrist during extension

- **CMC**
  - **Capsule**: connective tissue surrounds and stabilizes the CMC joints

- **MCP, PIP, & DIP**
  - **Capsule**: connective tissue surrounds and stabilizes the joints
  - **Radial & Ulnar Collateral Ligaments**: limit abduction and adduction
  - **Fibrous Digital Sheaths**: form tunnels or pulleys for the extrinsic finger flexor tendons; contain synovial sheaths to help lubrication

- **MCP only**
  - **Volar Plates**: ligaments cross palmar surface of each MCP joint limiting hyperextension
  - **Deep Transverse Metacarpal Ligaments**: wide flat ligaments that loosely binds the 2nd through 5th metacarpals

Lippert, p174 & Mansfield, p151, 153, 156
Myology of the Hand (Muscles)

- **Extrinsic Muscles:**
  - **Anterior:**
    - Flexor Digitorum Superficialis (FDS)
    - Flexor Digitorum Profundus (FDP)
    - Flexor Pollicis Longus (FPL)
  - **Posterior:**
    - Abductor Pollicis Longus (APL)
    - Extensor Pollicis Brevis (APB)
    - Extensor Pollicis Longus (EPL)
    - Extensor Digitorum (ED)
    - Extensor Indices (EI)
    - Extensor Digiti Minimi (EDM)

Anatomic snuff box

Lippert, p176
# Myology of the Hand: Extrinsic

## Flexor Digitorum Superficialis

<table>
<thead>
<tr>
<th><strong>Origin</strong></th>
<th>Common flexor tendon on the medial epicondyle of the humerus, coronoid process of the ulna and radius lateral to the bicipital tuberosity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insertion</strong></td>
<td>By 4 tendons, each to the sides of the middle phalanges of the fingers</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Median n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>MCP and PIP flexion</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
# Myology of the Hand: Extrinsic

## Flexor Digitorum Profundus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Anterior ulna and interosseous membrane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>By 4 tendons, each to the base of the distal phalanx of digits 2-5</td>
</tr>
<tr>
<td>Innervation</td>
<td>Medial half: Ulnar n.</td>
</tr>
<tr>
<td></td>
<td>Lateral half: Median n.</td>
</tr>
<tr>
<td>Action</td>
<td>MCP, PIP and DIP flexion, wrist flexion</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
## Myology of the Hand: Extrinsic

<table>
<thead>
<tr>
<th><strong>Flexor Pollicis Longus</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Middle anterior portion of the radius and interosseous membrane</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Base of the distal phalanx of the thumb</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Median n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>CMC, MCP and IP flexion of the thumb</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
“Anatomic Snuff Box”

- Extensor Pollicis Longus
- Extensor Pollicis Brevis
- ABDuctor Pollicis Longus
# Myology of the Hand: Extrinsics

<table>
<thead>
<tr>
<th><strong>ABDuctor Pollicis Longus</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Posterior surface of the radius, ulna and interosseous membrane</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Base of the 1\textsuperscript{st} metacarpal</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Radial n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>ABD and extension of the CMC of the thumb</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
# Myology of the Hand: Extrinsic Muscles

## Extensor Pollicis Brevis

<table>
<thead>
<tr>
<th><strong>Origin</strong></th>
<th>Posterior aspect of the radius and interosseous membrane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insertion</strong></td>
<td>Dorsal base of the proximal phalanx of the thumb</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Radial n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Extension of the MCP &amp; CMC joints of the thumb</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
## Myology of the Hand: Extrinsic

<table>
<thead>
<tr>
<th><strong>Extensor Pollicis Longus</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Posterior surface of the ulna and interosseous membrane</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Dorsal base of the distal phalanx of the thumb</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Radial n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Extension of the IP, MCP and CMC of the thumb</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
# Myology of the Hand: Externsics

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Extensor Digitorum</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Origin</strong></td>
<td>Lateral epicondyle of the humerus-common extensor tendon</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>By 4 tendons, each to the base of the extensor mechanism and base of the proximal phalanx of all 4 fingers</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Radial n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Extension of the fingers</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
## Myology of the Hand: Extrinsic Muscles

<table>
<thead>
<tr>
<th><strong>Extensor Indicis</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Posterior surface of distal ulna and interosseous membrane</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Blends with the index tendon of the extensor digitorum</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Radial n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Extension of the index finger</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
Where would we be without the extensor indicis?
### Extensor Digiti Minimi

<table>
<thead>
<tr>
<th>Origin</th>
<th>Ulnar side of the belly of the extensor digitorum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Joins the tendon of the extensor digitorum to the little finger</td>
</tr>
<tr>
<td>Innervation</td>
<td>Radial n.</td>
</tr>
<tr>
<td>Action</td>
<td>Extension of the 5\textsuperscript{th} finger</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
How would you drink tea if you didn’t have an EDM?
Myology of the Hand (Muscles)

- **Intrinsics:**
  - **Thenar:**
    - Flexor Pollicis Brevis (FPB)
    - Abductor Pollicis Brevis (APB)
    - Opponens Pollicis (OP)
  - **Deep Palm:**
    - Adductor Pollicis (AP)
    - Dorsal Interossei
    - Palmar Interossei
    - Lumbricales
  - **Hypothenar:**
    - Flexor Digiti Minimi (FDM)
    - Abductor Digiti Minimi (ADM)
    - Opponens Digiti Minimi (ODM)

Lippert, p181
Myology of the Hand: Intrinsics

Thenar Eminence
### Myology of the Hand: Intrinsics

#### Thenar Muscles

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Action</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexor Pollicis Brevis</td>
<td>Flexes the CMC &amp; MCP of the thumb</td>
<td>Median Nerve (C6, C7)</td>
</tr>
<tr>
<td>Abductor Pollicis Brevis</td>
<td>Abducts the CMC of the thumb</td>
<td>Median Nerve (C6, C7)</td>
</tr>
<tr>
<td>Opponens Pollicis</td>
<td>Opposes the CMC of the thumb</td>
<td>Median Nerve (C6, C7)</td>
</tr>
</tbody>
</table>

Lippert, p181-182
## Myology of the Hand: Intrinsics

### Deep Palm Muscles

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Action</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adductor Pollicis</td>
<td>Adducts CMC of thumb</td>
<td>Ulnar Nerve (C8, T1)</td>
</tr>
<tr>
<td>Dorsal Interossei</td>
<td>Abduct MCP of fingers</td>
<td>Ulnar Nerve (C8, T1)</td>
</tr>
<tr>
<td>Palmar Interossei</td>
<td>Adduct MCP of fingers</td>
<td>Ulnar Nerve (C8, T1)</td>
</tr>
</tbody>
</table>
| Lumbricals          | Flexes MCP joints while extending PIP & DIP joints    | 1<sup>st</sup> & 2<sup>nd</sup> lumbricals – medial nerve  
                   |                                                        | 3<sup>rd</sup> & 4<sup>th</sup> lumbricals – ulnar nerve |

Lippert, p182-184
Myology of the Hand: Intrinsics

Hypothenar eminence
**Hypothenar Muscles**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Action</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexor Digiti Minimi</td>
<td>Flexes CMC and MCP of small finger (5\textsuperscript{th})</td>
<td>Ulnar Nerve (C8, T1)</td>
</tr>
<tr>
<td>Abductor Digiti Minimi</td>
<td>Abducts the MCP joint of small finger (5\textsuperscript{th})</td>
<td>Ulnar Nerve (C8, T1)</td>
</tr>
<tr>
<td>Opponens Digiti Minimi</td>
<td>Opposes the 5\textsuperscript{th} finger</td>
<td>Ulnar Nerve (C8, T1)</td>
</tr>
</tbody>
</table>
Strengthening the Hand
Hand Function

- **Functional Position of the Hand:**
  - Wrist in slight extension
  - MCP & PIP in some degree of flexion
  - Thumb is in opposition.

Lippert, p189
Hand Function...cont

- The primary function of the human hand is **prehension**: to hold or manipulate objects

  - **Power Grips:**
    - Cylindrical grip
    - Spherical grip
    - Hook grip

  - **Precision Grips**
    - Pad-to-pad grip
    - Tip-to-tip grip
    - Pad-to-side grip
    - Side-to-side grip
    - Lumbrical grip

Lippert, p189-192
Hand Function: Power Grips

- Power grip
  - Significant amount of force
  - Most powerful grip
    - Fingers flex around an object in one direction and the thumb wraps around in the opposite direction providing counterforce to keep the object in contact with the palm and/or fingers.

- 3 types
  - Cylindrical, spherical & hook

Lippert, p189
Hand Function: Power Grips

- **Cylindrical Grip:**
  - All fingers are flexed around the object which is usually at a right angle to the forearm.
  - The thumb is wrapped around the object, often overlapping the fingers.

Lippert, p190
Hand Function: Power Grips

- **Spherical Grip**
- All of the fingers and the thumb are ADDUcted around an object, and unlike the cylindrical grip, the fingers are more spread apart. The palm of the hand is often not involved.

Lippert, p190
Hand Function: Power Grips

- **Hook Grip:**
  - Involves the second through fifth fingers flexed around an object in a hooklike manner.
  - The MCP joints are extended, and the PIP and DIP joints are in some degree of flexion. The thumb is usually not involved.

Lippert, p190
Hand Function: Precision Grips

- Tend to hold the object between the tips of the fingers and thumb.
- Involves intrinsics and extrinsics
- Thumb is ABDucted
  - Fine movement & accuracy
    - Objects are small or fragile, no palm involvement, no movement of proximal joints
  - 5 main categories:
    - Pad to pad, tip to tip, pad-to-side, side-to-side & lumbrical grip

Lippert, p194
Hand Function: Precision Grips

- **Pinch Grip**
- MCP and PIP of the fingers are flexed, thumb is ABDucted and the distal joints of both are extended bringing the pad of the finger(s) and thumb together.
  - **Pinch grip**: with thumb and one finger
  - **Three-jaw chuck**: thumb and two fingers

Lippert, p191
Hand Function: Precision Grips

- **Tip-to-tip grip**: bring tip of thumb up against the tip of another digit, usually the index finger, to pick up a small object such as a coin or a pin
- AKA: pincer grip
- Very difficult with long nails

Lippert, p191
Hand Function: Precision Grips

- **Pad-to-side grip (aka lateral prehension)**
- Pad of the extended thumb presses an object against the racial side of the index finger
Hand Function: Precision Grips

- **Side-to-side grip:**
- Requires ADDuction of 2 fingers, usually the index and middle fingers
- Weak grip and does not permit much precision

Lippert, p191
Hand Function: Precision Grips

- **Lumbrical Grip:**
- Sometimes referred to as the plate grip
  - MCP and PIP joint flexed and the DIP joint extended the thumb opposed the fingers holding and object horizontal.
  - The lumbricals flex the MCPs while extending the IP joints
Common Wrist & Hand Pathologies

• **Colles’ Fracture:**
  • Transverse fracture of distal radius with a posterior displacement of the distal fragment due to FOOSH

• **Smith’s Fracture:**
  • Transverse fracture of distal radius with an anterior displacement of the distal fragment due to a fall on the back of the hand

• **Carpal Tunnel Syndrome:**
  • Compression of the medial nerve within the carpal tunnel causing numbness, tingling, and weakness in hand

Lippert, p186-187
Common Wrist & Hand Pathologies

- **DeQuervain’s Tenosynovitis:**
  - Inflammation of tendons of and the sheath containing the APL & EPB causing radial sided pain

- **Dupuytren’s Contracture:**
  - Palmar aponeurosis thickens and causes flexion contractures mostly in the pinky and ring fingers

- **Skier’s Thumb:**
  - Acute tear of the ulnar collateral ligament of the thumb
Common Wrist & Hand Pathologies

- **Swan Neck Deformity:**
  - Flexion of the MCP joint, hyperextension of the PIP joint, and flexion of the DIP joint.

- **Boutonniere Deformity:**
  - Extension of the MCP joint, flexion of the PIP joint and extension of the DIP joint

- **Ulnar Drift:**
  - Ulnar deviation of the fingers at the MCP joints

Lippert, p186-187
Certified Hand Therapists

- Hand specialists study and treat the hand exclusively to be considered hand therapists.
- Most clinicians refer patients with diagnoses of the hand to a hand therapist.
- What is expected?
  - Osteology
  - Extrinsic myology
  - Familiarity with the intrinsic myology by names of the muscles
  - Familiarity with the overall function of the structures intrinsically and extrinsically
  - Common injuries and potential causes
Identify!

- Flexor digitorum superficialis
- Flexor digitorum profundus
- Flexor pollicis longus
Identify!

Extensor digitorum
Extensor digiti minimi
Extensor indicis
ABDuctor pollicis longus
Extensor pollicis brevis
Extensor pollicis longus
References