



ELBOW ANATOMY, BIOMECHANICS AND PATHOLOGY

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Orthopaedic Manual Physical Therapy Series
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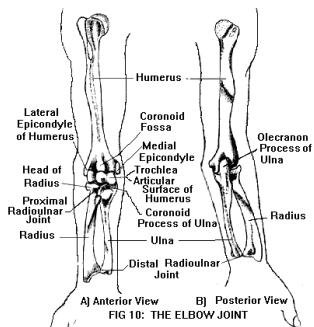
Elbow Joint Anatomy

– Joint articulations

- Humeroulnar
- Radiohumeral
- Radioulnar (proximal and distal)



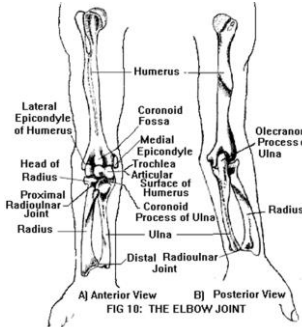
Bone Anatomy



- **Mid-Distal Humerus**
- Trochlea
- Medial epicondyle
- Coronoid fossa
- Capitulum
- Radial fossa
- Lateral epicondyle
- Olecranon fossa



Bone Anatomy



- **Proximal Radius**
- Head
- Fovea
- Radial tuberosity
- **Proximal Ulna**
- Olecranon process
- Coronoid process
- Trochlear notch
- Radial notch



Elbow ROM

Flexion & Extension Humero-Ulnar/Humero-Radial joints

- Normal (maximal): +5°-145°
- Functional: 30°-130°

Pronation/Supination Radioulnar joints

- Normal Pronation 75°
- Normal Supination 85°
- Functional: 50° for both



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Elbow Resting Position (open packed)

- UH: 70° flexion, slight supination
- RH: full extension, supination
- Proximal RU: 70° flexion, 35° supination
- Distal RU: 10° supination



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Elbow Closed Packed Position

- UH: full extension
- RH 90 flexion, 5° supination
- Proximal RU: 5° supination, full elbow extension
- Distal RU: 5° supination

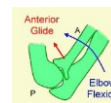


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Arthrokinematics: Humero-ulnar Jt

- Humero-ulnar Joint:
Concave trochlear notch rolls and glides on the convex trochlea



- Humero-radial Joint:
Concave radial fovea rolls and glides on the convex capitulum
-flexion: proximal radial glide
-extension: posterior and distal radial glide



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Arthrokinematics: Radio-ulnar Joint

Pronation

- Ulna and radius cross
- Ulna moves posterior/lateral
- Limited by bone on bone

Supination

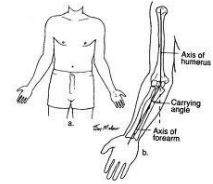
- Radius and ulna are parallel
- Ulna moves medial and anterior
- Limited by tightening of interosseus membrane, quadrate ligament and anterior ligament of distal RU joint



Carrying Angle

Carrying angle: average 13°

--conjunct rotation of the ulna producing slight pronation in ext, slight supination in flexion



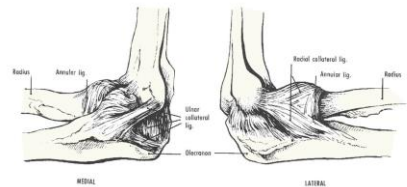
Joints of the Forearm

Radio-ulnar joint

- Proximal radio-ulnar jt
 - lateral surface: radial head
 - medial surface: radial notch and annular ligament
- Distal radio-ulnar jt
 - Btw concave ulnar notch of radius and convex lower end of ulna
 - Joint surface enclosed by articular capsule and disc (TFCC)
- Radio-ulnar syndesmosis

Ligament Stabilizing Structures

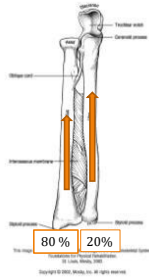
- Anterior/Medial—UCL, Anterior Capsule, Annular Ligament
- Lateral—RCL



Joint Stabilizing Structures

Interosseous Membrane

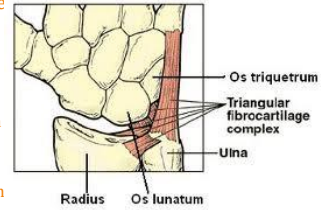
- Stabilize the radius & ulna
- Transmit forces proximally through the ulna (20%) and radius (80%)
- Site of muscle attachments



Joint Stabilizing Structures

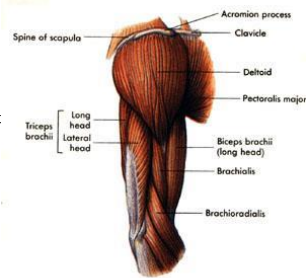
Distal Radio-ulnar Joint Triangular Fibrocartilage Complex (TFCC)

- Articular Disc Functions:
 - Connection of Radius and Ulna
 - Separation of RU joint from RC joint
 - Provides a dual articular surface to ulna during pronation and to triquetrum during wrist ROM



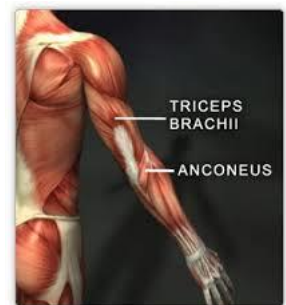
Function Elbow-Forearm Muscles

- Elbow Flexors**—strength max 90-110 deg
- Biceps brachii—fast resistor
 - Brachialis—primary
 - Brachioradialis



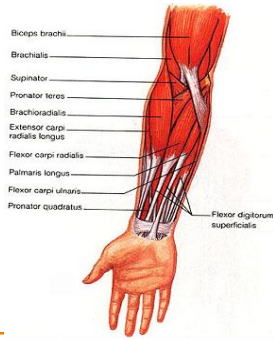
Function Elbow-Forearm Muscles

- Elbow Extensors
 - Triceps brachii
 - Anconeus



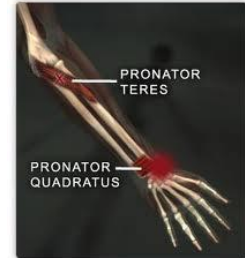
Function Elbow-Forearm Muscles

- Forearm Supinators
- Supinator—slow
- Biceps—fast/resisted, strongest at 90 deg



Function Elbow-Forearm Muscles

- Forearm Pronators
- Pronator teres
- Pronator quadratus



Medical Orthopedics-Elbow

- Arterial Injury
 - Pain out of proportion to injury and associated with stretch of muscle
 - Decreased or absent pulses, changes in skin color and decreased skin temperature
- Compartment Syndrome (Volkmann's Ischemia)
 - Pain out of proportion to injury and not relieved by immobilization
 - Swelling, numbness, weakness, tense tissues, but intact pulses and no changes in skin color
- Olecranon Bursitis
 - Inflammation of bursal sac
 - Acute onset of unexplained swelling
 - Septic (aspiration) vs. aseptic (quick resolution)

Elbow Instability

- Subluxation/Dislocation
 - MOI-fall on outstretched hand or traumatic event
 - Presentation-deformity/asymetry
 - Need to rule out vascular and neural involvement
 - Ulnar and median common w/simple dislocations, radial with complex ones involving radial head

Elbow Instability

- Fractures
 - Olecranon
 - common in elderly
 - Need to know fracture site and/or surgical procedure for PT decision making
 - Radial head
 - Fracture MOI: axial load on pronated forearm, direct blow to elbow or hyperflexion
 - Excision: used when UCL intact
 - Replacement: may be performed if surrounding stabilizing structures are compromised
 - Capitulum
 - Uncommon
 - Young makes with high force trauma or elderly females, low trauma
 - Coronoid
 - Typically part of terrible triad: posterior dislocation of elbow w/fracture of radial head, olecranon or medial epicondyle



Elbow Instability

- Little Leager's Elbow
 - Children/adolescent overhead throwers
 - Apophysitis/fragmentation due to insufficient ossification centers
 - Risk factors: # of pitches
 - < 25 pitches increased risk of elbow injury to 21%
 - 75-99 pitches = 35% risk
 - Treatment: REST, gradual return to sport, limit # pitches
- Distal Biceps Rupture
 - Males 40-60 yrs or younger athletes (weight lifters)
 - MOI: rapid, eccentric contraction of biceps with "pop"
 - Erythema at antecubital fossa, deformity of biceps insertion when acute
 - Surgery within 10 days



Complications of Elbow Trauma, Instability and Injury

- Elbow stiffness
 - Presentation—loss of extension, mild/mod pain, possible ulnar neuritis
 - Non-operative management
 - NSAIDs
 - Gentle mobilization
 - Operative management—failure of non-operative management, contracture for 12 months, lack of functional AROM
 - Dictated by structures involved
- Complex Regional Pain Syndrome
 - Pain disproportionate to injury
 - Intractable pain in a nonperipheral nerve distribution
 - Edema, sensory, motor changes
 - Hyperalgesia, hyperpathia, allodynia, skin changes, integumentary changes

