Elbow & Forearm

HOW VITAL IS THE ELBOW TO OUR DAILY LIVES?

Clarification of Terms

- **The elbow includes:**
  - 3 bones (humerus, radius, and ulna)
  - 2 joints (humeroulnar and humeroradial)
  - Allows for elbow flexion and extension of the elbow

- **The forearm includes:**
  - 2 bones (radius and ulna)
  - 2 joints (proximal radioulnar joint and distal radioulnar joint)
  - Allows for forearm pronation and supination

- The interaction among the 4 joints enables the hand to be placed in a nearly infinite number of positions, greatly enhancing the functional potential of the entire UE

Mansfield, p91-92

Osteology of the Elbow & Forearm (Bones)

- 4 bones relate to the function of the elbow and forearm:
  - Scapula
  - Humerus
  - Ulna
  - Radius

Mansfield, p92
Osteology of the Elbow & Forearm (Bones)... cont

- Scapula:
  - Infraglenoid tubercle
  - Supraglenoid tubercle
  - Coracoid process

Lippert, p149

Humerus:
- Trochlea
- Capitulum
- Medial Epicondyle
- Lateral Epicondyle
- Lateral Supracondylar Ridge
- Olecranon Fossa

Lippert, p149-150
Osteology of the Humerus

- Olecranon Process
- Trochlear Notch
- Coronoid Process
- Radial Notch
- Ulnar Tuberosity
- Styloid Process
- Head

Lippert, pg 150
Osteology of the Elbow & Forearm (Bones)...cont

- **Radius:**
  - Head
  - Radial tuberosity
  - Styloid process
  - Fovea
Osteology of the Proximal Structures of the Forearm

- Ulna

Osteology of the Distal Structures of the Forearm
What can you palpate?  
What can you NOT palpate?

- Think-Pair-Share

---

**Joint Structure of the Elbow**

- **Humeroulnar Joint**
  - Provides most of the structural stability to the elbow through the jaw-like trochlear notch of the ulna interlocking with the spool-shaped trochlea of the humerus
  - This hinge-like joint limits motion of the elbow to ________ and ________

- **Humeroradial Joint**
  - Formed by the ball-shaped capitulum of the humerus with the bowl-shaped fovea of the radius
  - This permits continuous contact between the radial head and the capitulum during pronation and supination, as the radius spins about its own axis

  **Mansfield, p93**

---

**Joint Structure of the Elbow...cont**

- **Carrying Angle:**
  - With the forearm supinated and elbow fully extended, the forearm projects laterally about 15-20° relative to the humerus. This is normal, but tends to be greater in females.

  **Lippert, p148-149**
Joint Movement of the Elbow

- **Osteokinematics:**
  - Flexion
  - Extension

- **Arthrokinematics:**
  - The concave radius/ulna move on the convex humerus

Varum & Valgum

- **Anterior Capsule:**
  - Thin connective tissues encloses the humeroulnar joint, humeroradial joint and proximal radioulnar joint

- **Medial Collateral Ligament:**
  - Attaches proximally to the medial epicondyle and distally to the coronoid and olecranon processes, providing stability by resisting valgus forces

- **Lateral Collateral Ligament:**
  - Originates on lateral epicondyle and attaches to the lateral aspect of the proximal forearm, providing stability by resisting varus forces

Mansfield, pp7
Joint Structure of the Forearm

- **Proximal Radioulnar Joint:**
  - The head of the radius articulates with the radial notch of the ulna
- **Distal Radioulnar Joint:**
  - The distal end of the radius rotates around the distal end of the ulna
- Functionally, they are considered one joint
- The radioulnar joint is a uniaxial pivot joint allowing only pronation and supination of the forearm

Joint Movement of the Forearm

- Osteokinematics:
  - Pronation
  - Supination

Arthrokinematics:

- The distal radius rotates around the ulna which is stationary
- The distal radius is larger and broader than the distal ulna
Joint Movement of the Forearm...cont

- Supination & Pronation
  - Shoulder rotation can often be functionally substituted for each motion
    - But not if the humerus is held tight against the thorax and the elbow is in 90° of flexion

Supporting Structures of the Forearm

- Annular Ligament:
  - Thick circular band of connective tissue that wraps around the radial head and attaches it to either side of the radial notch of the ulna.
  - This ring-like structure holds the radial head firmly against the ulna, allowing it to spin freely during pronation/supination.

- Distal Radioulnar Joint Capsule:
  - Provides stability to the distal radioulnar joint

- Interosseous Membrane:
  - Helps bind the radius to the ulna; serves as a site for muscle attachments, and acts as a mechanism to transmit forces proximally through the forearm

Mansfield, p99
Supporting Structures of the Forearm...cont

Interosseous Membrane

Myology of the Elbow & Forearm (Muscles)

The Muscles of the Elbow & Forearm:
- Biceps
- Brachialis
- Brachioradialis
- Triceps
- Anconeus
- Supinator
- Pronator teres
- Pronator quadratus

<table>
<thead>
<tr>
<th>Biceps Brachii</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin</td>
<td>Long Head: Supraglenoid tubercle of the scapula</td>
</tr>
<tr>
<td></td>
<td>Short Head: Coracoid process of the scapula</td>
</tr>
<tr>
<td>Insertion</td>
<td>Bicipital tuberosity of the radius</td>
</tr>
<tr>
<td>Innervation</td>
<td>Musculocutaneous n.</td>
</tr>
<tr>
<td>Action</td>
<td>Elbow flexion, sh flexion and forearm supination</td>
</tr>
</tbody>
</table>

Lippert, p153
Biceps brachii

- How do we stretch the biceps brachii?
- How do we strengthen the biceps brachii concentrically?
- Eccentrically?
- Isometrically?
- Closed chain?
- Open chain?

Biceps Brachii

- Reversal of Function:
  - Open chain: the bicep causes what to happen?
  - Closed chain: the bicep causes what to happen?

Myology of the Elbow & Forearm (Muscles)

<table>
<thead>
<tr>
<th>Brachialis</th>
<th>Anterior aspect of the distal humerus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Coronoid process of the ulna</td>
</tr>
<tr>
<td>Innervation</td>
<td>Musculocutaneous n.</td>
</tr>
<tr>
<td>Action</td>
<td>Elbow flexion</td>
</tr>
<tr>
<td>&quot;tidbit&quot;</td>
<td>&quot;workhorse&quot; for elbow flexion</td>
</tr>
</tbody>
</table>

Lippert, p152
**Myology of the Elbow & Forearm (Muscles)**

**Brachioradialis**
- **Origin**: Lateral supracondylar ridge of the humerus
- **Insertion**: Near the styloid process of the distal radius
- **Innervation**: Radial n.
- **Action**: Elbow flexion, Pronation or supination of the forearm to the neutral position

---

**Brachialis & Brachioradialis**

- How do we stretch the brachialis & brachioradialis?
- How do we strengthen them concentrically?
- Eccentrically?
- Isometrically?

---

**Myology of the Elbow & Forearm (Muscles)**

**Triceps Brachii**
- **Origin**: Long Head: infraglenoid tubercle of the scapula
  - Lateral Head: posterior aspect of the superior humerus,
  - Medial Head: posterior aspect of the superior humerus,
- **Insertion**: Olecranon process of the ulna
- **Innervation**: Radial n.
- **Action**: Elbow extension
  - Sh extension: Long head only
Triceps brachii

- How do we stretch the triceps brachii?
- How do we strengthen the triceps brachii concentrically?
- Eccentrically?
- Isometrically?
- Closed chain?
- Open chain?

Myology of the Elbow & Forearm (Muscles)

Anconeus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Posterior aspect of the lateral epicondyle of the humerus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Olecranon process of the ulna &amp; the annular ligament</td>
</tr>
<tr>
<td>Innervation</td>
<td>Radial n.</td>
</tr>
<tr>
<td>Action</td>
<td>Elbow extension?</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>Believed to “clear” the joint space of soft tissue to permit full elbow extension. Too small to create torque for elbow extension.</td>
</tr>
</tbody>
</table>

Lippert, p153

Myology of the Elbow & Forearm (Muscles)

Supinator

<table>
<thead>
<tr>
<th>Origin</th>
<th>Lateral epicondyle of the humerus and supinator crest of the ulna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Lateral surface of the proximal radius</td>
</tr>
<tr>
<td>Innervation</td>
<td>Radial n.</td>
</tr>
<tr>
<td>Action</td>
<td>Forearm supination</td>
</tr>
</tbody>
</table>

Lippert, p155
Supinator

- How do we stretch the supinator?
- Strengthen it concentrically? Eccentrically?

Myology of the Elbow & Forearm (Muscles)

**Pronator Teres**

- **Origin**: Medial epicondyle of the humerus
- **Insertion**: Lateral surface of the midshaft of the radius
- **Innervation**: Median n.
- **Action**: Forearm pronation, secondary elbow flexion

Myology of the Elbow & Forearm (Muscles)

**Pronator Quadratus**

- **Origin**: Anterior surface of the distal ulna
- **Insertion**: Anterior surface of the distal radius
- **Innervation**: Median n.
- **Action**: Forearm pronation
Pronators

- How do we stretch the pronator muscles?
- How do we strengthen them concentrically? Eccentrically? Isometrically?

Myology of the Elbow & Forearm (Muscles)

- Anatomical Relationships:
  - Muscle bellies of biceps, brachialis, and triceps are proximal to the elbow joint, while muscle bellies of brachioradialis, pronator teres, pronator quadratus, and supinator are distal to the elbow joint.
  - Anteriorly lies the biceps, brachialis, brachioradialis, pronator teres and pronator quadratus
  - The brachialis is deep to the biceps, except at the distal humerus where it can be palpated on either side of the biceps tendon
  - The brachioradialis and pronator teres are located superficially
  - The pronator quadratus is located deep to several wrist and hand tendons

Lippert, p155

Myology of the Elbow & Forearm (Muscles)

- Anatomical Relationships continued:
  - Posteriorly, the triceps makes up the entire posterior arm proximal to the elbow joint
  - The long and lateral heads are superficial and the medial head is deep
  - The anconeus is very small and is located superficially on the posterior elbow, just distal to the triceps insertion
  - The supinator lies deep to the wrist extensors and the brachialis

Lippert, p156
Myology of the Elbow & Forearm (Muscles)

### Prime Movers:

<table>
<thead>
<tr>
<th>Action</th>
<th>Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbow Flexion</td>
<td>Biceps, brachialis, brachioradialis</td>
</tr>
<tr>
<td>Elbow Extension</td>
<td>Triceps</td>
</tr>
<tr>
<td>Forearm Pronation</td>
<td>Pronator teres, pronator quadratus</td>
</tr>
<tr>
<td>Forearm Supination</td>
<td>Biceps, supinator</td>
</tr>
</tbody>
</table>

Lippert, p.157

### Summary of Muscle Innervation:

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Nerve</th>
<th>Spinal Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachialis</td>
<td>Musculocutaneous</td>
<td>C5, C6</td>
</tr>
<tr>
<td>Biceps</td>
<td>Musculocutaneous</td>
<td>C5, C6</td>
</tr>
<tr>
<td>Brachioradialis</td>
<td>Radial</td>
<td>C5, C6</td>
</tr>
<tr>
<td>Triceps</td>
<td>Radial</td>
<td>C6, C7</td>
</tr>
<tr>
<td>Anconeus</td>
<td>Radial</td>
<td>C7, C8</td>
</tr>
<tr>
<td>Pronator Teres</td>
<td>Median</td>
<td>C6, C7</td>
</tr>
<tr>
<td>Pronator Quadratus</td>
<td>Median</td>
<td>C8, T1</td>
</tr>
<tr>
<td>Supinator</td>
<td>Radial</td>
<td>C6</td>
</tr>
</tbody>
</table>

Lippert, p.158
Redundancy is a fact of life/function

- Innervation
  - The musculocutaneous n.
    - Supplies the elbow flexors EXCEPT the brachioradialis
  - The radial n.
    - Supplies the elbow extensors
  - The median n.
    - Supplies all the pronators of the forearm

Common Pathologies

- Lateral Epicondylitis (Tennis Elbow)
  - Overuse of common wrist extensor tendon where it inserts due to repetitive wrist extension activities

- Medial Epicondylitis (Golfer's Elbow)
  - Inflammation and overuse of the common flexor tendon at its insertion site due to repetitive wrist flexion activities

- Little League Elbow
  - Overuse injury at medial epicondyle due to a repetitive throwing motion, creates valgus stress at elbow

- Nursemaid's Elbow
  - Radial head subluxation due to being picked up by one hand
Pin the Tail on the Donkey

- Point to the...
- Elbow flexors
- Elbow extensors

Identify!

- Triceps brachii
- Anconeus
- Teres Major
- Teres Minor
- Infraspinatus

Identify!

- Biceps Brachii
- Brachialis
- Brachioradialis
- Pronator Teres
- Pronator Quadratus
<table>
<thead>
<tr>
<th>References</th>
</tr>
</thead>
</table>