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Anatomy & Positioning: Upper Extremities

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Upper Extremity

Anatomy and Procedures of the Digits, Hand, Wrist, Forearm, and Humerus

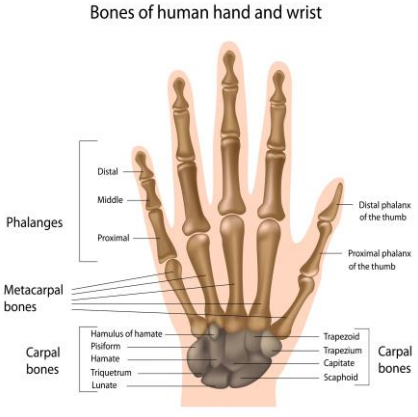
Anatomy Review

Digits, Hand, and Wrist

Anatomy: Hand and Fingers

Divisions

- 27 bones in each hand
  - phalanges (14 in each hand), bones of the digits
  - metacarpals (5 in each hand), bones of the palm
  - carpals (8 in each wrist), bones of the wrist



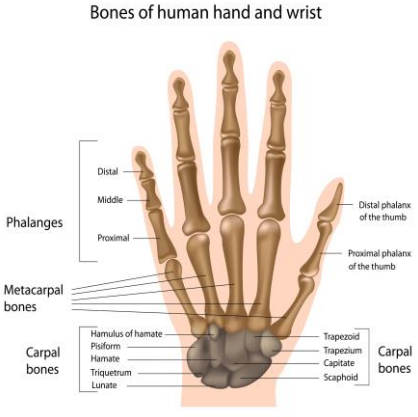
Anterior aspect

14 Phalanges

- Numbered 1-5 laterally to medially
- Three in digits 2 to 5
- Two in first digit (thumb)
- Named by location (e.g., distal phalanx of third digit)
- Classified as long bones, each has a head, body, and base
- More distal, they become flattened

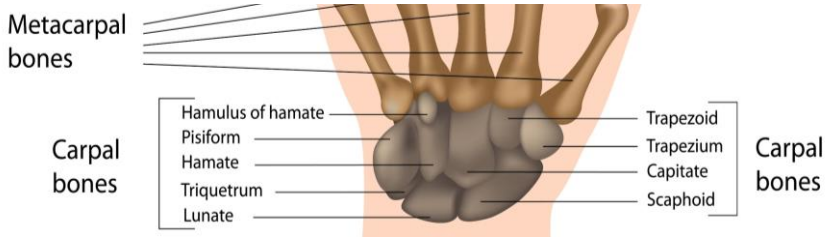
Metacarpals

- Identified by numbers, laterally to medially
- Heads of metacarpals are distal; articulate with phalanges
- Neck and body
- Bases are proximal; articulate with carpals
- Classified as long bones



Carpals

- Two rows of four (proximal and distal)
- Proximal row, lateral to medial: scaphoid, lunate, triquetrum, pisiform
- Distal row, lateral to medial: trapezium, trapezoid, capitate, hamate
- Classified as short bones



Carpals

Mnemonic aids in remembering names and locations

Some Lovers Try Positions That They Can't Handle

Proximal Row, laterally	Distal Row, laterally
Some = Scaphoid	**That = Trapezium**
Lovers = Lunate	**They = Trapezoid**
Try = Triquetrum	**Can't = Capitate**
Positions = Pisiform	**Handle = Hamate**

Articulations

- Interphalangeal (IP) joints
  - articulations between phalanges
  - identified by location and digit number
  - classified as synovial, diarthrotic, or freely moveable joint, hinge type
  - distal interphalangeal (DIP) and proximal interphalangeal (PIP) joint

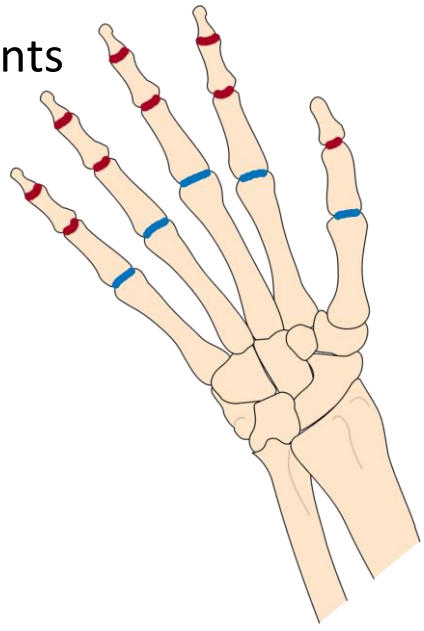
Articulations

- Metacarpophalangeal (MCP) joints
  - articulations between the heads of the metacarpals and the proximal phalanges
  - identified by number: first, second, third
  - classified as synovial, diarthrotic, ellipsoidal type

IP and MCP Joints

IP joints

MCP joints



Articulations

- Carpometacarpal (CMC) joints
  - articulations between the bases of the metacarpals and the carpal bones
  - first CMC joint classified as synovial, diarthrotic, saddle type
  - second to fourth CMC joints are gliding types

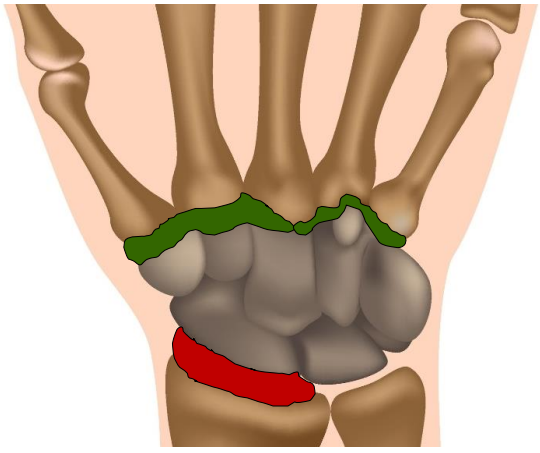
Articulations

- Intercarpal joints
  - articulations between the carpal bones
  - classified as synovial, diarthrotic, gliding type

Articulations

- Radiocarpal joint
  - articulation between the carpals and the distal radius
  - classified as synovial, diarthrotic, ellipsoidal type

CMC and Radiocarpal Joints



Green = CMC joints
Red = Radiocarpal joint

General Procedural Guidelines

Digits, Hand, and Wrist

General Procedural Guidelines

- Patient preparation
- General patient position
- Image receptor (IR)/collimated field size
- Source–to–image-receptor distance (SID)
- Identification (ID) markers
- Radiation protection
- Patient instructions

General Patient Position

- Ambulatory patients
  - seated at end of x-ray table
  - affected limb rests on IR placed on tabletop
- Nonambulatory patients - alter positioning to maximize patient comfort

IR/Collimated Field Size

- Common practice - place more than one projection on an IR (computerized radiography affected by scatter, digital radiography)
- Collimation critical
  - ethical radiation protection
  - optimum image quality

SID

- SID is standardized as a part of procedural protocol
  - when SID is not specified under a projection, 40 inches (102 cm) is recommended

ID Markers

- Right or left side markers must be included on at least one of the projections on an IR
- Other required ID markers must be in the blocker or elsewhere on the final image
- Avoid using annotation on digital to place side markers

Radiation Protection

- Shield pediatric patients and patients of reproductive age
- Close collimation
- Optimum technique

Patient Instructions

- Explain and demonstrate positions
- Breathing instructions not required for digit, hand, and wrist procedures

Radiographic Procedures

Essential Projections of the Digits, Thumb, Hand, and Wrist

Essential Projections: Digits 2 to 5

- Posterior/anterior (PA)
- Lateral
- PA oblique

Essential Projections: Digits 2 to 5

- Collimated field size - 1 inch on all sides of the digit, including 1 inch proximal to the MCP joint

PA Digits 2 to 5

- Part position
  - extended with palmar surface in center of unmasked portion of IR
  - long axis of digit aligned parallel
- Computed Radiography (CR)
  - perpendicular to IR
  - enters patient at PIP joint

PA Digits 2 to 5

- Evidence of proper collimation
- No rotation of digit
  - phalangeal shafts should be concave on both sides
  - equal amounts of soft tissue should be demonstrated on both sides of phalanges
  - fingernail, if visible and normal, should be centered on distal phalanx

PA Digits 2 to 5

- Entire digit from fingertip to distal portion of the adjoining metacarpal
- No soft tissue overlap from adjacent digits
- Open IP and MCP joints
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Lateral Digits 2 to 5

- Separate digit of interest using cotton swab, tape, or step wedge and fold other digits into fist
- Digit of interest in center of unmasked portion of IR
- Long axis of digit parallel with IR

Lateral Digits 2 to 5

- Part position - second and third digits
  - extended with lateral surface in contact with IR (mediolateral projection)
- Part position - fourth and fifth digits
  - extended with medial surface in contact with IR (lateromedial projection)

Lateral Digits 2 to 5

- CR
  - directed perpendicular to the IR
  - enters patient at PIP joint

Lateral Digits 2 to 5

- Evidence of proper collimation
- Entire digit in true lateral position without rotation
  - fingernail, if visible and normal, should be in profile
  - anterior surface of phalanges should be concave

Lateral Digits 2 to 5

- Proximal phalanx and MCP demonstrated without superimposition by adjacent digits
- Open IP joint spaces
- Density and contrast adequate to make bony trabeculation and soft tissue visible

PA Oblique Digits 2 to 5

- Part position
  - extended with palmar surface resting on 45-degree wedge sponge
  - digit of interest separated to prevent soft tissue overlap

PA Oblique Digits 2 to 5

- CR - perpendicular to PIP joint of affected digit

PA Oblique Digits 2 to 5

- Evidence of proper collimation
- Entire digit rotated at a 45-degree angle, including distal part of adjoining metacarpal
- Proximal phalanx and MCP joint demonstrated without superimposition of adjacent digits

PA Oblique Digits 2 to 5

- Open IP and MCP joints
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Essential Projections: 1st Digit

- Anteroposterior (AP)
- Lateral
- PA oblique

Essential Projections: 1st Digit

- Collimated field size - 1 inch on all sides of the digit, including 1 inch proximal to the CMC joint

AP 1st Digit

- Part position
  - hand in extreme internal rotation
  - posterior surface of thumb on IR
  - MCP joint centered to unmasked portion of IR
  - long axis of thumb aligned parallel

AP 1st Digit

- Part position
  - other digits separated from thumb with tape or opposite hand
  - check thumb position to ensure true AP projection

- CR - perpendicular to MCP joint

AP 1st Digit

- Evidence of proper collimation

AP 1st Digit

- No rotation of digit
  - shafts of phalanges and metacarpals should be concave on both sides
  - equal amounts of soft tissue should be demonstrated on both sides of phalanges

AP 1st Digit

- No rotation of digit
  - thumbnail, if visible and normal, should be centered on distal phalanx
  - anatomy from distal tip of thumb to trapezium should be included in its entirety

AP 1st Digit

- Open IP and MCP joints
- Overlap of soft tissue profile of the palm over the midshaft of the first metacarpal
- Density and contrast adequate to make bony trabeculation and soft tissues visible

Lateral 1st Digit

- Part position
  - palmar surface on IR
  - align long axis of thumb parallel
  - center MCP joint to unmasked portion of IR
  - rotate thumb until lateral surface is on IR (mediolateral projection)
- CR - perpendicular to MCP joint of thumb

Lateral 1st Digit

- Evidence of proper collimation
- First digit in true lateral position without rotation
  - thumbnail, if visible and normal, should be in profile
  - anterior surface of proximal phalanx should be concave

Lateral 1st Digit

- Anatomy from distal tip to trapezium visible in its entirety
- Open IP and MCP joint spaces
- Density and contrast adequate to make bony trabeculation and soft tissue visible

PA Oblique 1st Digit

- Part position
  - palmar surface on IR
  - ulnar deviate hand slightly
  - align long axis of thumb parallel
  - center MCP joint to unmasked portion of IR
- CR - perpendicular to MCP joint

PA Oblique 1st Digit

- Evidence of proper collimation
- Proper rotation of phalanges, soft tissues, and first metacarpal
- Anatomy from distal tip of thumb to trapezium included in its entirety
- Open IP and MCP joint spaces
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Essential Projections: Hand

- PA
- Lateral
  - lateral in extension position
  - fan lateral position
- PA oblique

Essential Projections: Hand

- Collimated field size - 1 inch on all sides of the hand, including 1 inch proximal to the ulnar styloid

PA Hand

- Part position
  - palmer surface on unmasked section of IR
  - forearm on table
  - extend and separate digits to prevent soft tissue overlap
  - center third MCP joint to unmasked portion of IR
- CR - perpendicular to third MCP joint

PA Hand

- Evidence of proper collimation

PA Hand

- No rotation of the hand
  - metacarpal and phalangeal shafts should be concave on both sides
  - equal amounts of soft tissue on both sides of phalanges
  - fingernails, if visible and normal, should be centered on distal phalanx

PA Hand

- Open MCP and IP joints are evidence that hand was flat on IR

PA Hand

- No soft tissue overlap of digits
- Anatomy from distal phalanges to distal part of radius and ulna demonstrated
- Density and contrast adequate to make bony trabeculation and soft tissues visible

PA Oblique Hand

- Part position
  - forearm on table
  - palmar surface on unmasked portion of IR
  - rotate palm away from IR until MCP joint forms 45-degree angle

PA Oblique Hand

- Part position
  - support digits extended on sponge
    - demonstrates IP joints
    - prevents foreshortening of phalanges
  - MCP joints in center of IR
- CR - perpendicular to third MCP joint

PA Oblique Hand

- Evidence of proper collimation
- Minimal overlap of third-to-fourth and fourth-to-fifth metacarpal shafts
- Slight overlap of metacarpal bases and heads
- Second and third metacarpals should be separated
- Open IP and MCP joint spaces, if digits positioned parallel to IR

PA Oblique Hand

- No soft tissue overlap of digits
- Anatomy from distal phalanges to distal part of radius and ulna demonstrated
- Density and contrast adequate to make bony trabeculation and soft tissues visible

Lateral Hand

- Part position - extension position
  - forearm on table
  - elbow flexed 90 degrees
  - hand on medial surface
  - radial and ulnar styloids superimposed and perpendicular to IR (lateromedial projection)

Lateral Hand

- Part position - extension position
  - palmar surface perpendicular to IR
  - first digit abducted to right angle to palm
  - MCP joints centered to IR
  - digits and long axis of hand aligned parallel

- CR - perpendicular to second MCP joint

Lateral Hand

- Part position - fan lateral position
  - forearm on table with elbow flexed 90 degrees
  - hand resting on medial surface
  - radial and ulnar styloids superimposed and perpendicular to IR (lateromedial projection)

Lateral Hand

- Part position - fan lateral position
  - palmar surface perpendicular to IR
  - digits positioned out of superimposition supported by a wedge sponge
  - MCP joints centered to IR
  - digits and long axis of hand aligned parallel
- CR - perpendicular to second MCP joint

Lateral Hand

- Evidence of proper collimation
- Hand in true lateral position
  - in extension position, phalanges are superimposed
  - in fan lateral position, phalanges demonstrated individually
  - metacarpals superimposed
  - distal radius and ulna superimposed

Lateral Hand

- Extended digits
- Thumb free of motion and superimposition
- Each bone outlined through superimposed shadows of the other metacarpals

Essential Projections: Wrist

- PA
- Lateral
- PA oblique
- PA projection in ulnar deviation position

Essential Projections: Wrist

- Collimated field size - 2½ inches proximal and distal to the wrist joint and 1 inch on the sides

Essential Projections: Wrist

- Scaphoid - PA axial (Stecher method)
- Carpal canal - tangential (Gaynor-Hart method)

PA Wrist

- Part position - upper limb on table
  - position entire upper limb in the same plane
  - elbow flexed 90 degrees
  - wrist placed in center of unmasked portion of IR
  - flex digits slightly to place wrist closer to IR
- CR - perpendicular to midcarpal area

PA Wrist

- Evidence of proper collimation
- No rotation in carpals, metacarpals, or radius
- No excessive flexion of digits (digits are not overlapping metacarpals)
- Anatomy demonstrated: distal radius and ulna, carpals, and proximal half of metacarpals
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Lateral Wrist

- Part position
  - rest upper limb on table (axilla in contact)
  - elbow flexed 90 degrees
  - forearm and wrist resting on medial surface (lateromedial projection)

Lateral Wrist

- Part position
  - digits extended
  - radial and ulnar styloid superimposed and perpendicular to IR
- CR - perpendicular to wrist joint

Lateral Wrist

- Evidence of proper collimation
- Superimposed radius and ulna, carpals, and proximal half of metacarpals
- Anatomy demonstrated: distal radius and ulna, carpals, and proximal half of metacarpals

Lateral Wrist

- Density and contrast adequate to make bony trabeculation and soft tissue visible
  - requires increased exposure factors to compensate for greater part thickness

PA Oblique Wrist

- Part position
  - upper limb positioned as described for previous wrist projections
  - from lateral position, rotate palmar surface toward IR until wrist forms 45-degree angle with IR

PA Oblique Wrist

- Part position
  - from pronated position, rotate palmar surface away from IR until wrist forms 45-degree angle with IR
  - support wrist with 45-degree wedge sponge

- CR - perpendicular to midcarpal area, just distal to radius

PA Oblique Wrist

- Evidence of proper collimation
- Adequate amount of obliquity demonstrated by
  - slight interosseous spaces between the third-to-fourth and fourth-to-fifth metacarpal shafts
  - slight overlap of the distal radius and ulna

PA Oblique Wrist

- Well-demonstrated scaphoid and trapezium
- Anatomy demonstrated: distal radius and ulna, carpals, and proximal half of metacarpals
- Density and contrast adequate to make bony trabeculation and soft tissue visible

PA Projection in Ulnar Deviation Position

- Part position
  - upper limb resting on table (axilla in contact) to place entire upper limb in same plane
  - elbow flexed 90 degrees
  - wrist placed in center of unmasked portion of IR

PA Projection in Ulnar Deviation Position

- Part position
  - flex digits slightly to place wrist closer to IR
  - hold hand over wrist while turning hand outward toward the ulna into extreme ulnar deviation
- CR - perpendicular to the scaphoid

PA Projection in Ulnar Deviation Position

- Evidence of proper collimation
- Scaphoid demonstrated without foreshortening and adjacent articulations open
- No rotation of the wrist

PA Projection in Ulnar Deviation Position

- Extreme ulnar deviation - evidenced by an angle formed between longitudinal axes of the forearm compared with the longitudinal axes of the metacarpals
- Density and contrast adequate to make bony trabeculation and soft tissue visible

PA Projection in Radial Deviation Position

- Part position
  - upper limb resting on table (axilla in contact) to place entire upper limb in same plane
  - elbow flexed 90 degrees
  - wrist placed in center of unmasked portion of IR

PA Projection in Radial Deviation Position

- Part position
  - flex digits slightly to place wrist closer to IR
  - hold hand over wrist while turning hand inward toward the radius extreme radial deviation

- CR - perpendicular to the midcarpal area

PA Axial Scaphoid (Stecher Method)

- Part position
  - upper limb resting on table (axilla in contact) to place entire upper limb in the same plane
  - wrist placed in center of unmasked portion of IR
  - place finger end of IR on support to elevate it 20 degrees
  - may also place wrist in ulnar deviation for this projection

PA Axial Scaphoid (Stecher Method)

- CR - perpendicular to table and enters at scaphoid

Note: If proper support for IR is unavailable, CR may be angled 20 degrees toward the elbow.

PA Axial Scaphoid (Stecher Method)

- Evidence of proper collimation
- Scaphoid without self-superimposition
- No rotation in carpals, metacarpals, or radius
- Anatomy demonstrated: distal radius and ulna, carpals, and proximal half of metacarpals
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Tangential Carpal Tunnel Canal (Gaynor-Hart Method)

- Part position
  - forearm resting on table and aligned parallel with long axis of table
  - hyperextend wrist to place long axis of hand as vertical as possible

Tangential Carpal Tunnel Canal (Gaynor-Hart Method)

- Part position
  - center IR to joint at level of radial styloid
  - grasp digits with opposite hand to maintain extended position
  - rotate hand slightly toward radial side

Tangential Carpal Tunnel (Gaynor-Hart Method)

- CR
  - angled 25 to 30 degrees toward palm of hand (elbow)
  - enters at a point approximately 1 inch (2.5 cm) distal to the base of the third metacarpal

Tangential Carpal Tunnel (Gaynor-Hart Method)

- Evidence of proper collimation
- Carpals in an arch arrangement
- Pisiform in profile and free of superimposition
- Hamulus of hamate

Tangential Carpal Tunnel
(Gaynor-Hart Method)

- All carpals (Gaynor-Hart method shows palmar aspect of all carpals)
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Common Fractures

Hand and Wrist

Common Fractures

- Although radiographers are not responsible for diagnosing fractures on images, knowledge of common fracture types is essential to provide optimum patient care while obtaining images of the best possible quality

Common Hand Fractures

- Bennett's
  - a fracture at the base of the first metacarpal
  - often the result of fist fights
- Boxer's
  - a fracture of the fifth metacarpal
  - often caused by direct force to a closed fist

Common Wrist Fractures

- Colles’
  - fracture of the distal radius and ulnar styloid with posterior displacement
  - more common in older adults who fall on an outstretched hand

Common Wrist Fractures

- Smith’s
  - fracture of the distal radius and ulnar styloid with anterior displacement
  - often referred to as a reverse Colles'

Common Wrist Fractures

- Torus or buckle
  - impacted fracture with a bulging of the periosteum
  - most common fracture of the distal radius and ulna in young children

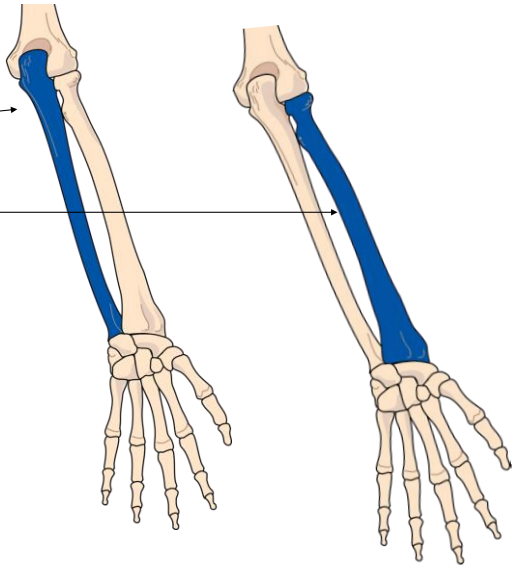
Anatomy and Procedures of the Forearm, Elbow, and Humerus

Anatomy Review

Forearm, Elbow, and Humerus

Anatomy: Forearm

- Consists of two long bones
  - ulna
  - radius
- Ulna is on medial side
- Radius is on lateral side



Anatomy: Forearm

- Ulnar anatomy
  - olecranon process is proximal and posterior
  - trochlear notch directly under olecranon process
  - coronoid process is proximal and anterior
  - body-shaft
  - styloid process is distal
  - ulnar head is distal

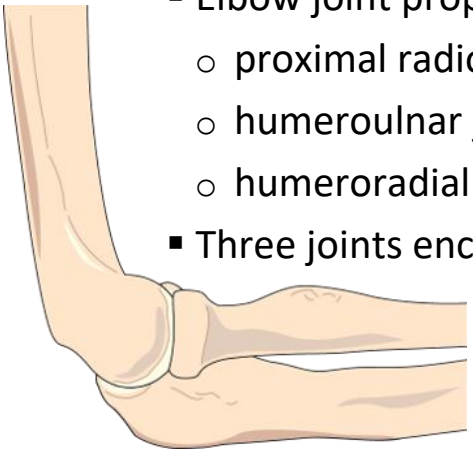
Anatomy: Forearm

- Radial anatomy
  - radial head is proximal
  - radial tuberosity is proximal

Anatomy: Forearm

- Radial anatomy
  - radial head is proximal
  - radial neck directly distal to radial head
  - radial tuberosity is proximal and distal to head/neck
  - body-shaft
  - radial styloid process is distal

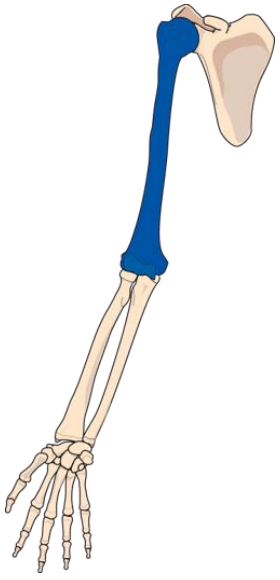
Anatomy: Elbow



- Elbow joint proper
  - proximal radioulnar joint - radius and ulna
  - humeroulnar joint - trochlear and trochlear notch
  - humeroradial joint - capitulum and radial head
- Three joints enclosed in a common capsule

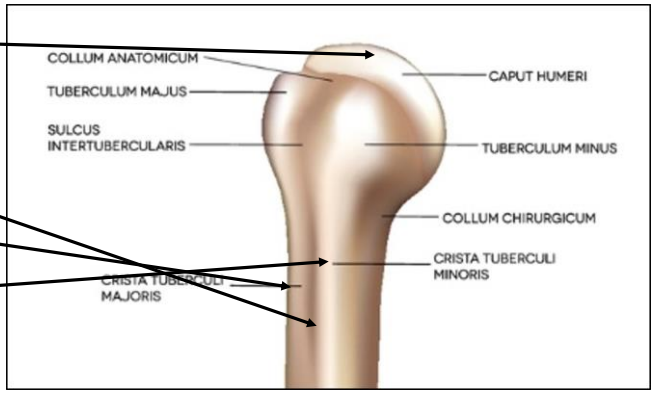
Anatomy: Humerus

- Long bone in the upper arm
- Head articulates with scapula to form shoulder joint
- Distal end forms part of elbow joint



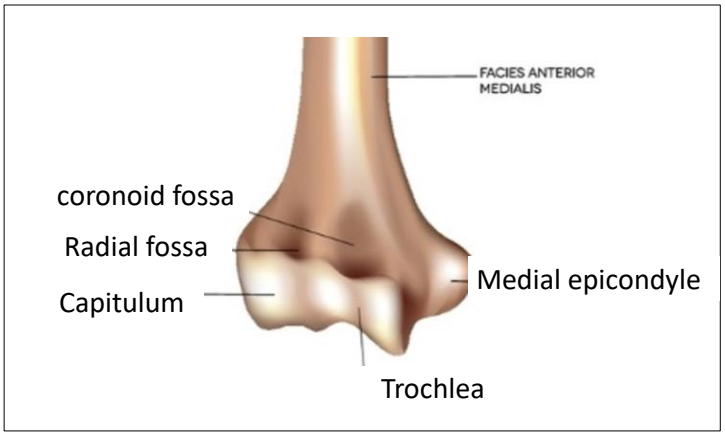
Anatomy: Humerus

- Proximal anatomy
  - head
  - neck
  - surgical neck
  - greater tubercle
  - lesser tubercle



Anatomy: Humerus

- Distal anatomy
  - medial epicondyle
  - lateral epicondyle
  - trochlea
  - capitulum
  - coronoid fossa
  - olecranon fossa (posterior)



General Procedural Guidelines

Forearm, Elbow, and Humerus

General Procedural Guidelines

- Patient preparation
- General patient position
- IR size
- SID
- ID markers
- Radiation protection
- Patient instructions

Patient Preparation

- In general, patient preparation for all procedures of the upper limb require removal of radiopaque artifacts from the anatomy of interest
  - watches, rings, bracelets
  - humerus examinations require removal of bra in female patients and a gown provided
- Secure all patient possessions in designated manner and location

General Patient Position

- Ambulatory patients: radiographs of forearm and elbow are taken with the patient seated at the end of the x-ray table
- The patient's affected limb rests on the IR placed on the tabletop
- Nonambulatory patients: positioning can be altered to allow imaging of this anatomy with the patient in the bed or on a stretcher in a supine position

General Patient Position

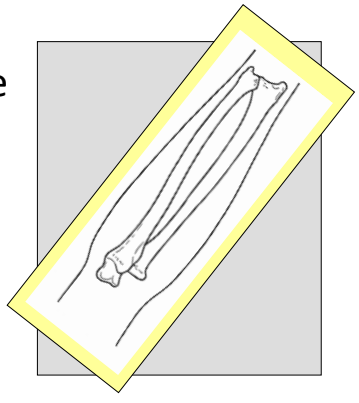
- Humerus radiographs may be obtained with the patient standing or seated upright or in supine position on the radiographic table or on a stretcher

IR/Collimated Field Size

- Textbook gives most common IR sizes used for procedures of the forearm, elbow, and humerus
- Use the smallest IR available that will adequately demonstrate all of the anatomy of interest
- Place more than one projection on an IR, when possible; lead rubber must be used to protect the unexposed side of the IR
- Always use close collimation

IR/Collimated Field Size

- Some facilities allow the collimated field *(yellow)* to be aligned diagonally on the IR *(gray)* to accommodate long bones



SID

- SID is standardized as a part of procedural protocol
  - when SID is not specified under a projection, 40 inches (102 cm) is recommended

ID Markers

- Right or left side markers must be included on at least one of the projections on an IR
- All other vital ID markers must be included either in the blocker or on the final image
- Avoid using digital annotation to place side markers on images

Radiation Protection

- A lead apron or a piece of lead rubber should be placed over reproductive organs for radiation protection
- Close collimation and use of optimum technique factors also protect patient from unnecessary radiation exposure

Patient Instructions

- Explain and demonstrate the positions to be performed
- After the patient's anatomy has been placed in the proper position, it is usually sufficient to remind the patient to hold the position until given further instructions
- Humerus examinations require the patient to suspend respirations during the exposure

Radiographic Procedures

Essential Projections of the
Forearm, Elbow, and Humerus

Essential Projections: Forearm

- AP
- Lateral

Essential Projections: Forearm

- Collimated field size - 2 inches distal to the wrist joint and proximal to the elbow joint, and 1 inch on the sides

AP Forearm

- Part position
  - elbow extended with hand supinated
  - upper limb in same plane
  - humeral epicondyles equidistant from IR
  - long axis of forearm aligned parallel

AP Forearm

- CR
  - perpendicular to IR
  - enters patient at midpoint of forearm

AP Forearm

- Evidence of proper collimation
- Wrist to distal humerus demonstrated
- Radial head, neck, and tuberosity slightly superimposed on proximal ulna
- No elongation or foreshortening of humeral epicondyles

AP Forearm

- Elbow joint partially open
- Density similar on proximal and distal portions of forearm
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Lateral Forearm

- Part position
  - entire upper limb in same plane with forearm resting on ulnar surface (lateromedial projection)
  - elbow flexed 90 degrees
  - ulnar and radial styloid processes superimposed
  - long axis aligned parallel with IR
  - digits extended and in true lateral

Lateral Forearm

- CR
  - directed perpendicular to the IR
  - enters patient at midpoint of forearm

Lateral Forearm

- Evidence of proper collimation
- Wrist to distal humerus demonstrated
- Lateral position demonstrated by
  - superimposition of humeral epicondyles
  - superimposition of distal ends of radius and ulna
  - elbow flexed 90 degrees

Lateral Forearm

- Radial head superimposed over coronoid process
- Radial tuberosity pointing anteriorly
- Density and contrast adequate to make bony trabeculation and soft tissue visible

Essential Projections: Elbow

- AP
- Lateral
- AP oblique
  - medial rotation position
  - lateral rotation position

Essential Projections: Elbow

- AP
  - partial flexion position to demonstrate distal humerus
  - partial flexion position to demonstrate proximal forearm
- Axiolateral (Coyle method)

Essential Projections: Elbow

- Collimated field size - 3 inches proximal and distal to the elbow joint, and 1 inch on the sides

AP Elbow

- Part position
  - upper limb in same plane with posterior surface in contact with IR
  - elbow extended and hand supinated
  - elbow centered to middle of unmasked portion of IR
  - humeral epicondyles parallel with IR
- CR - perpendicular to elbow joint

AP Elbow

- Evidence of proper collimation
- Radial head, neck, and tuberosity slightly superimposed over proximal ulna
- Elbow joint open and centered
- No rotation of humeral epicondyles
- Density and contrast sufficient to make bony trabeculation and soft tissues visible

Lateral Elbow

- Part position
  - limb in same plane with long axis parallel to IR
  - elbow flexed 90 degrees and placed in center of unmasked part of IR
  - forearm resting on ulnar surface
  - wrist in true lateral
- CR - perpendicular to elbow joint

Lateral Elbow

- Evidence of proper collimation
- Open elbow joint in center of IR and collimated field
- Elbow flexed 90 degrees
- Superimposed humeral epicondyles
- Radial tuberosity facing anteriorly

Lateral Elbow

- Radial head partially superimposing the coronoid process
- Olecranon process in profile
- Density and contrast adequate to make bony trabeculation, soft tissues, and any elevated fat pads visible

AP Oblique Elbow
Medial Rotation Position

- Part position
  - limb in same plane with elbow extended
  - elbow centered to unmasked part of IR
  - pronate hand and medially, or internally, rotate elbow to place anterior surface 45 degrees from IR plane
- CR - perpendicular to elbow joint

AP Oblique Elbow
Medial Rotation Position

- Evidence of proper collimation
- Coronoid process in profile
- Elongated medial epicondyle
- Ulna superimposed by radial head and neck
- Olecranon process within the olecranon fossa
- Density and contrast adequate to make bony trabeculation and soft tissue visible

AP Oblique Elbow
Lateral Rotation Position

- Part position
  - limb in same plane with elbow extended
  - elbow centered to unmasked part of IR
  - supinate hand and laterally, or externally, rotate elbow to place anterior surface 45 degrees from IR plane
  - first and second digits will touch table when elbow is sufficiently rotated
- CR - perpendicular to elbow joint

AP Oblique Elbow
Lateral Rotation Position

- Evidence of proper collimation
- Radial head, neck, and tuberosity projected free of ulna
- Open elbow joint
- Density and contrast adequate to make bony trabeculation and soft tissue visible

AP Elbow - Distal Humerus
Partial Flexion Position

- Can be used in place of AP projection of elbow when patient cannot completely extend the joint
- Requires distal humerus and proximal forearm to be imaged separately

AP Elbow - Distal Humerus
Partial Flexion Position

- Part position
  - humerus in same plane with posterior surface resting on IR
  - elevated forearm supported
  - supinate hand, if possible, and center IR to condyles of humerus
- CR - perpendicular to humerus, passing through elbow joint

AP Elbow - Distal Humerus
Partial Flexion Position

- Evidence of proper collimation
- Distal humerus without rotation or distortion
- Proximal radius superimposed over the ulna
- Closed elbow joint
- Greatly foreshortened proximal forearm
- Trabecular detail on distal humerus

AP Elbow - Proximal Forearm
Partial Flexion Position

- Part position
  - Leaving elbow flexed, place dorsal surface of forearm on IR
  - Supinate hand, if possible, and center IR to condyles of humerus
- CR
  - Perpendicular to elbow joint and long axis of forearm

Axiolateral (Coyle)

- Useful in trauma to demonstrate radial head and coronoid process
- Part position - for radial head
  - elbow flexed 90 degrees
  - hand pronated
- CR angled 45 degrees toward shoulder

Axiolateral (Coyle)

- Part position – for coronoid process
  - elbow flexed 80 degrees
  - hand pronated
- CR angled 45 degrees away from shoulder

Axiolateral (Coyle)

- Radial head
  - evidence of proper collimation
  - open joint space between radial head and capitulum
  - radial head, neck, and tuberosity in profile and mostly free of superimposition

Axiolateral (Coyle)

- Radial head
  - humeral epicondyles distorted (CR angle)
  - radial tuberosity facing posteriorly
  - elbow flexed 90 degrees
  - soft tissue and bony trabeculation visible

Axiolateral (Coyle)

- Coronoid process
  - open joint space between coronoid process and trochlea
  - coronoid process in profile and elongated
  - radial head and neck superimposed by ulna
  - elbow flexed 80 degrees
  - soft tissue and bony trabeculation visible

Essential Projections: Humerus

- AP
- Lateral
- Lateral for known or suspected fracture

Note: Humerus is usually imaged using the Bucky, if possible. The lateral projection for a fracture does not use the Bucky.

Essential Projections: Humerus

- Collimated field size - 2 inches distal to the elbow joint and superior to the shoulder, and 1 inch on the sides

AP Humerus

- Part position
  - place top border of IR approximately 1½ inches (3.8 cm) above humeral head
  - slightly abduct humerus from body and supinate hand
  - coronal plane passing through humeral epicondyles should be placed parallel to IR plane
- CR - perpendicular to midportion of humerus and centered to IR

AP Humerus

- Evidence of proper collimation
- Elbow and shoulder joints
- Maximal visibility of epicondyles without rotation
- Humeral head and greater tubercle in profile

AP Humerus

- Outline of the lesser tubercle seen between humeral head and greater tubercle
- Beam divergence partially closes elbow joint
- Little variation in density of proximal and distal humerus

Lateral Humerus

- Part position
  - place top border of IR approximately 1½ inches (3.8 cm) above humeral head
  - if possible, internally rotate humerus, flex elbow 90 degrees, and rest palm of hand on hip
  - coronal plane passing through epicondyles should be perpendicular to plane of IR

Lateral Humerus

- CR - perpendicular to midportion of humerus and centered to IR

Lateral Humerus

- CR
  - for recumbent (supine) position: horizontal and perpendicular to midportion of humerus (between the elbow joint and the shoulder joint) and centered to IR
  - for lateral recumbent position: perpendicular to midportion of humerus and centered to IR
- Collimated field - include as much of proximal humerus as possible to below the elbow joint

Lateral Humerus

- Evidence of proper collimation
- Elbow and shoulder joints
- Superimposed epicondyles
- Lesser tubercle in profile
- Greater tubercle superimposed over humeral head
- Beam divergence partially closed elbow joint
- Little variation in density of proximal and distal humerus

Common Fractures

Forearm, Elbow, and Humerus

Common Fractures

- Monteggia - fracture of proximal third of ulna with dislocation of radial head
- Supracondylar fracture
  - most common elbow fracture in children
  - fracture of the distal humerus above the humeral condyles
- Humeral fracture - typically in adults that have fallen

Anatomy & Positioning: Upper Extremities

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