

Upper Limb and Shoulder Girdle

Learning Objectives

At the conclusion of this chapter, you will be able to:

- Name the bones that compose the upper limb and shoulder girdle and identify each on an anatomic diagram and on a radiograph
- Name and identify the significant bony prominences and depressions of the upper limb and shoulder girdle and identify significant positioning landmarks by palpation
- Demonstrate correct body and part positioning for routine projections and common special projections of the upper limb and shoulder girdle
- Correctly evaluate radiographs of the upper limb and shoulder girdle for positioning accuracy
- Describe and recognize on radiographs pathology common to the upper limb and shoulder girdle

Key Terms

acromion process	osteoarthritis
axilla	osteoblastic
bursitis	osteolytic
carpal bones	osteomyelitis
carpus	osteophytes
clavicle	phalanx (pl. phalanges)
coracoid process	radial deviation
digits	radius
fat pad sign	scapula
glenoid process	sesamoid bones
humerus	tendinitis
joint effusion	ulna
metacarpals	ulnar deviation
olecranon process	

Although the focus of this chapter is on the upper limb and shoulder girdle, many of the principles introduced in this chapter apply equally well to the lower limb. For example, similar types of fractures and other pathologies occur in both the upper and the lower extremities.

ANATOMY

The upper limb, also called the upper extremity, includes the fingers, thumb, hand, wrist, forearm, elbow, humerus, and shoulder girdle (Fig. 13.1).

Fingers and Thumb

The fingers are called the **digits** and are considered to be part of the hand (Fig. 13.2). They are numbered from 1 to 5, beginning with the thumb. Digits 2 through 5 consist of three small long bones called **phalanges** (singular, **phalanx**). The phalanges are distinguished from one another as proximal (nearest the hand), middle, and distal. For example, the bone at the tip of the “ring finger” is called the *fourth distal phalanx*. The rounded tips of the distal phalanges are called *ungual tufts*. The hinge joints that connect the phalanges are called the *interphalangeal (IP) joints* and are distinguished as proximal and distal. The thumb has only two phalanges with one IP joint.

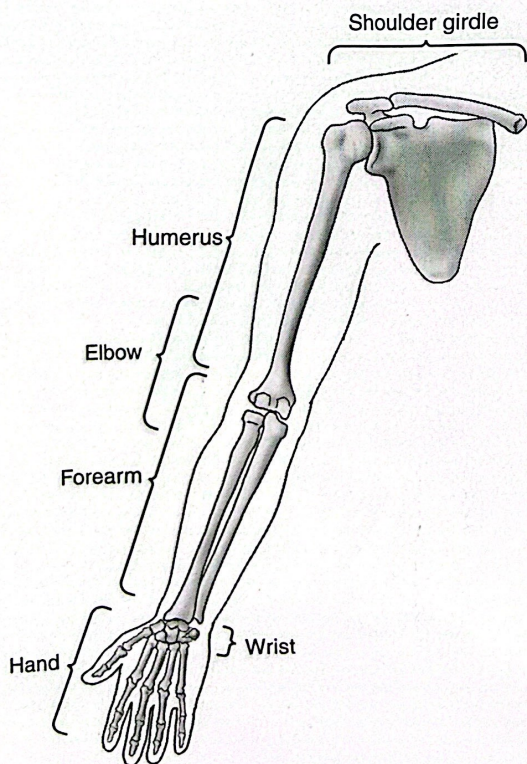


Fig. 13.1 Upper limb.

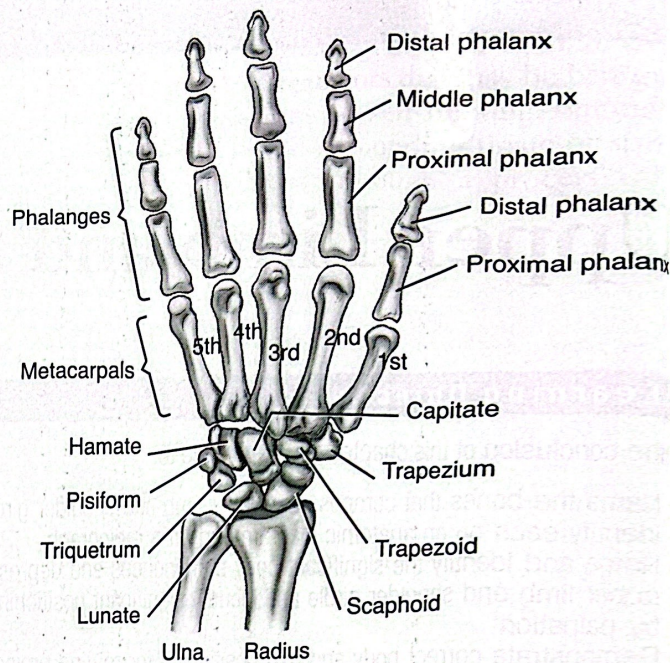


Fig. 13.2 Posterior aspect of hand and wrist.

Hand

The bones of the hand are called **metacarpals**. They are numbered 1 through 5, starting on the lateral aspect. The numbers correspond to the digits with which they articulate. The distal end of a metacarpal is called its *head*, and the proximal end is referred to as the *base*. For example, the thumb is attached to the head of the first metacarpal. The hinge joints between the metacarpals and the proximal phalanges are called the *metacarpophalangeal (MCP) joints*.

There are usually one or more small bones in the region of the first MCP joint called **sesamoid bones**. These small, flat, oval bones within tendons are not counted among the bones of the body. They are called *sesamoid bones* because they resemble a sesame seed. They serve to protect the joint.

Wrist

The wrist consists of eight short bones called **carpal bones**. Together, they are referred to as the **carpus**. They are arranged in two rows. Beginning with the proximal row on the lateral aspect (thumb side), they are named *scaphoid*, *lunate*, *triquetrum*, and *pisiform*. The scaphoid is the most frequently fractured carpal bone. Continuing back toward the thumb, the distal row consists of the *trapezium*, *trapezoid*, *capitate*, and *hamate*. The capitate is the largest of the carpal bones. There is a small curved projection on the anterior aspect of the hamate called the *hook* or *hamulus*. As a whole, the wrist is capable of all joint motions except rotation. It moves in four directions: anterior, posterior, medial, and lateral. The greatest degree of movement is (anterior) flexion, followed by (posterior) extension,

ulnar deviation, and **radial deviation** (Fig. 13.3). Ulnar deviation occurs when the hand is moved toward the medial (ulnar) side of the wrist. Movement of the hand toward the lateral (radial) side of the wrist is radial deviation.

Forearm

The forearm (Fig. 13.4) consists of two long bones, the **radius** and the **ulna**. The ulna is the longer, thinner bone on the medial aspect. The radius is thicker and somewhat shorter and is located on the lateral aspect. The styloid process of the radius is a bony prominence that can be

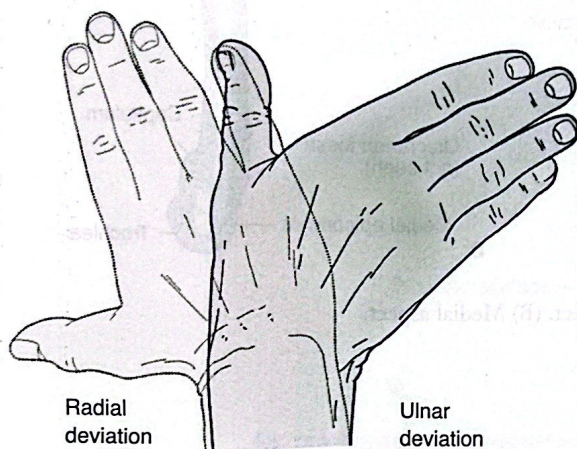


Fig. 13.3 Illustration of radial deviation and ulnar deviation at the wrist.

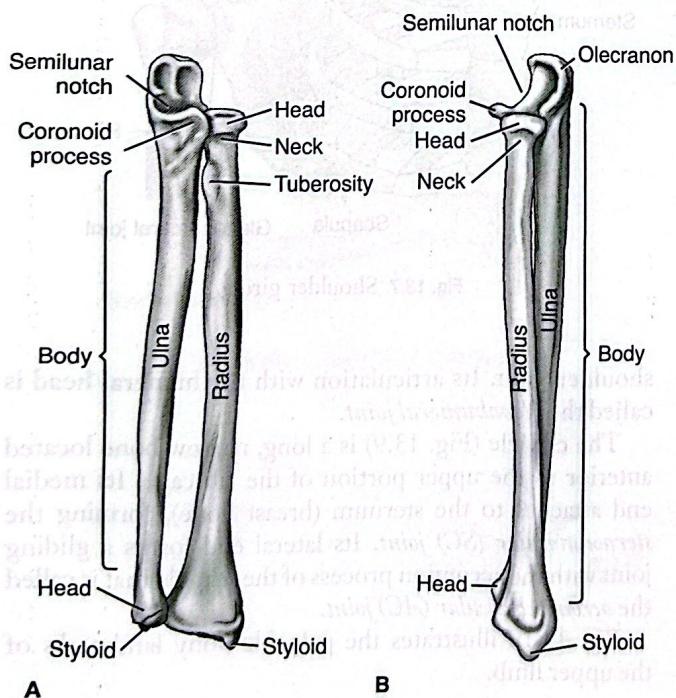


Fig. 13.4 Forearm. (A) Anterior aspect. (B) Lateral aspect.

palpated on the lateral aspect of the wrist. The ulnar styloid can be felt on the posteromedial aspect of the wrist; it is most prominent when the hand is pronated. Pronation causes the radius to cross over the ulna (Fig. 13.5). The forearm is radiographed with the hand in supination to prevent this superimposition.

The proximal end of the radius is referred to as the **radial head**. The **radial tuberosity**, which is distal to the radial head, is a muscle attachment that is not normally palpable.

The proximal end of the ulna terminates in the posterior aspect of the olecranon process. In lay terms, the **olecranon process** is sometimes called the *funny bone* or *crazy bone*. Anterior to the olecranon process is the semilunar notch. The inferior lip of the semilunar notch is called the **coronoid process**.

Humerus

The single bone of the upper arm is called the **humerus** (Fig. 13.6). The distal end of the humerus is the humeral condyle. Just superior to the condyle are two palpable prominences, the medial and lateral epicondyles. Between the epicondyles on the posterior aspect is the olecranon fossa, a depression into which the olecranon process of the proximal ulna fits when the elbow joint is extended. There are two distal articular surfaces on the humerus: the rounded capitulum (also called the *capitellum*), which articulates with the head of the radius, and the trochlea, a spool-shaped process that articulates within the semilunar notch of the ulna. Just superior to the trochlea is the coronoid fossa, into which the coronoid process of the ulna fits when the elbow is flexed. Just superior to the capitulum is the radial fossa, a depression into which the radial head fits when the elbow joint is flexed.

The superior end of the humerus is called the **head**. The portion just inferior to the head is the **anatomic neck**. Two prominences on the head of the humerus are significant: the greater tubercle, which is superior and lateral, and the lesser tubercle, which is medial and inferior. The greater tubercle can be felt on the upper outer aspect of

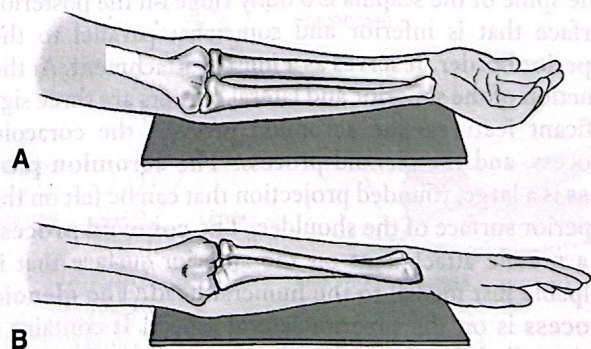


Fig. 13.5 Positions of forearm bones. (A) Supination. (B) Pronation.

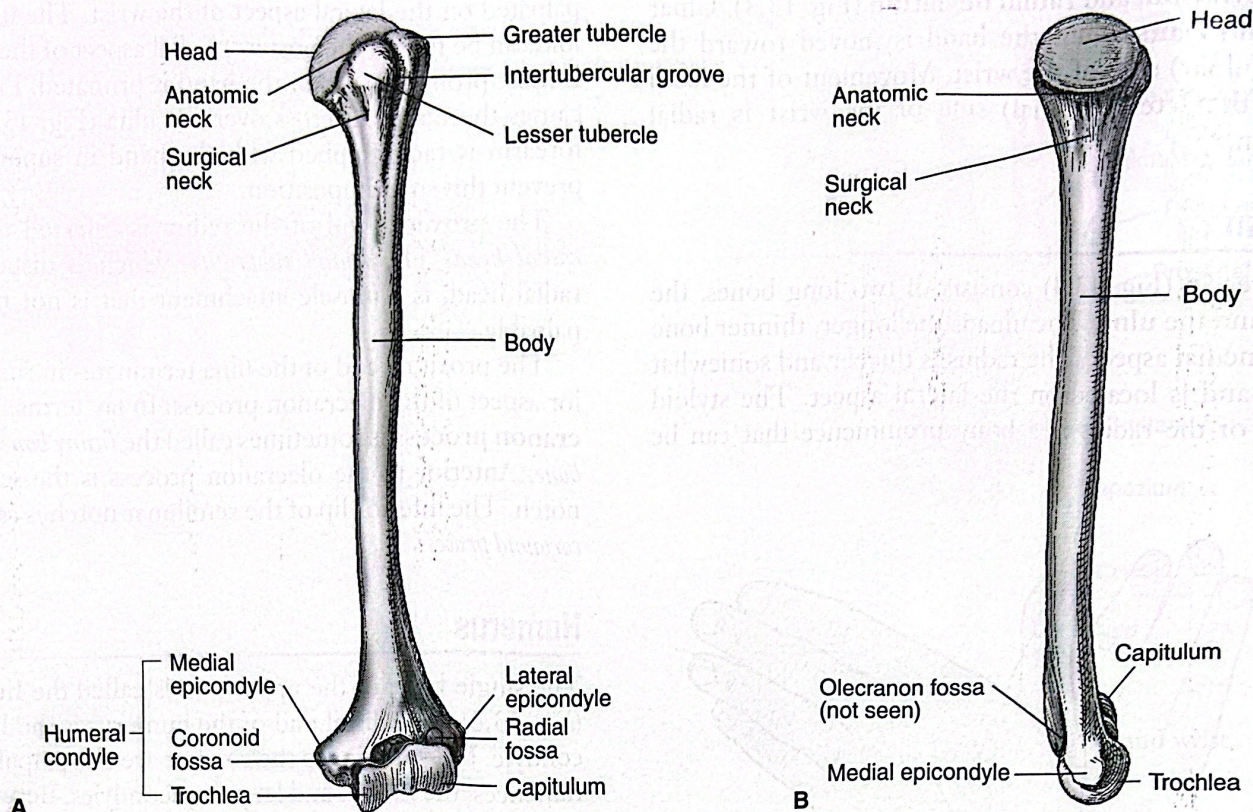


Fig. 13.6 Humerus. (A) Anterior aspect. (B) Medial aspect.

the shoulder when the patient is in anatomic position. The constricted area just distal to the tubercles is called the *surgical neck*, which is a common site of fractures.

Shoulder Girdle

The bones of the shoulder are often referred to as the *shoulder girdle* (Fig. 13.7). They include the **scapula** (shoulder blade), the **clavicle** (collar bone), and the proximal portion of the humerus.

The scapula (Fig. 13.8) is a flat, triangular bone. Its three sides are called the *superior border*, the *lateral border*, and the *medial border*. The junction of the lateral and medial borders at the lower tip is called the *inferior angle*. The spine of the scapula is a bony ridge on the posterior surface that is inferior and somewhat parallel to the superior border. It serves as a muscle attachment. At the junction of the superior and lateral borders are three significant features: the acromion process, the coracoid process, and the glenoid process. The **acromion process** is a large, rounded projection that can be felt on the superior surface of the shoulder. The **coracoid process** is a muscle attachment on the anterior surface that is palpable just medial to the humeral head. The **glenoid process** is on the superior lateral aspect. It contains a cavity called the *glenoid fossa* that forms the socket of the

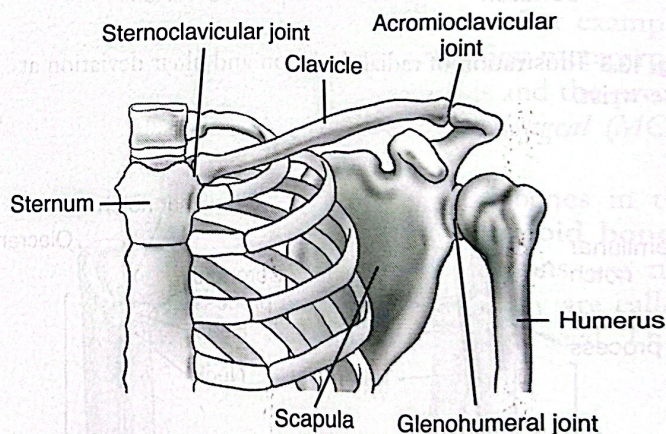


Fig. 13.7 Shoulder girdle.

shoulder joint. Its articulation with the humeral head is called the *glenohumeral joint*.

The clavicle (Fig. 13.9) is a long, narrow bone located anterior to the upper portion of the rib cage. Its medial end attaches to the sternum (breast bone), forming the *sternoclavicular (SC) joint*. Its lateral end forms a gliding joint with the acromion process of the scapula that is called the *acromioclavicular (AC) joint*.

Fig. 13.10 illustrates the palpable bony landmarks of the upper limb.

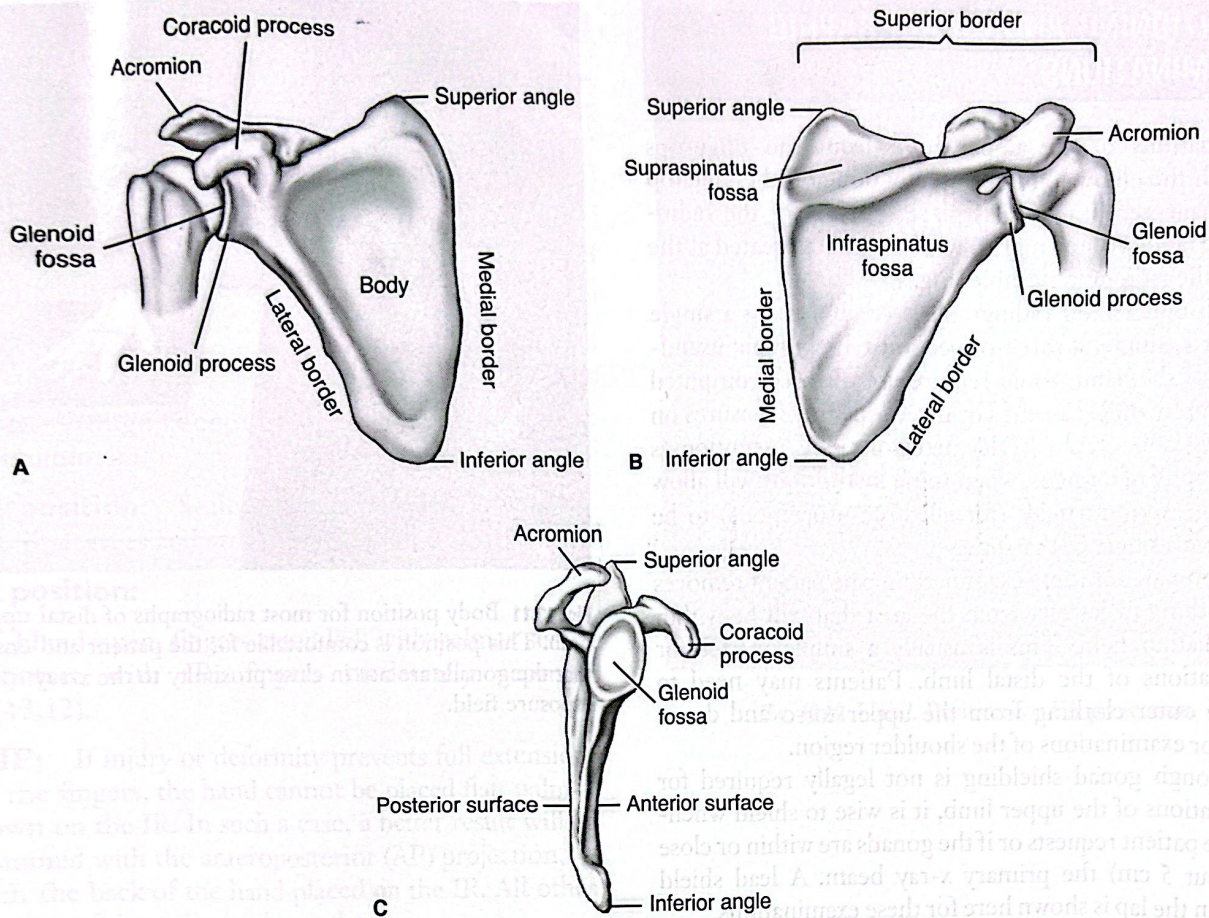


Fig. 13.8 Scapula. (A) Anterior aspect. (B) Posterior aspect. (C) Lateral aspect.

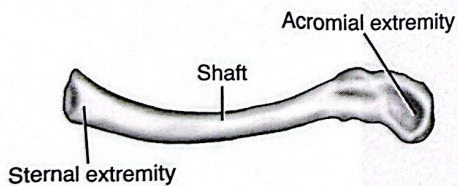


Fig. 13.9 Anterior aspect of clavicle.

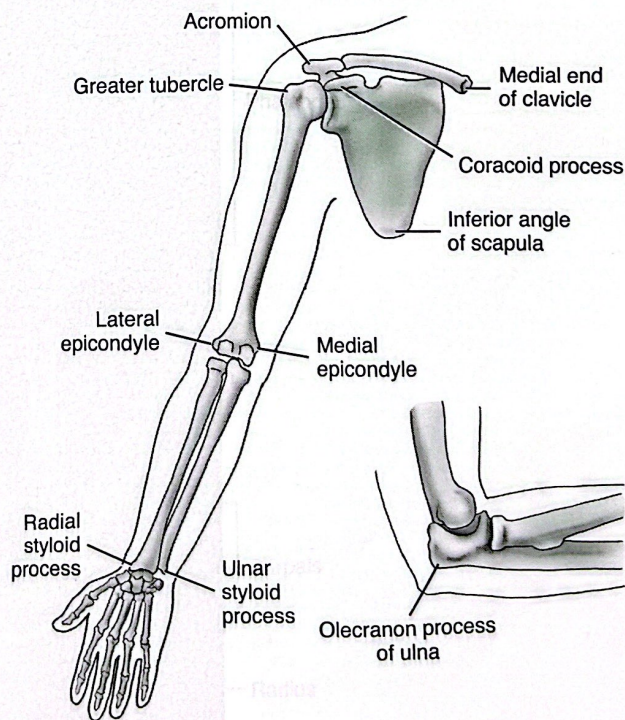


Fig. 13.10 Palpable bony landmarks of upper limb.

POSITIONING AND RADIOGRAPHIC EXAMINATIONS

Examinations of the upper limb from the fingertips through the elbow joint are usually done on the tabletop (the image receptor [IR] is placed on top of the radiographic table without a grid) with the patient seated at the end of the radiographic table (Fig. 13.11).

Each upper limb radiograph is created using a single IR. For example, a three-projection radiographic examination of the hand would require use of three computed radiography (CR) cassettes or three separate exposures on a digital radiography (DR) detector. The exception is radiography of a finger, when some institutions will allow multiple exposure fields (for all three projections) to be placed on a single CR cassette.

To prepare for these examinations, the patient removes any clothing or jewelry from the area that will be within the radiation field. This is usually a simple matter for examinations of the distal limb. Patients may need to remove outer clothing from the upper torso and don a gown for examinations of the shoulder region.

Although gonad shielding is not legally required for examinations of the upper limb, it is wise to shield whenever the patient requests or if the gonads are within or close to (about 5 cm) the primary x-ray beam. A lead shield placed in the lap is shown here for these examinations.



Fig. 13.11 Body position for most radiographs of distal upper limb. This position is comfortable for the patient and ensures that the gonads are not in close proximity to the x-ray exposure field.

Hand

ROUTINE EXAMINATION

The routine examination of the hand includes the posteroanterior (PA), PA oblique-lateral rotation, and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) or 10 × 12 inches (24 × 30 cm)

Grid: No

Source–image receptor distance (SID): 40 inches minimum

Body position: Seated at end of table with elbow flexed 90 degrees and arm resting on the table.

Part position:

PA: Hand open, fingers extended, with palmar surface in contact with IR, fingers moderately separated (Fig. 13.12).

TIP: If injury or deformity prevents full extension of the fingers, the hand cannot be placed flat, palm-down on the IR. In such a case, a better result will be obtained with the anteroposterior (AP) projection, with the back of the hand placed on the IR. All other aspects of the radiograph are the same.

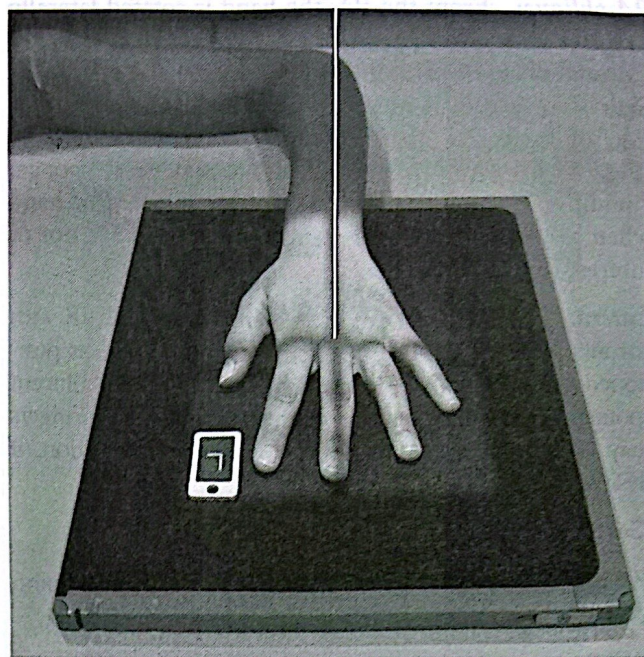


Fig. 13.12 Hand. Position for PA projection.

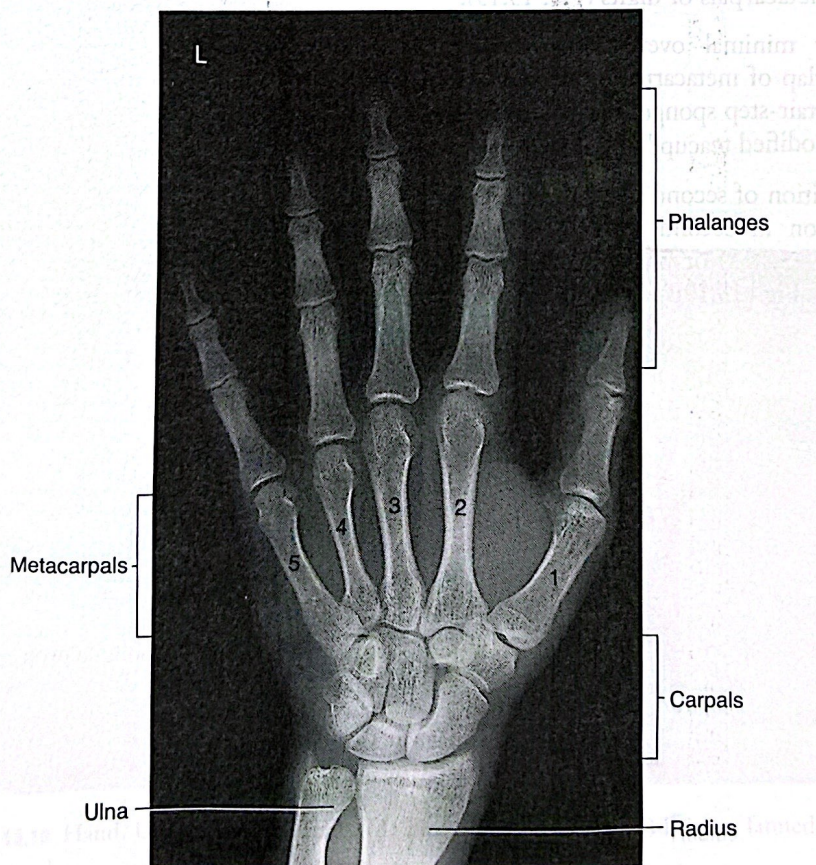


Fig. 13.13 Hand. PA projection.

PA oblique: From the PA, the hand is rotated laterally to place the anteromedial aspect in contact with IR. Coronal plane of hand forms a 45-degree angle with IR. Stair-step sponge is used to support and maintain position of fingers so that IP joints are clearly visualized (Fig. 13.14). Alternatively, without stair-step sponge, “modified teacup” position (named for position of hand when holding a teacup) is used when fingers are not of interest (Fig. 13.16).

Lateral: Medial aspect of hand is in contact with IR with coronal plane of hand perpendicular to IR. Thumb is positioned as for PA projection and is supported on a radiolucent sponge. Wrist will be slightly pronated (Fig. 13.18A). Fingers may be separated (fanned) to prevent superimposition, if desired (see Fig. 13.18B).

Central ray:

PA and PA oblique: Perpendicular to third MCP joint.

Lateral: Perpendicular to second MCP joint.

Collimation: Adjust light field to 1 inch (2.5 cm) on all sides of the hand, including 1 inch (2.5 cm) proximal to the ulnar styloid process. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Anatomy of entire hand (including fingertips), carpus, and distal radius and ulna.

PA: No overlap of metacarpals or digits (Fig. 13.13).

PA oblique: No or minimal overlap of metacarpal shafts, with some overlap of metacarpal heads and bases. IP joint spaces open (stair-step sponge, Fig. 13.15) or not well demonstrated (“modified teacup,” Fig. 13.17).

Lateral: Superimposition of second through fifth metacarpals. Superimposition of second through fifth phalanges (extension, Fig. 13.19A) or phalanges individually demonstrated (fanned, Fig. 13.19B). Thumb is seen in PA projection.

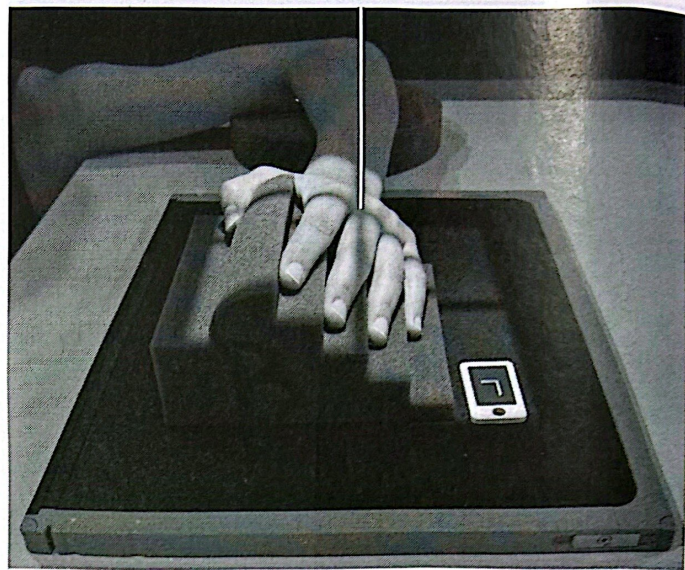


Fig. 13.14 Hand. Position for PA oblique projection—lateral rotation, using stair-step sponge.



Fig. 13.15 Hand. PA oblique projection, using stair-step sponge.

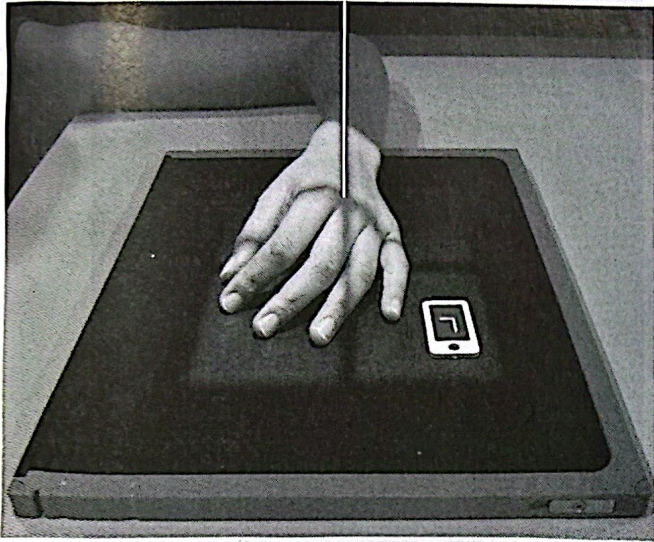


Fig. 13.16 Hand. Position for PA oblique projection—lateral rotation, “modified teacup” position.



Fig. 13.17 Hand. PA oblique projection, “modified teacup” position.

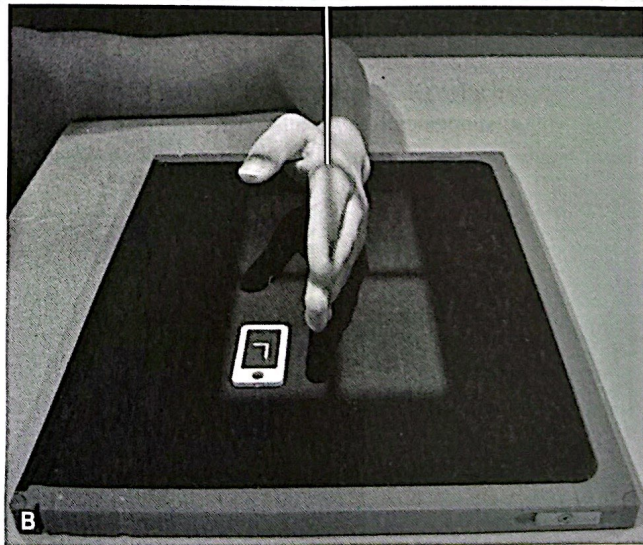
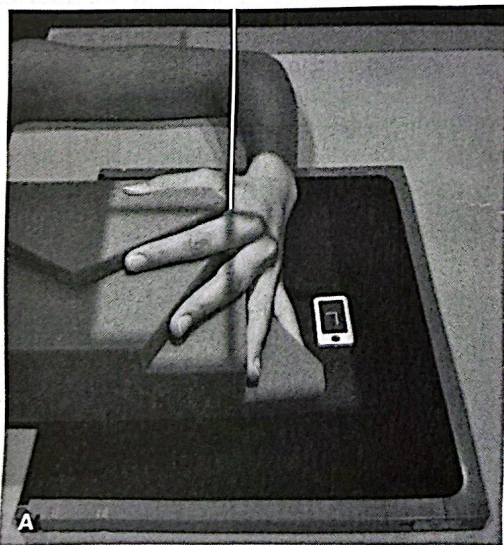


Fig. 13.18 Hand. Ulnar lateral position. (A) Fingers in extension. (B) Fingers fanned.

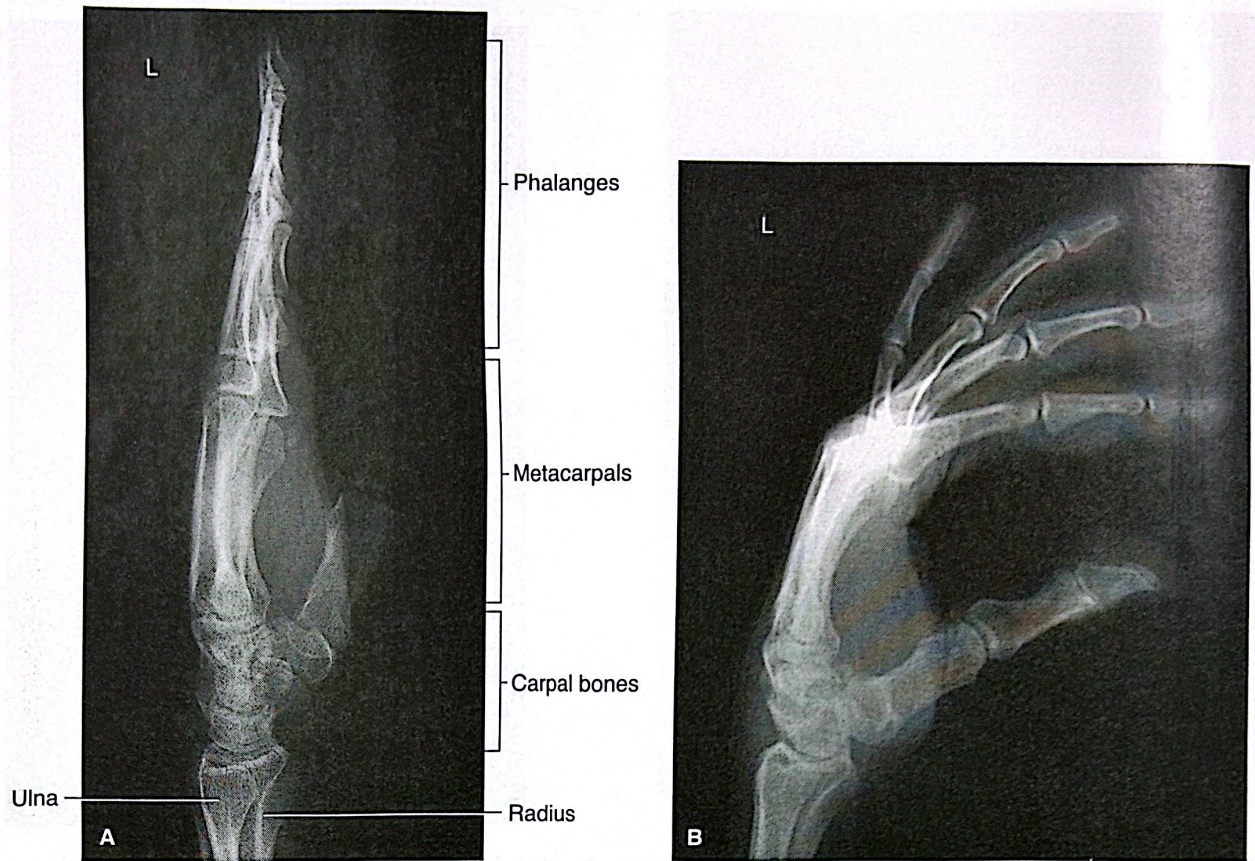


Fig. 13.19 Hand. Lateral (lateromedial) projection. (A) Fingers in extension. (B) Fingers fanned.

Fingers

Although the fingers are included in the examination of the hand, separate finger studies are often performed when the area of clinical interest is limited to a specific finger. Depending on department protocol, the routine projections for the fingers may include a PA projection of the entire hand plus oblique and lateral projections of the affected finger, or the examination may be limited to the PA, oblique, and lateral projections of the affected finger only. Each projection of the finger should include at least the entire digit and the distal portion of the corresponding metacarpal. It is not uncommon that the digits on either side of the digit of interest are also included.

The hand position for lateral projections of the fingers will vary, depending on which finger is involved and what movements are possible for the patient.

Keep the finger as close to the IR as possible and maintain the finger in a position parallel to the IR. When the finger is angled in relation to the IR, the IP and MCP joint spaces are not well seen (Fig. 13.20). A stair-step sponge is a desirable aid for oblique and lateral positioning because it supports the finger parallel to the IR. This position decreases distortion and improves visualization of the IP joints. A stair-step sponge or other radiolucent support also reduces the motion that is likely to occur if the finger trembles because it is not supported during the exposure.

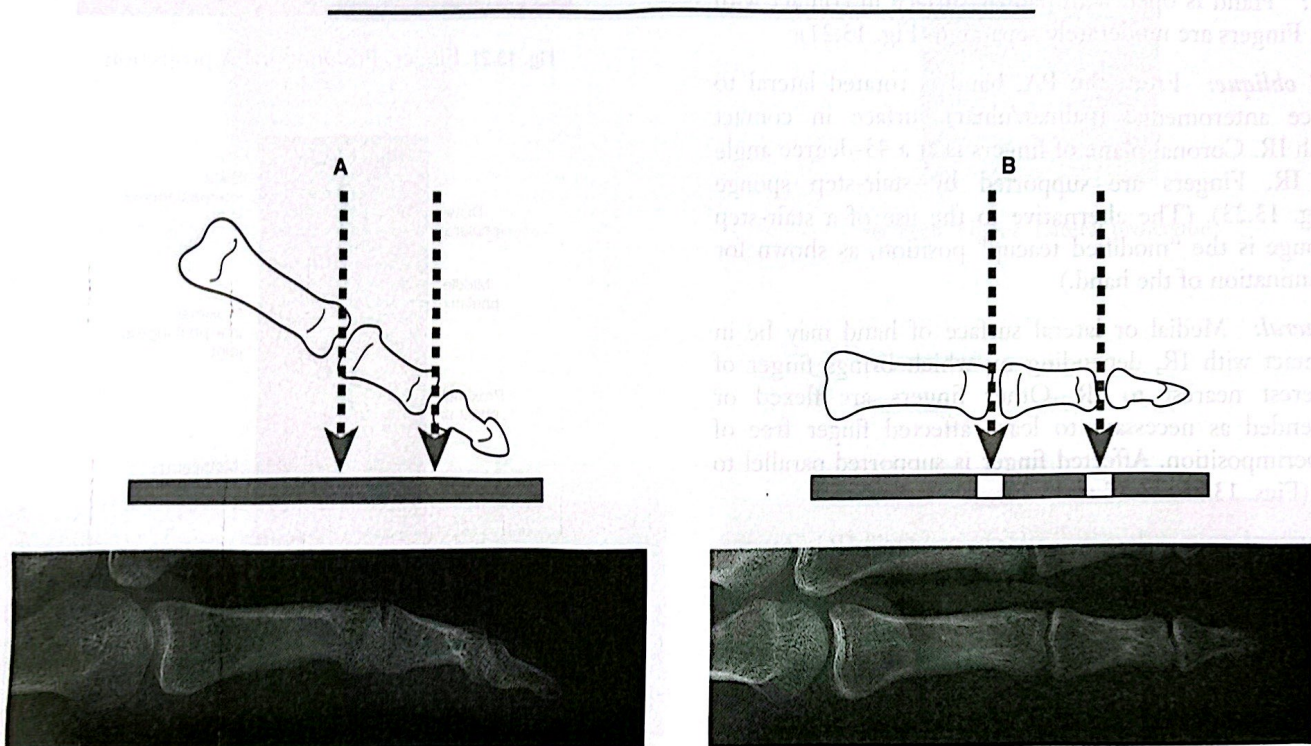


Fig. 13.20 (A) Orientation of finger with hand in “modified teacup” position. Finger is not parallel to image receptor (IR). Articular surfaces are not parallel to central ray (CR), which obscures interphalangeal (IP) joint spaces. (B) Orientation of finger when stair-step sponge is used. Finger is parallel to IR and articular surfaces are parallel to CR, so IP joint spaces are visible.

ROUTINE EXAMINATION

The routine examination of the fingers includes the PA, PA oblique-lateral rotation, and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position: Seated at end of table with elbow flexed and arm resting on table.

Part position:

PA: Hand is open with palmar surface in contact with IR. Fingers are moderately separated (Fig. 13.21).

PA oblique: From the PA, hand is rotated lateral to place anteromedial (palmar/ulnar) surface in contact with IR. Coronal plane of fingers is at a 45-degree angle to IR. Fingers are supported by stair-step sponge (Fig. 13.23). (The alternative to the use of a stair-step sponge is the “modified teacup” position, as shown for examination of the hand.)

Lateral: Medial or lateral surface of hand may be in contact with IR, depending on which brings finger of interest nearest to IR. Other fingers are flexed or extended as necessary to leave affected finger free of superimposition. Affected finger is supported parallel to IR (Figs. 13.25, 13.27 to 13.29).

Central ray: Perpendicular to proximal IP joint.

Collimation: Adjust light field to 1 inch (2.5 cm) on all sides of the digit, including 1 inch (2.5 cm) proximal to the MCP joint. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Entire digit and distal portion of metacarpal with IP and MCP joint spaces open and clearly visualized (Figs. 13.22, 13.24, and 13.26). Department protocol may require including an adjacent digit in each image.

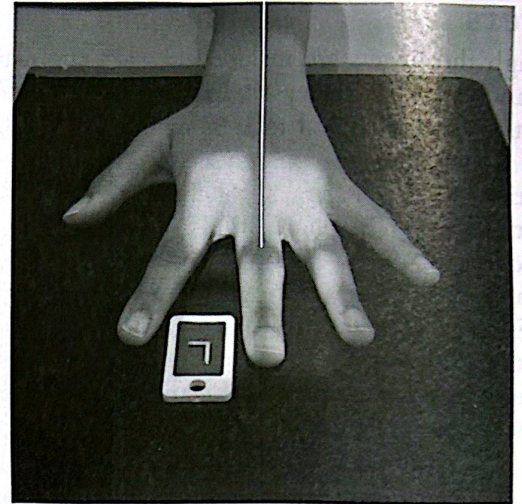


Fig. 13.21 Finger. Position for PA projection.

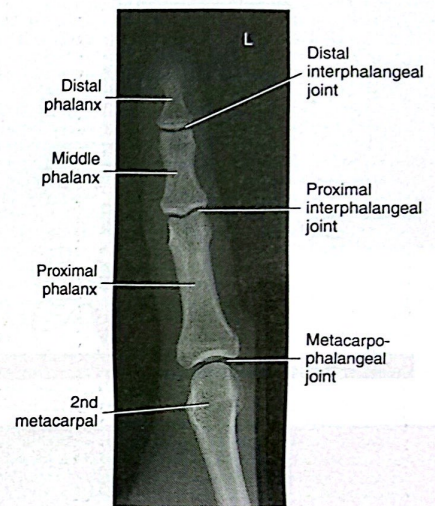


Fig. 13.22 Finger. PA projection.

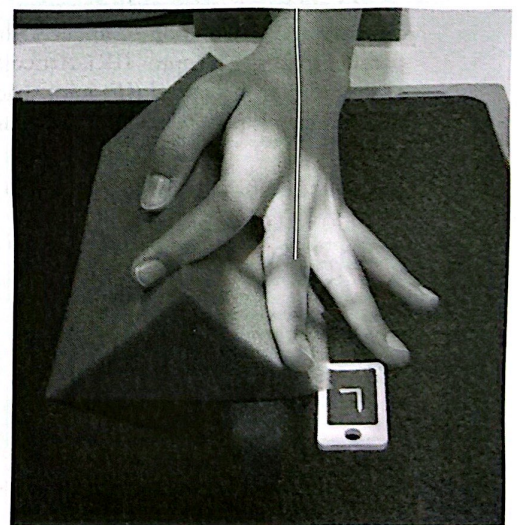


Fig. 13.23 Finger. Position for PA oblique projection—lateral rotation.

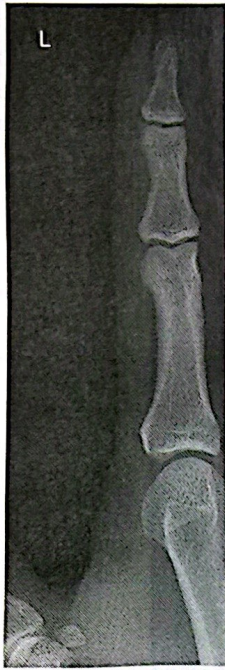


Fig. 13.24 Finger. PA oblique projection.



Fig. 13.26 Finger. Lateral projection.

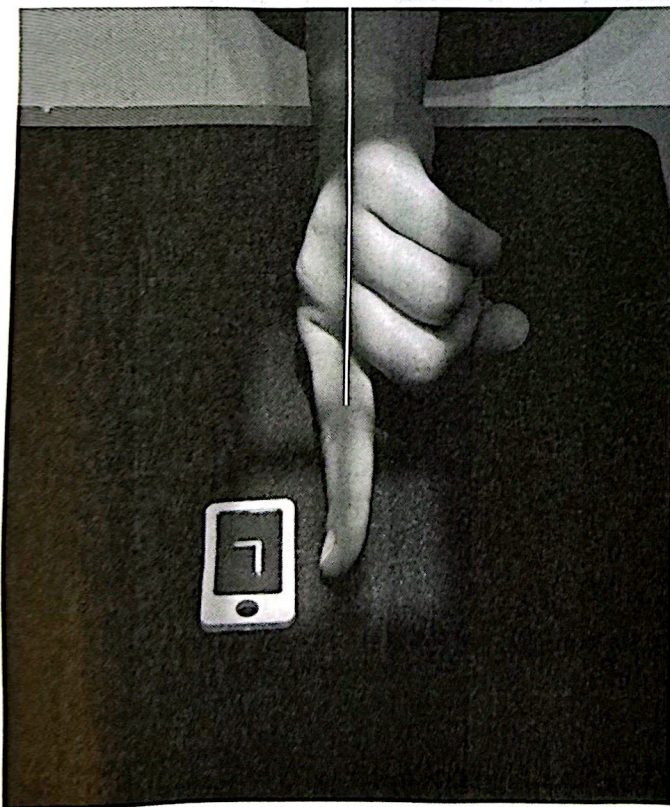


Fig. 13.25 Finger. Position for lateral projection of second (index) finger.



Fig. 13.27 Finger. Position for lateral projection of third (middle) finger.

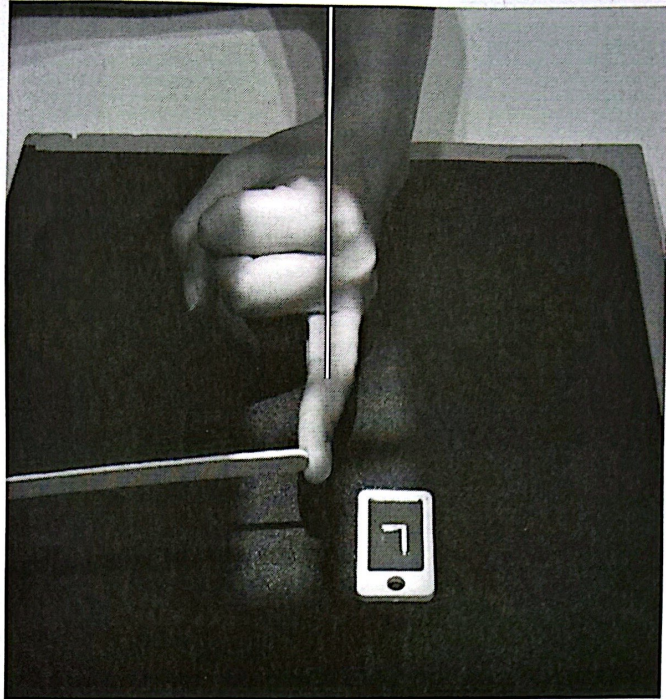


Fig. 13.28 Finger. Position for lateral projection of fourth (ring) finger.

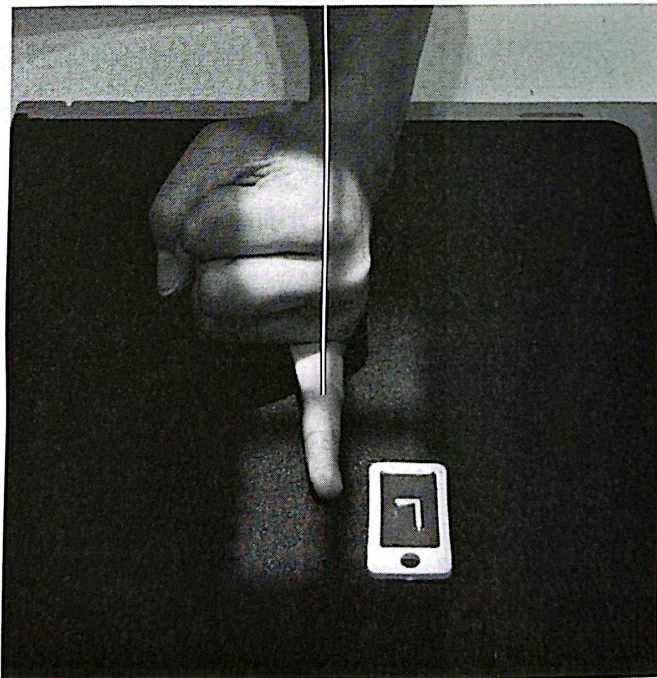


Fig. 13.29 Finger. Position for lateral projection of fifth (little or pinky) finger.

Thumb

Examination of the thumb differs from examinations of the other fingers because the thumb attaches to the hand at a different angle. In addition, examinations of the thumb must include the entire first metacarpal

rather than only a portion of it. As with the finger, the thumb examination may include a PA projection of the entire hand. When this is the case, the PA hand position results in an oblique position of the thumb.

ROUTINE EXAMINATION

The routine examination of the thumb includes the AP, PA oblique, and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position:

AP: Seated at end of table, leaning forward, arm abducted 90 degrees, with forearm rotated internally into exaggerated degree of pronation.

PA oblique and lateral: Seated at end of table with elbow flexed 90 degrees, arm fully supported, and palm resting on the IR.

Part position:

AP: Dorsal surface of thumb is in contact with IR. Coronal plane of thumb is parallel to IR. Plane of palm of hand is perpendicular to IR (Fig. 13.30).

TIPS:

- Place the fifth metacarpal and medial (ulnar) aspect of hand back far enough to avoid superimposition with the first metacarpal.
- If patient is unable to assume a satisfactory position for this projection, substitute the PA projection.

PA oblique: Palmar surface of hand is in contact with IR as for PA projection of hand. Coronal plane of thumb will be 45 degrees to plane of IR (Fig. 13.32).

Lateral: Beginning with hand positioned for PA oblique thumb, patient flexes MCP joints 2 through 5 with the fingers extended, “tenting” hand until thumb is in lateral position (Fig. 13.34).

Central ray: Perpendicular to first MCP joint.

Collimation: Adjust light field to 1 inch (2.5 cm) on all sides of the digit, including 1 inch (2.5 cm) proximal to the carpometacarpal (CMC) joint. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Entire thumb and first metacarpal with all joint spaces open and clearly visualized (Figs. 13.31, 13.33, and 13.35).

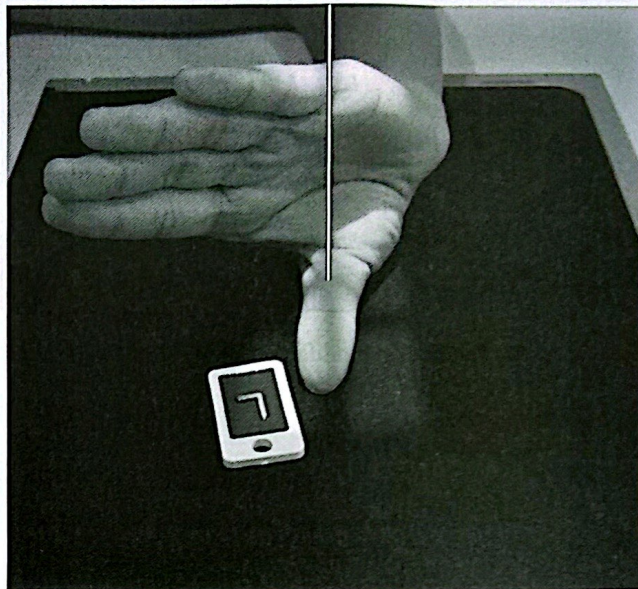


Fig. 13.30 Thumb. Position for AP projection.

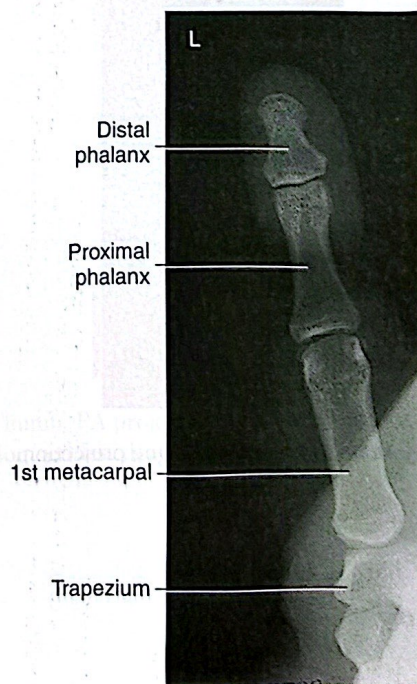


Fig. 13.31 Thumb. AP projection.

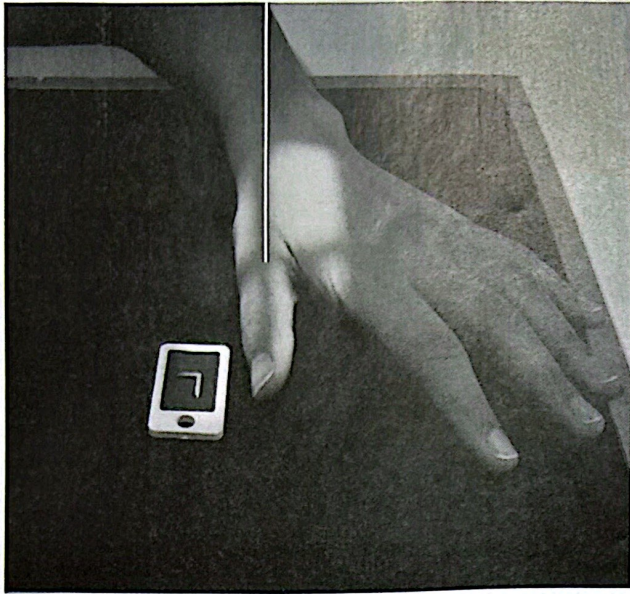


Fig. 13.32 Thumb. Position for PA oblique projection.

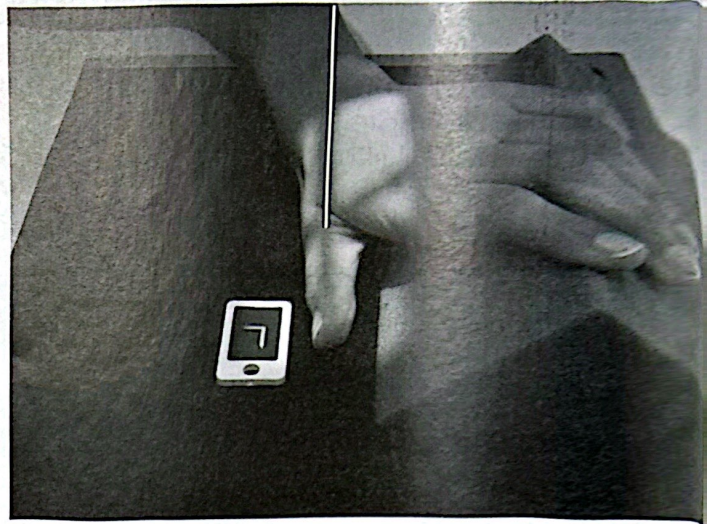


Fig. 13.34 Thumb. Position for lateral projection.



Fig. 13.33 Thumb. PA oblique projection.



Fig. 13.35 Thumb. Lateral projection.

ALTERNATIVE THUMB PROJECTION: PA

When patients are unable to rotate the arm enough to assume the proper position for an AP projection, the PA projection is substituted. However, the resulting image will have less detail than the AP projection image because the increased object–image receptor distance (OID) results in greater magnification distortion (geometric unsharpness).

Body position: Same as for PA oblique and lateral thumb projections.

Part position: Medial (ulnar) aspect of hand is in contact with IR and palm of hand is perpendicular to IR. Thumb is supported with coronal plane parallel to IR (Fig. 13.36).

Central ray: Perpendicular to first MCP joint.

Collimation: Adjust light field to 1 inch (2.5 cm) on all sides of the digit, including 1 inch (2.5 cm) proximal to the CMC joint. Place side marker in the collimated light field.

Structures seen: Entire thumb and first metacarpal with all joint spaces open (Fig. 13.37).

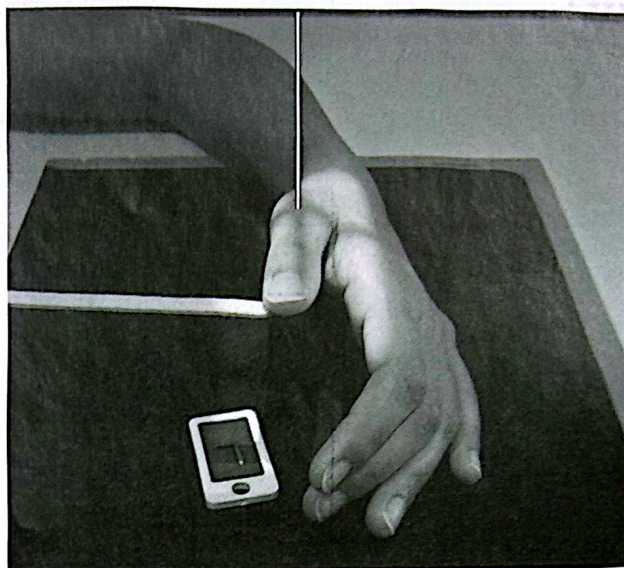


Fig. 13.36 Thumb. Position for PA projection.



Fig. 13.37 Thumb. PA projection. (NOTE: Results in greater magnification and less detail than AP projection.)

Wrist

The wrist is a complex structure with many small bones and joints. Although the routine projections are usually

sufficient, there are a number of supplemental projections and methods designed to demonstrate specific bones and joints of this region.

ROUTINE EXAMINATION

The routine examination of the wrist includes the PA, PA oblique-lateral rotation, and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) or 10 × 12 inches (24 × 30 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position: Seated at end of table with elbow flexed 90 degrees and forearm resting on table.

Part position:

PA: Anterior surface of wrist is in contact with IR. Fingers are flexed to form a loose fist, placing wrist in firmer contact with IR and opening intercarpal joints (Fig. 13.38).

PA oblique: Anteromedial surface of wrist is in contact with IR so that coronal plane of wrist forms a 45-degree angle with IR. Position may be supported by wedge sponge, stair-step sponge, or patient's thumb (Fig. 13.40).

Lateral: Medial surface of wrist is in contact with IR. Coronal plane of wrist is perpendicular to IR (Fig. 13.42).

Central ray: Perpendicular to the midcarpal area.

Collimation: Adjust light field to 2.5 inches (6 cm) proximal and distal to the wrist joint and 1 inch (2.5 cm) on the sides. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Distal portion of radius and ulna, carpal bones, and proximal halves of metacarpals (Figs. 13.39, 13.41, and 13.43).

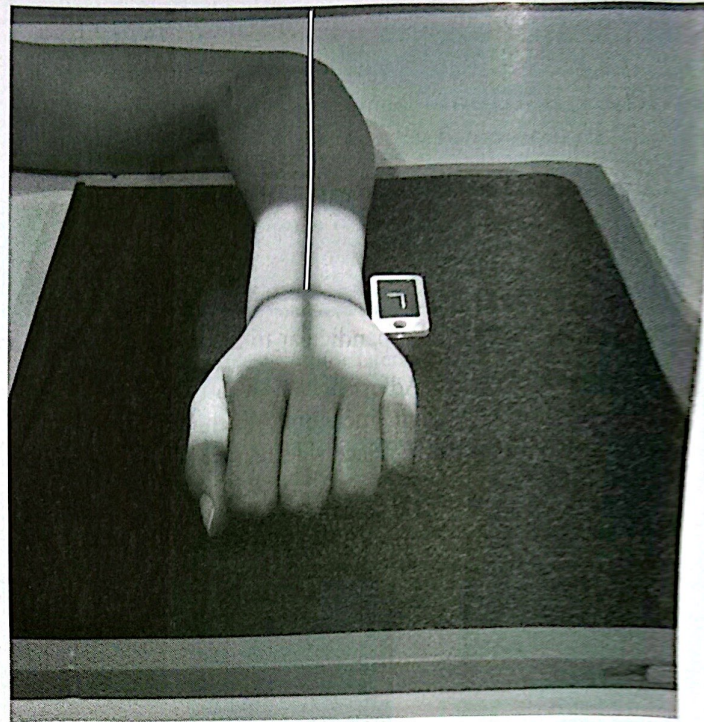


Fig. 13.38 Wrist. Position for PA projection.

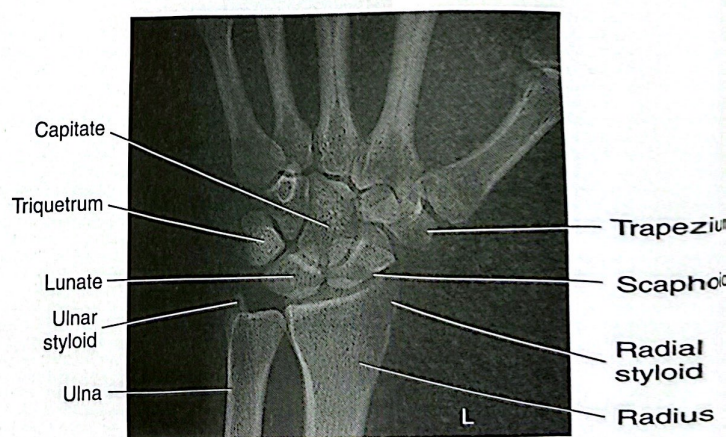


Fig. 13.39 Wrist. PA projection.

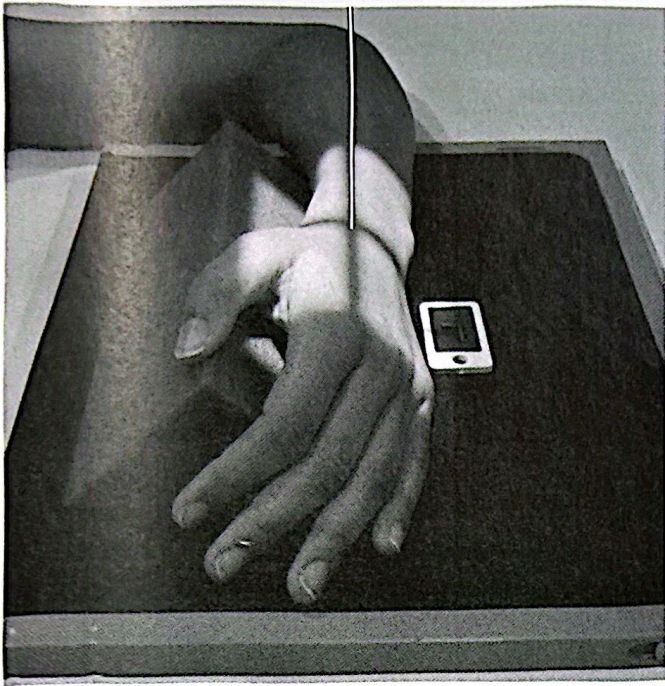


Fig. 13.40 Wrist. Position for PA oblique projection—lateral rotation.

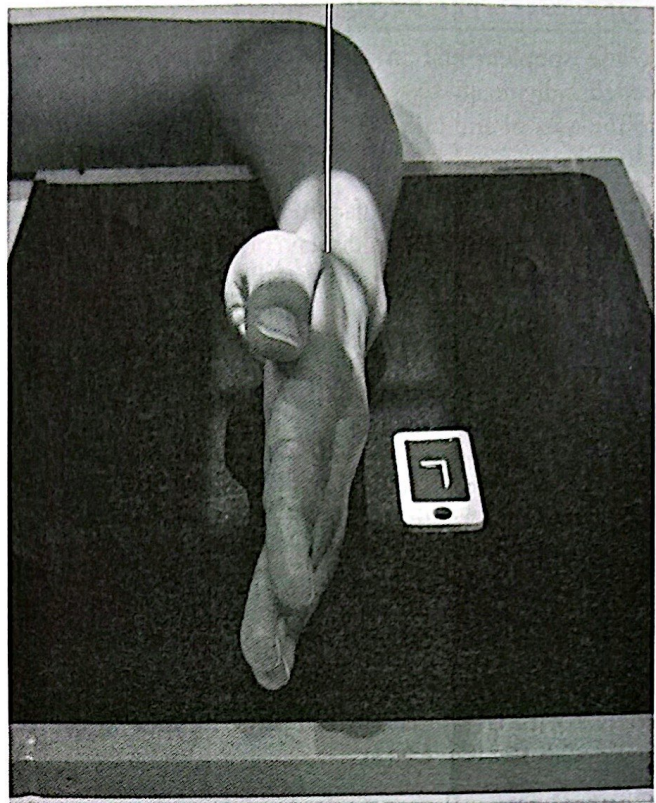


Fig. 13.42 Wrist. Position for lateral (lateromedial) projection.

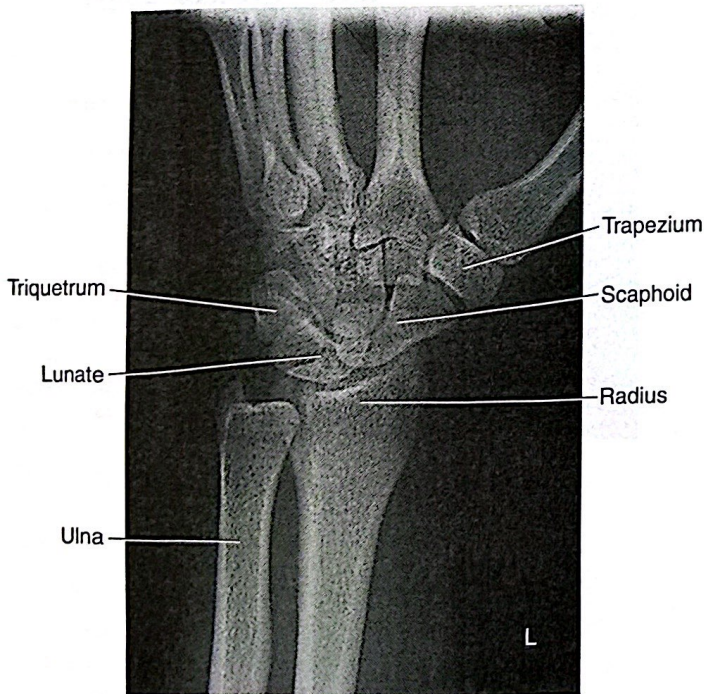


Fig. 13.41 Wrist. PA oblique projection.

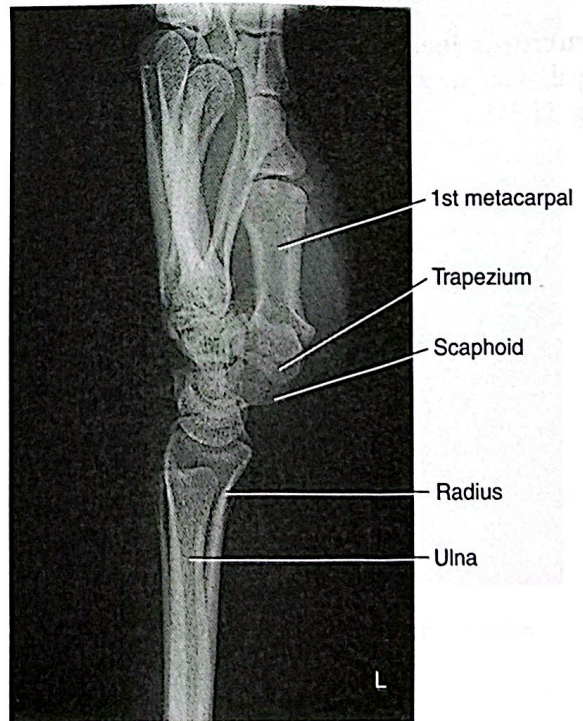


Fig. 13.43 Wrist. Lateral (lateromedial) projection.

SUPPLEMENTAL PROJECTIONS

These supplemental projections and methods may be added individually to the routine examination according to the area of clinical interest and the instructions of the physician.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) lengthwise

Grid and SID same as for routine examination.

AP OBLIQUE PROJECTION—MEDIAL ROTATION

The AP oblique projection with medial rotation is the opposite of the routine oblique. It is useful for demonstration of the medial aspect of the carpus, particularly the lunate and the pisiform.

Body position: Same as for other wrist projections.

Part position: Posteromedial surface of wrist is in contact with IR so that coronal plane forms a 45-degree angle with IR (Fig. 13.44).

Central ray: Perpendicular to midcarpal area.

Collimation: Adjust light field to 2.5 inches (6 cm) proximal and distal to the wrist joint and 1 inch (2.5 cm) on the sides. Place side marker in the collimated light field.

Structures seen: Distal portion of radius and ulna, carpal bones, and proximal halves of metacarpals (Fig. 13.45).

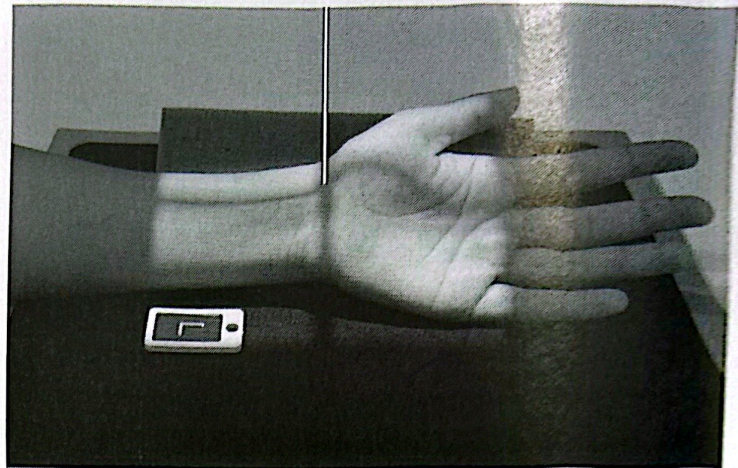


Fig. 13.44 Wrist. Position for AP oblique projection—medial rotation.

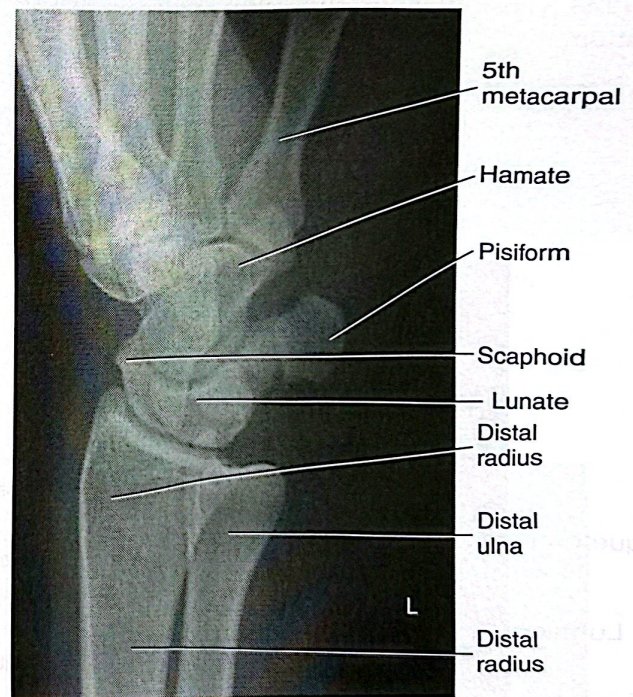


Fig. 13.45 Wrist. AP oblique projection.

PA PROJECTION—ULNAR DEVIATION

The PA projection with ulnar deviation is performed when fracture of the scaphoid is suspected. It reduces foreshortening of the scaphoid.

Part position: Same as for PA wrist with fingers extended. Hand is then deviated outward, in the direction of ulna, to extent that patient can tolerate (Fig. 13.46).

Central ray: Perpendicular, centered to scaphoid (a point slightly proximal and medial to first metacarpal base).

Collimation: Adjust light field to 2.5 inches (6 cm) proximal and distal to the wrist joint and 1 inch (2.5 cm) on the sides. Place side marker in the collimated light field.

Structures seen: Distal portion of radius and ulna, carpal bones, and metacarpals deviated toward ulna. Scaphoid seen with minimal foreshortening (Fig. 13.47).

PA AXIAL PROJECTION (STECHEER METHOD)

The Stecher method projection is performed when fracture of the scaphoid is suspected. It reduces foreshortening of the scaphoid. It is preferred when ulnar deviation is too painful for patient.

Part position: Arm is extended and parallel to long axis of table for correct alignment with angled x-ray beam. One end of the IR is elevated so the plane of the IR is 20 degrees with respect to tabletop. Wrist is positioned with anterior aspect on IR as for PA wrist, with the fingers oriented to the elevated end of the IR (Fig. 13.48).

Central ray: Perpendicular to table and directed to enter the scaphoid (a point slightly proximal and medial to first metacarpal base).

Collimation: Adjust light field to 2.5 inches (6 cm) proximal and distal to the wrist joint and 1 inch (2.5 cm) on the sides. Place side marker in the collimated light field.

Structures seen: Distal portion of radius and ulna, carpal bones, and proximal metacarpals. Scaphoid seen with minimal foreshortening (Fig. 13.49).

TIP: A variation of the method is performed with a nonelevated IR and the CR angled 20 degrees in direction of elbow and centered to scaphoid (point slightly proximal and medial to first metacarpal base).

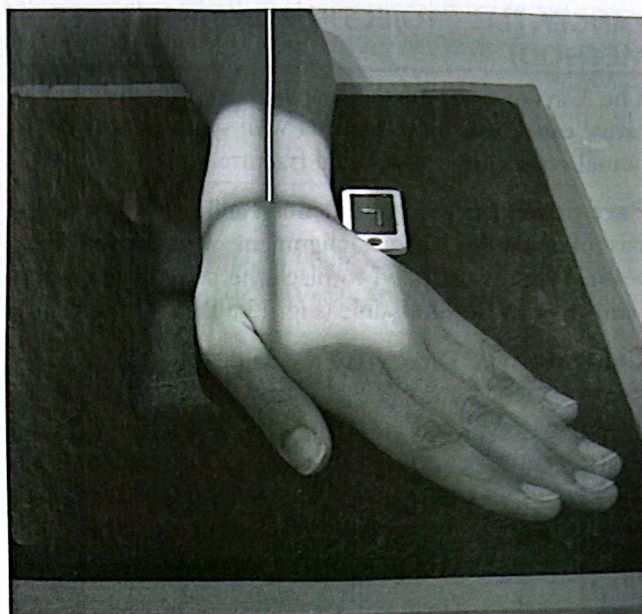


Fig. 13.46 Wrist. Position for PA projection—ulnar deviation.



Fig. 13.47 Wrist. PA projection—ulnar deviation.

TANGENTIAL PROJECTION (GAYNOR-HART METHOD)

The Gaynor-Hart method is used to demonstrate the carpal canal, usually in patients with symptoms of carpal tunnel syndrome or suspected fracture.

Part position: Arm is extended and parallel to long axis of table for correct alignment with angled x-ray beam. Wrist is extended to place the palm of hand perpendicular to IR, if possible (Fig. 13.50).

Central ray: Directed to the palm at a point approximately 1 inch (2.5 cm) distal to the base of the third metacarpal and at an angle of 25 to 30 degrees in direction of elbow. Greater angle may be required when the wrist cannot be extended as shown in Fig. 13.50.

Collimation: Adjust light field to 1 inch (2.5 cm) on the three sides of the shadow of the wrist. Place side marker in the collimated light field.

Structures seen: Carpal canal—anterior arch of carpal bones, including portions of the scaphoid, trapezium, pisiform, and hook of hamate (Fig. 13.51).

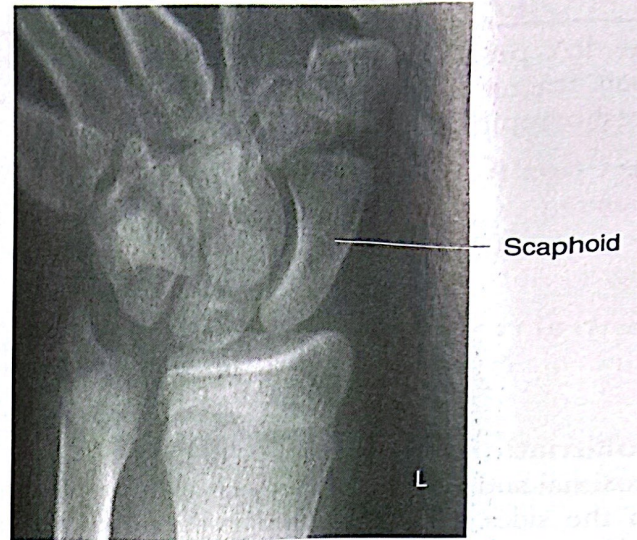


Fig. 13.49 Wrist. PA axial projection (Stecher method).

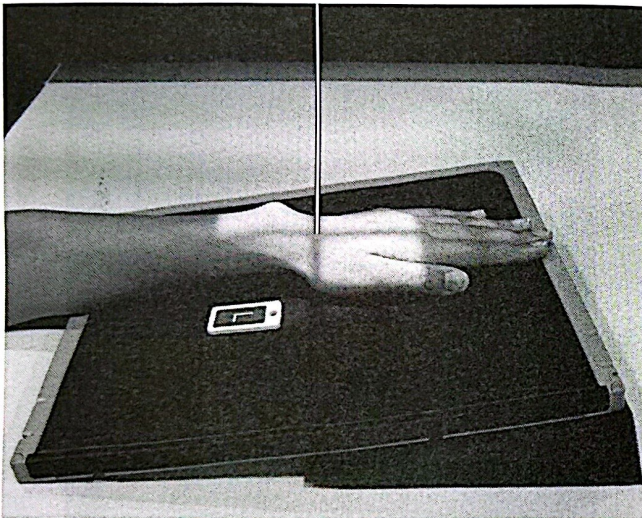


Fig. 13.48 Wrist. Position for PA axial projection (Stecher method).

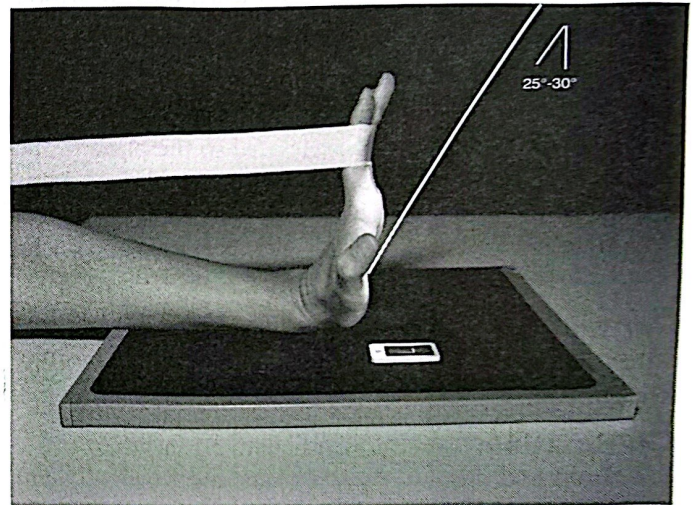


Fig. 13.50 Wrist. Position for tangential projection of carpal canal (Gaynor-Hart method).

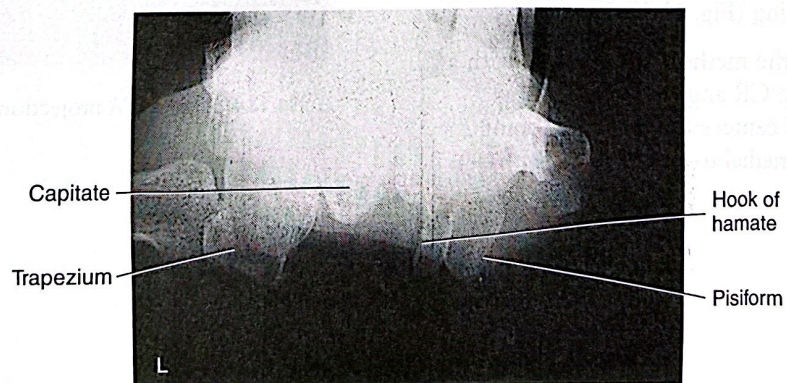


Fig. 13.51 Wrist. Tangential (inferosuperior) projection.

Forearm

Examination of the forearm is usually ordered when the area of clinical interest is in the shaft of the radius and/or the ulna. The examination should include the entirety of both bones and their articular surfaces.

ROUTINE EXAMINATION

The routine examination of the forearm includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) diagonal or 14 × 17 inches (35 × 43 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position: Seated at end of table with axilla (armpit) at table level; this may be achieved by lowering seat or by having patient lean toward table.

Part position:

AP: Arm is fully extended with hand supinated and posterior surface in contact with IR. Both wrist and elbow are supinated with coronal plane of arm parallel to IR (Fig. 13.52). This is achieved by adjusting the coronal plane of the humeral epicondyles parallel to the plane of the IR. A small sandbag in palm of hand can aid in maintaining position.

Visualization of both joints is preferable. If only one joint is demonstrated, the *same* joint must be demonstrated on both projections. In this case, additional radiographs that include the other joint will be needed.

Lateral: Elbow is flexed 90 degrees with medial surface in contact with IR. Wrist is in lateral position (Fig. 13.54).

Central ray: Perpendicular to midpoint of the forearm.

Collimation: Adjust light field to 2 inches (5 cm) distal to the wrist joint and proximal to the elbow joint and 1 inch (2.5 cm) on the sides. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Entire forearm, including both elbow and wrist joints (Figs. 13.53 and 13.55).

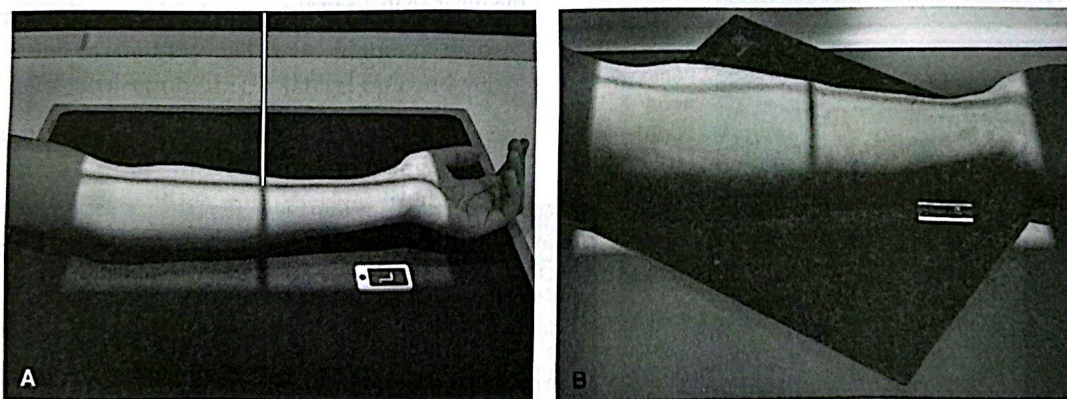


Fig. 13.52 Forearm. Position for AP projection. (A) Usual orientation of image receptor (IR). (B) Diagonal placement of IR, when forearm is too long to fit within the long dimension of the IR. Exposure field must include entire corners of a computed radiography imaging plate to ensure good image quality.

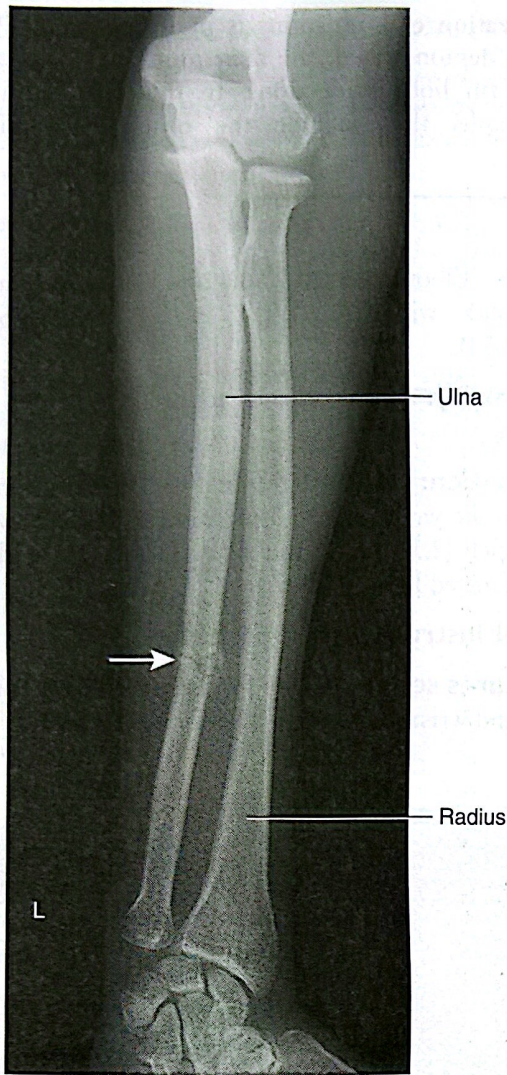


Fig. 13.53 Forearm. AP projection, with healing fracture of the ulnar shaft (*arrow*).



Fig. 13.55 Forearm. Lateral projection, with healing fracture of the ulnar shaft (*arrow*).

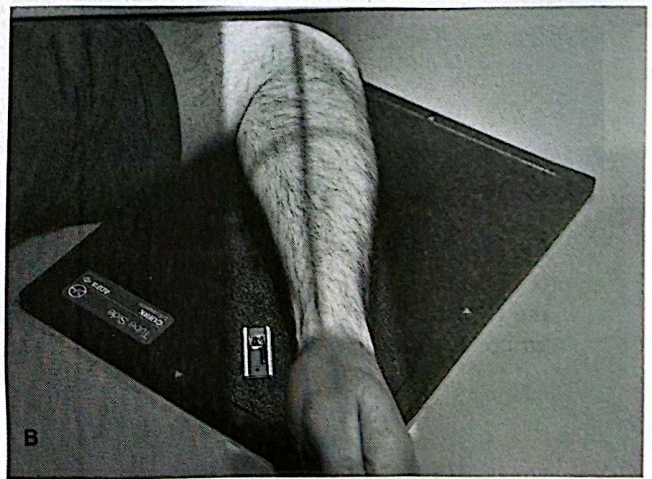
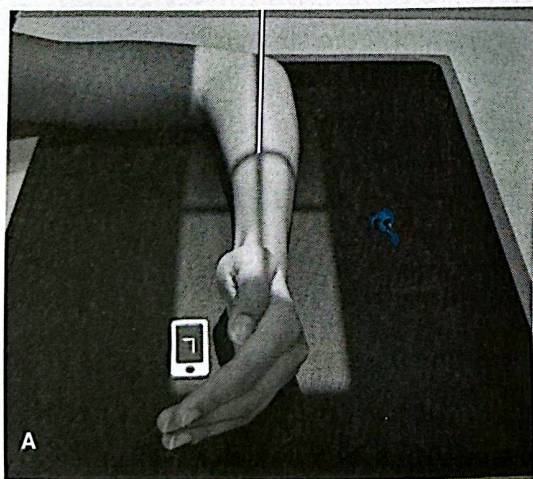


Fig. 13.54 Forearm. Position for lateral projection. (A) Usual orientation of image receptor (IR). (B) Diagonal orientation of IR, when forearm is too long to fit within the long dimension of the IR.

Elbow

The positions for the routine examination of the elbow are the same as those for the forearm. Because it is often impossible for patients with an injured elbow to fully extend

the elbow joint, alternatives are presented for the AP projection with the elbow partially flexed. Supplemental projections may be added to the basic examination for further visualization of specific aspects of the joint.

ROUTINE EXAMINATION

The routine examination of the elbow includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) or 10 × 12 inches (24 × 30 cm) lengthwise

Grid: No

SID: 40 inches minimum

Body position: Seated at end of table with axilla at level of table, as for AP forearm.

Part position:

AP: Arm is fully extended with hand supinated and posterior surface in contact with IR. Coronal plane of humeral epicondyles parallel to IR (Fig. 13.56). If patient is unable to fully extend arm, substitute alternate positions for AP projection with flexed elbow.

Lateral: Elbow is flexed 90 degrees with medial surface in contact with IR. Coronal plane of humeral epicondyles perpendicular to IR. Wrist is in lateral position to degree patient can achieve (Fig. 13.58).

Central ray: Perpendicular to elbow joint. For AP projection, joint is midway between humeral epicondyles. For lateral projection, it is at lateral epicondyle.

Collimation: Adjust light field to 3 inches (8 cm) proximal and distal to the elbow joint and 1 inch (2.5 cm) on the sides. Place side marker in the collimated light field.

Patient instruction: Do not move.

Structures seen: Elbow joint with portions of distal humerus and proximal forearm (Figs. 13.57 and 13.59).

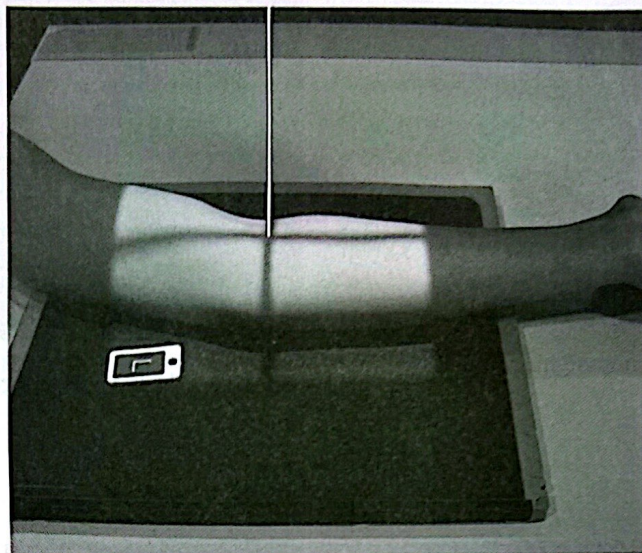


Fig. 13.56 Elbow. Position for AP projection.

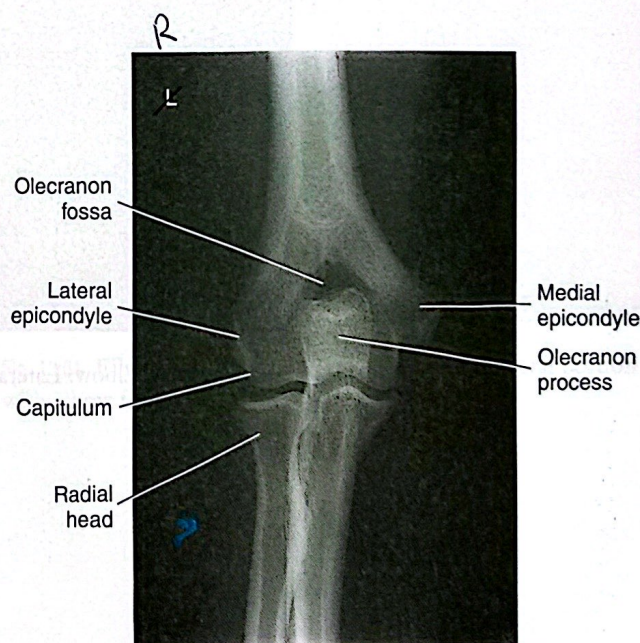


Fig. 13.57 Elbow. AP projection.

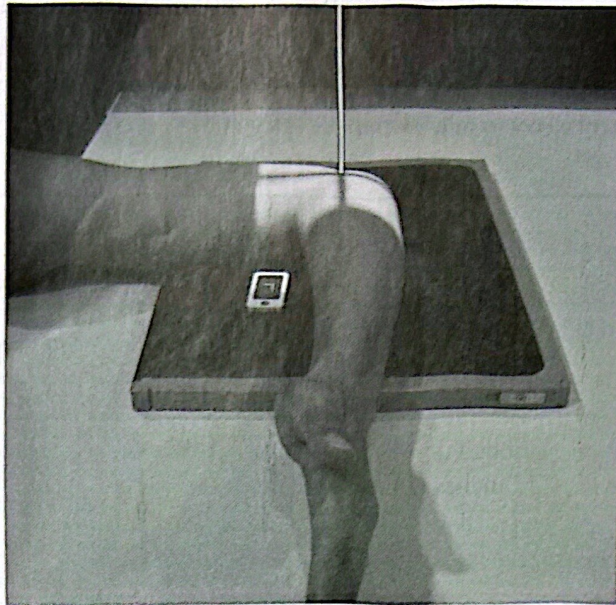


Fig. 13.58 Elbow. Position for lateral (lateromedial) projection.

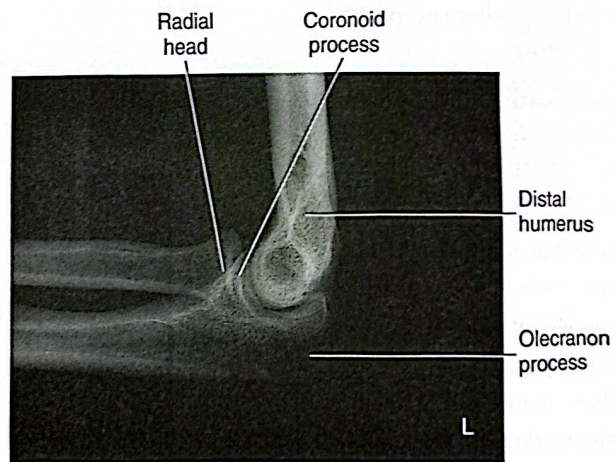


Fig. 13.59 Elbow. Lateral (lateromedial) projection.

ALTERNATIVE POSITIONS FOR AP PROJECTIONS

When the patient is unable to fully extend the elbow joint for an AP projection, *both* of the following AP projections with flexed elbow are necessary to substitute for the routine AP projection.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) lengthwise

AP ELBOW, PROXIMAL FOREARM

Body position: Standing and leaning over table, if possible.

Part position: Posterior aspect of forearm rests on IR and elbow is extended as much as possible. Rotation of forearm adjusted so coronal plane of humeral epicondyles is parallel to IR (Fig. 13.60).

Central ray: Perpendicular to center of elbow. If the elbow is flexed 90 degrees or more, it is necessary to angle central ray 5 to 15 degrees in proximal direction to avoid superimposing distal humerus over proximal forearm.

TIP: To ensure that the patient's head is not in the path of the x-ray beam, turn on the field light, look for the head shadow, and move the head out of the way, if needed.

Collimation: Adjust light field to 3 inches (8 cm) proximal and distal to the elbow joint and 1 inch on the sides. Place side marker in the collimated light field.

Structures seen: Proximal forearm portion of elbow joint. Distal humerus will be distorted (Fig. 13.62).

AP ELBOW, DISTAL HUMERUS

Body position: With axilla at table level as for routine AP projection, elbow is extended as much as possible and forearm is supported. Arm is rotated to place coronal plane of humeral epicondyles parallel to IR (Fig. 13.61).

Central ray: Directed to center of joint. If elbow is flexed 90 degrees or more, it is necessary to angle central ray 5 to 15 degrees in distal direction to avoid superimposing proximal forearm over distal humerus.

Collimation: Adjust light field to 3 inches (8 cm) proximal and distal to the elbow joint and 1 inch on the sides. Place side marker in the collimated light field.

Structures seen: Distal humeral portion of elbow joint. Proximal forearm will be distorted (Fig. 13.63).

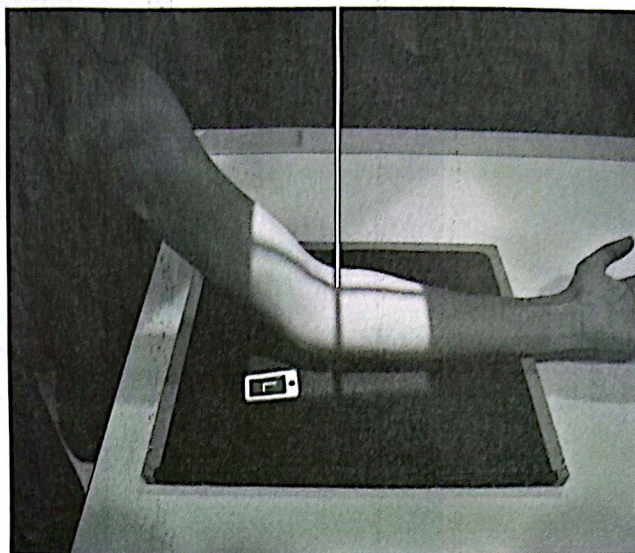


Fig. 13.60 Elbow. Position for AP projection of forearm portion with elbow flexed.

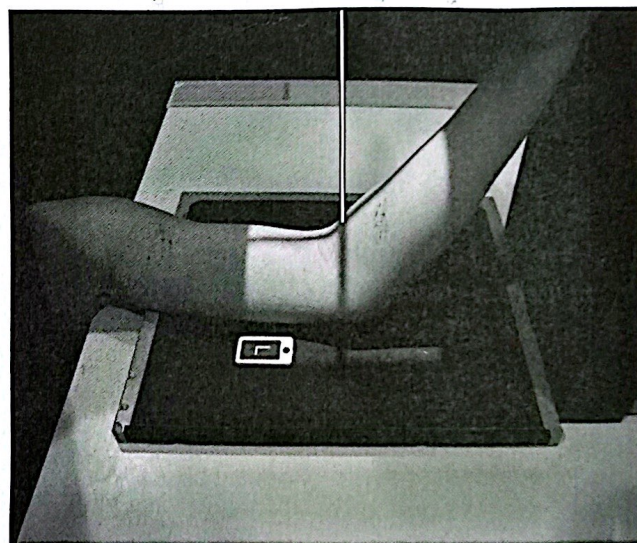


Fig. 13.61 Elbow. Position for AP projection of humeral portion with elbow flexed.

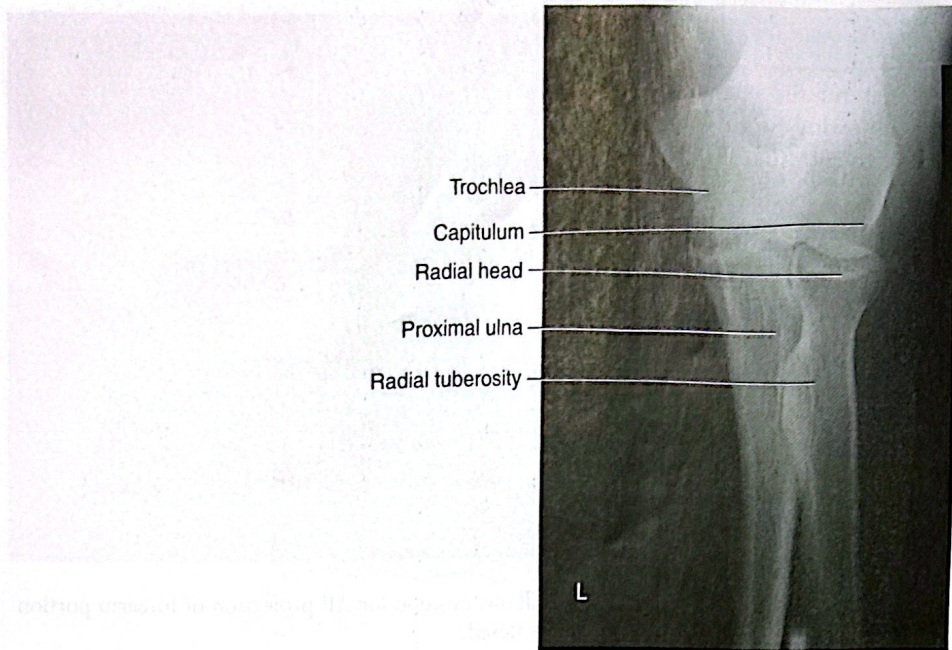


Fig. 13.62 Elbow. AP projection of forearm portion with elbow flexed.

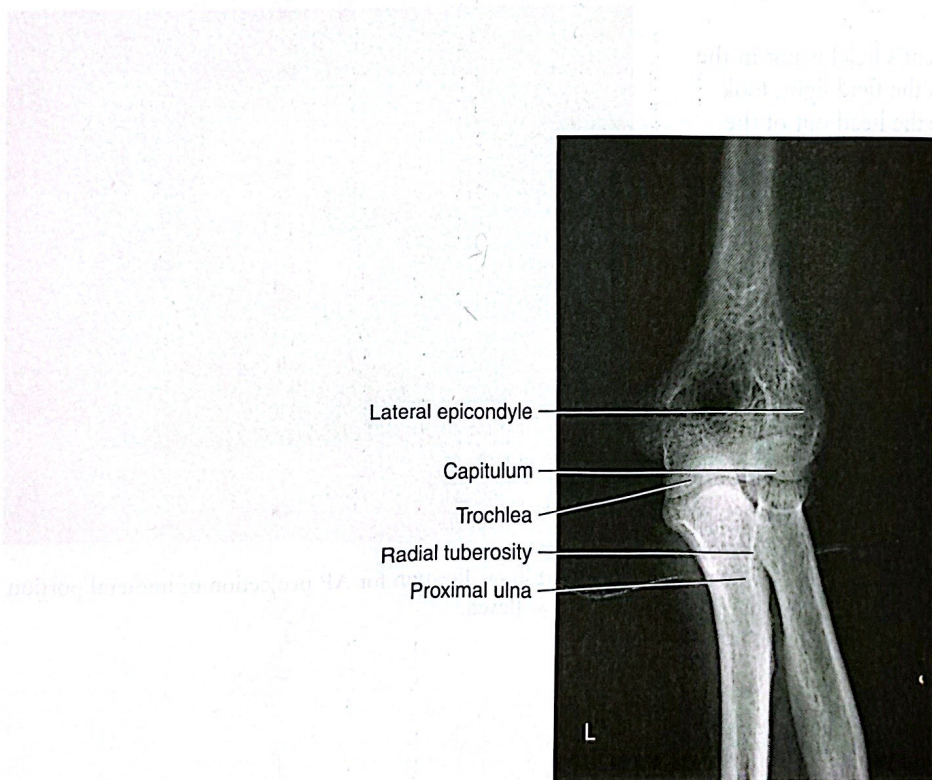


Fig. 13.63 Elbow. AP projection of humeral portion with elbow flexed.

SUPPLEMENTAL PROJECTIONS

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 8 × 10 inches (18 × 24 cm) lengthwise, for each.

Grid and SID same as for routine examination.

AP OBLIQUE—LATERAL ROTATION

Performed when injury to the lateral portion of the elbow (radial head or capitulum) is suspected.

Body position: From AP position, leaning laterally and rotating shoulder externally so that posterior lateral aspect of elbow is in contact with IR.

Part position: Coronal plane of elbow forms angle of 45 degrees with IR (Fig. 13.64).

Central ray: Directed to center of elbow joint.

Collimation: Adjust light field to 3 inches (8 cm) proximal and distal to the elbow joint and 1 inch on the sides. Place side marker in the collimated light field.

Structures seen: Radial head and capitulum without superimposition of ulna (Fig. 13.65).

AP OBLIQUE—MEDIAL ROTATION

Performed when injury to the medial portion of the elbow (coronoid process or trochlea) is suspected.

Body position: Same as for AP projection.

Part position: Hand pronated, which allows coronal plane of elbow to assume a 45-degree angle with IR (Fig. 13.66).

Central ray: Directed to center of elbow joint.

Collimation: Adjust light field to 3 inches (8 cm) proximal and distal to the elbow joint and 1 inch on the sides. Place side marker in the collimated light field.

Structures seen: Coronoid process and trochlea without superimposition (Fig. 13.67).

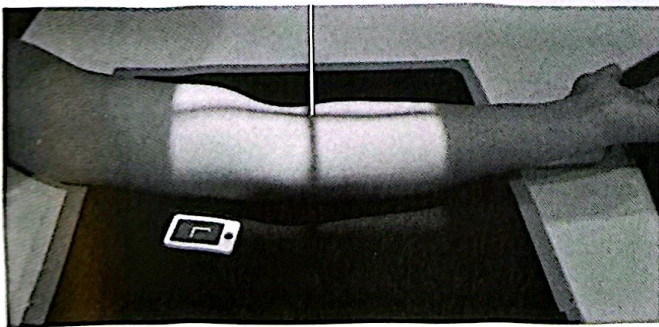


Fig. 13.64 Elbow. Position for AP oblique projection with lateral rotation of elbow.

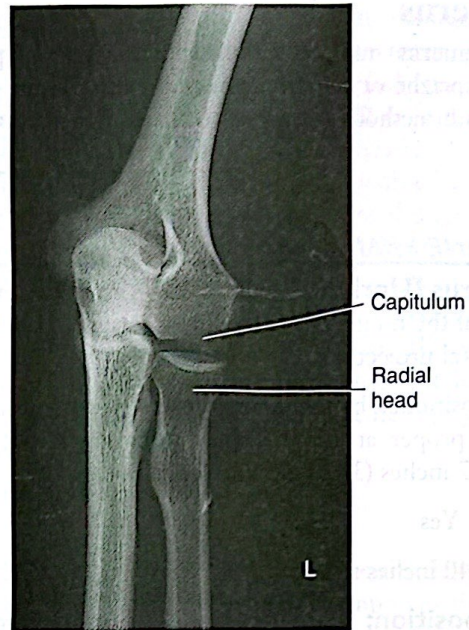


Fig. 13.65 Elbow. AP oblique projection with elbow in lateral rotation.

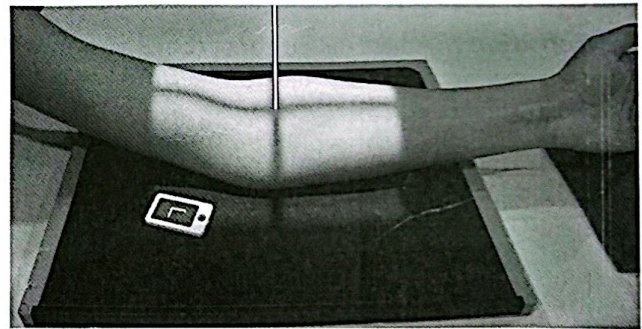


Fig. 13.66 Elbow. Position for AP oblique projection with medial rotation of elbow.

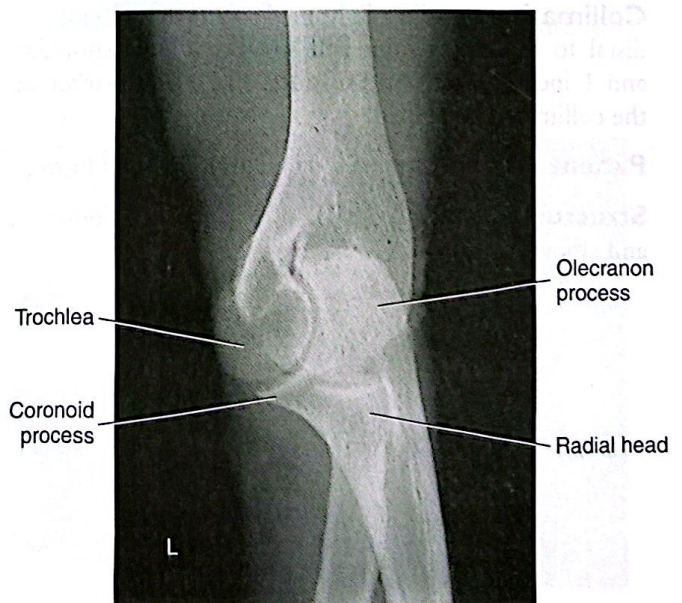


Fig. 13.67 Elbow. AP oblique projection with elbow in medial rotation.

Humerus

The humerus may be radiographed with the patient either upright or supine, depending on patient condition. Both methods are presented here. The thickness of

the shoulder joint usually dictates that this study be done using a Bucky or grid. For relatively small patients, however, a grid is not necessarily required.

ROUTINE EXAMINATION

Humerus (Upright Patient): The routine examination of the humerus, with patient upright, includes AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 14 × 17 inches (35 × 43 cm) lengthwise

Grid: Yes

SID: 40 inches minimum

Body position: Seated or standing with back to upright Bucky or grid cabinet. The body position, whether oblique or facing toward or away from the IR, is not critical as long as the epicondyles are oriented appropriately for the projection.

Part position: Adjust the height of the IR to place its upper margin about 1.5 inches (3.8 cm) above the head of the humerus.

AP: Arm slightly abducted with palm of hand supinated. Coronal plane of humeral epicondyles parallel to IR (Fig. 13.68).

Lateral: Elbow flexed approximately 45 degrees and palm of hand against hip so that fingertips point down and elbow is lateral with coronal plane of humeral epicondyles perpendicular to IR (Fig. 13.69).

Central ray: Perpendicular to midhumerus.

Collimation: Adjust light field to 2 inches (5 cm) distal to the elbow joint and superior to the shoulder and 1 inch (2.5 cm) on the sides. Place side marker in the collimated light field.

Patient instruction: Stop breathing. Do not move.

Structures seen: Entire humerus, shoulder joint, and elbow joint (Figs. 13.72 and 13.73).

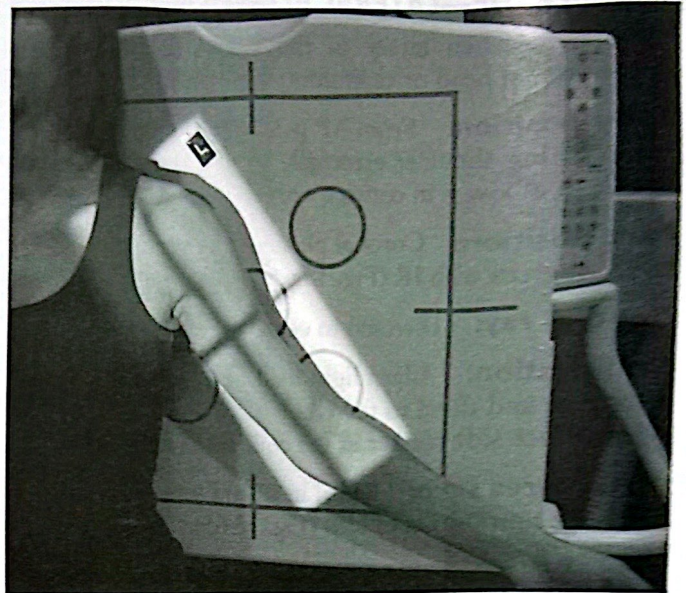


Fig. 13.68 Humerus. Position for AP projection, patient upright.

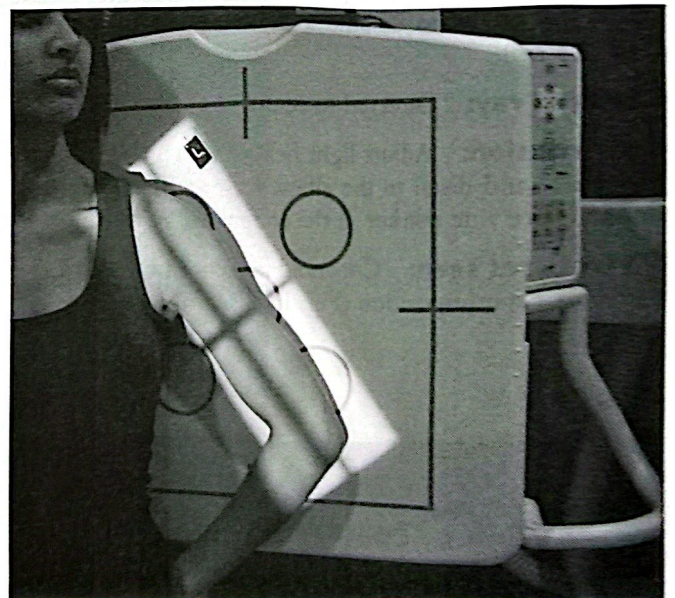


Fig. 13.69 Humerus. Position for lateral projection, patient upright.

Shoulder

Examinations of the shoulder girdle may be done with the patient recumbent on the radiographic table or upright using the upright Bucky or grid cabinet, depending on patient condition. In hospitals it is usual for patients who arrive in radiology on a stretcher to be kept in a recumbent position until their injuries have been evaluated. In outpatient facilities, ambulatory patients are frequently more comfortable in the upright position. Because a full lead apron may interfere with the examination, gonad shielding is shown here using a half-apron for examinations of the shoulder region.

The routine examination of the shoulder requires that the patient be able to rotate the humerus. This is usually

possible for relatively mild or chronic complaints. In such cases, it is desirable to examine the entire shoulder girdle, so the routine study should include the scapula, clavicle, and proximal humerus. The IR is placed crosswise to accommodate the length of the clavicle.

Acute injuries to the shoulder may involve fractures of the proximal humerus or dislocation of the glenohumeral joint. In such cases, the patient cannot rotate the shoulder, and arm movement could cause additional injury. In cases of acute injury, the examination is performed without moving the arm. The IR is placed lengthwise to include a greater portion of the humerus. Both the routine procedure and the acute injury procedure are presented.

ROUTINE EXAMINATION

The routine examination of the shoulder includes AP projections with both internal and external humerus rotation.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) crosswise

Grid: Yes

SID: 40 inches minimum

Body position: Standing or seated with back to upright Bucky or grid cabinet or supine on table; coronal plane of body parallel to IR.

Part position:

External rotation: Arm slightly abducted with palm of hand supinated. Arm adjusted to place coronal plane of humeral epicondyles parallel to IR (Figs. 13.74 and 13.76).

Internal rotation: Humerus and arm rotated internally until back of hand is against thigh. Arm adjusted to place coronal plane of humeral epicondyles perpendicular to IR (Figs. 13.75 and 13.77).

Patient instruction: Stop breathing. Do not move.

Central ray: Perpendicular to a point 1 inch inferior to coracoid process.

Collimation: Adjust light field to 10 × 12 inches (24 × 30 cm) on the collimator. Place side marker in the collimated light field.

Structures seen: Entire clavicle and scapula and proximal third of humerus. External rotation demonstrates greater tubercle in profile (Fig. 13.78); internal rotation demonstrates lesser tubercle in profile (Fig. 13.79).

Compensating filter: Use of a specially designed compensating filter for the shoulder improves the quality of the image. These filters are particularly useful when digital imaging (CR or DR) systems are used.

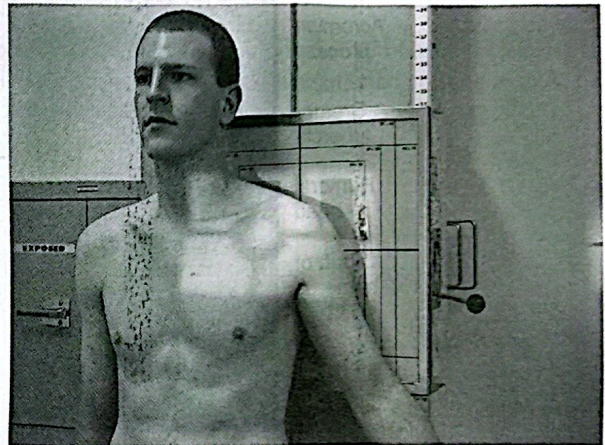


Fig. 13.74 Shoulder. Position for AP projection—external (arm) rotation, patient upright.

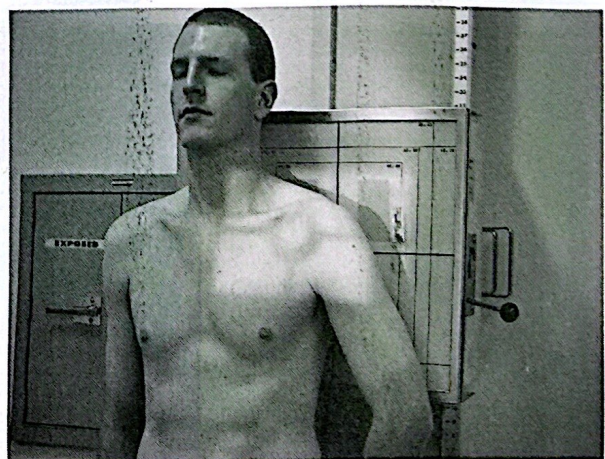


Fig. 13.75 Shoulder. Position for AP projection—internal (arm) rotation, patient upright.

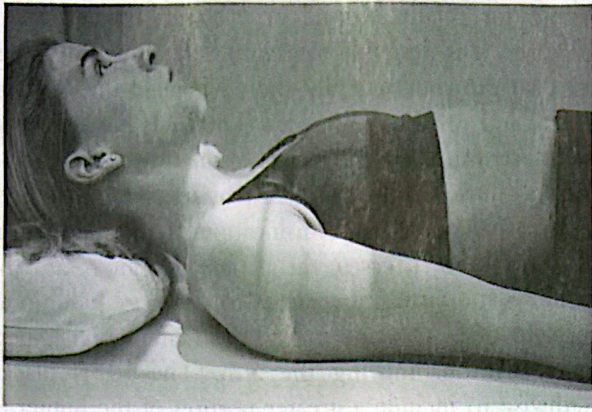


Fig. 13.76 Shoulder. Position for AP projection—external (arm) rotation, patient recumbent.

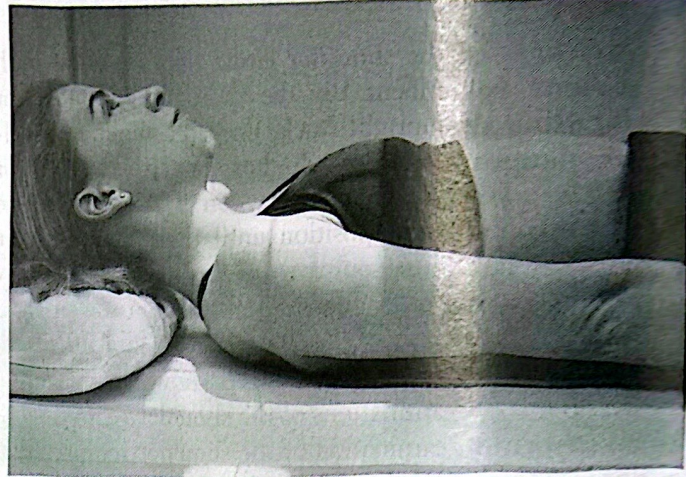


Fig. 13.77 Shoulder. Position for AP projection—internal (arm) rotation, patient recumbent.

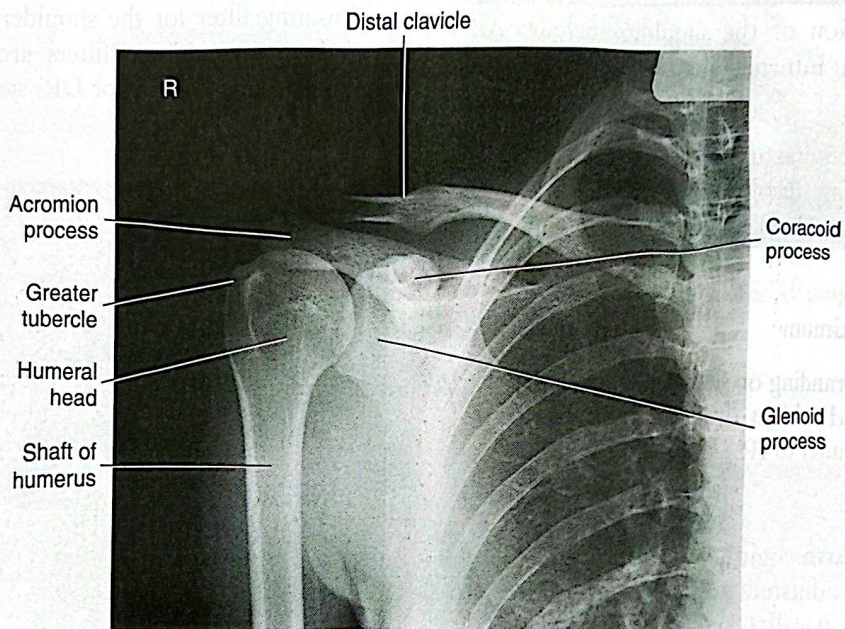


Fig. 13.78 Shoulder. AP projection—external (arm) rotation.

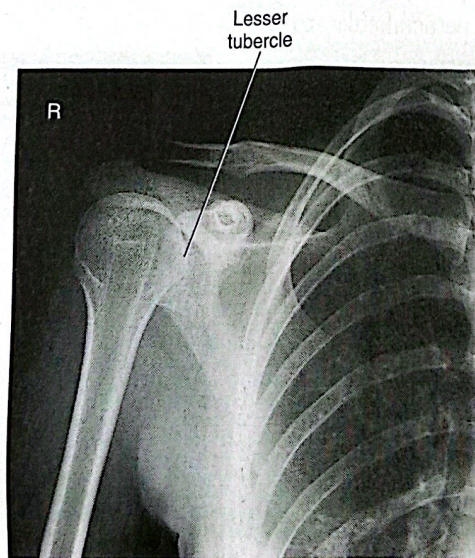


Fig. 13.79 Shoulder. AP projection—internal (arm) rotation.

ADDITIONAL SHOULDER PROJECTION**AP Oblique Projection (Grashey)**

Method: The AP oblique projection demonstrates the glenoid fossa in profile, allowing evaluation of glenohumeral joint integrity.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) crosswise

Grid and SID same as for routine examination.

Body position: Patient upright or recumbent. Coronal plane of body aligned 35 to 45 degrees with respect to IR (Fig. 13.80).

Part position: Posterolateral aspect of shoulder in contact with upright Bucky or table; scapular body parallel to IR; arm in internal, external, or neutral rotation.

Central ray: Perpendicular through glenohumeral joint, at a point 2 inches (5 cm) medial and 2 inches (5 cm) inferior to superolateral border of shoulder.

Collimation: Adjust light field to 10 × 12 inches (24 × 30 cm) on the collimator. Place side marker in the collimated light field.

Structures seen: Glenohumeral joint with open joint space and glenoid process in profile; coracoid process will usually obscure superior aspect of joint space (Fig. 13.81).

TIP: When patient is recumbent, body rotation of more than 45 degrees may be required to place the scapular body parallel to the IR and open joint space.

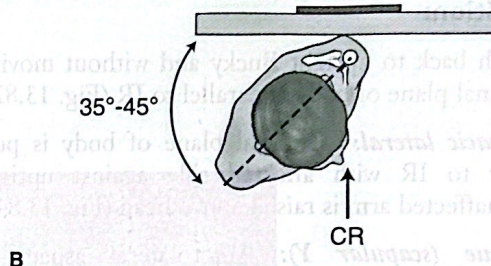
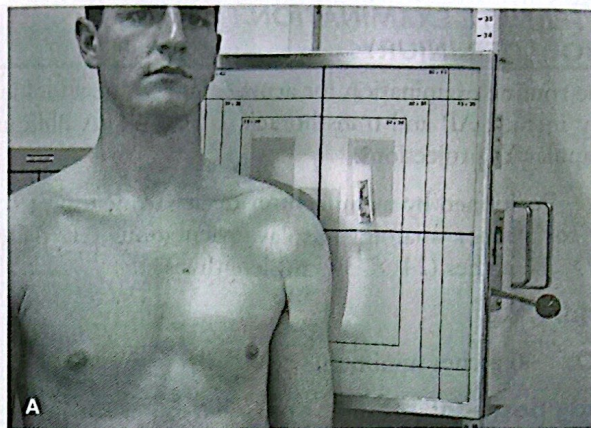


Fig. 13.80 Shoulder. (A) Position for AP oblique projection (Grashey method). (B) Top view of same position as in A. CR, Computed radiography.

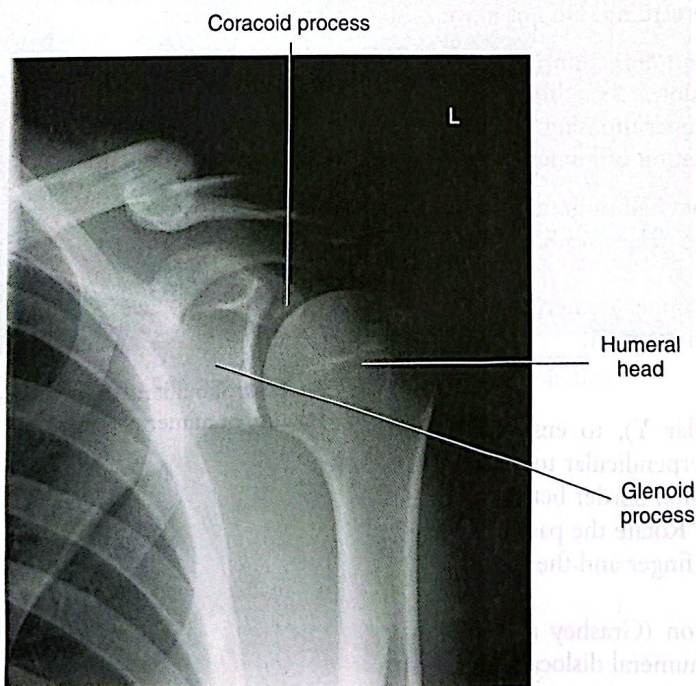


Fig. 13.81 Shoulder. AP oblique projection (Grashey method).

ALTERNATE EXAMINATION FOR ACUTE SHOULDER INJURY

The routine examination for acute injury to the shoulder may include AP and transthoracic lateral or PA oblique (scapular Y) projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) lengthwise

Grid: Yes

SID: 40 inches minimum

Body position: Standing or seated at upright Bucky or grid cabinet.

Part position:

AP: With back to upright Bucky and without moving arm. Coronal plane of body is parallel to IR (Fig. 13.82).

Transthoracic lateral: Coronal plane of body is perpendicular to IR with affected side against upright Bucky. Unaffected arm is raised above head (Fig. 13.84).

PA oblique (scapular Y): Anterolateral aspect of shoulder against upright Bucky. Coronal plane of body 45 to 60 degrees to IR. Body rotation adjusted to place scapular body perpendicular to IR (Fig. 13.86).

Central ray: Perpendicular to center of IR, with top of IR 1.5 inches to 2 inches above top of shoulder.

Collimation: Adjust light field to 10 × 12 inches (24 × 30 cm) on the collimator. Place side marker in the collimated light field.

Patient instruction:

AP and PA oblique: Stop breathing. Do not move.

Transthoracic lateral: Use “breathing technique.” (Exposure is made during slow, deep breathing. This technique effectively blurs superimposing rib and lung structures, improving visualization of humerus.)

Structures seen: Proximal half of humerus and portions of scapula and clavicle (Figs. 13.83, 13.85, and 13.87).

Demonstrates fractures of upper humerus and aids in evaluation of glenohumeral dislocation.

TIPS:

- For PA oblique (scapular Y), to ensure that the body of the scapula is perpendicular to the IR, grasp the lateral and medial border between the thumb and index finger. Rotate the patient’s body until a line between the finger and the thumb is perpendicular to the IR.
- An AP oblique projection (Grashey method) may be added for suspected humeral dislocation.

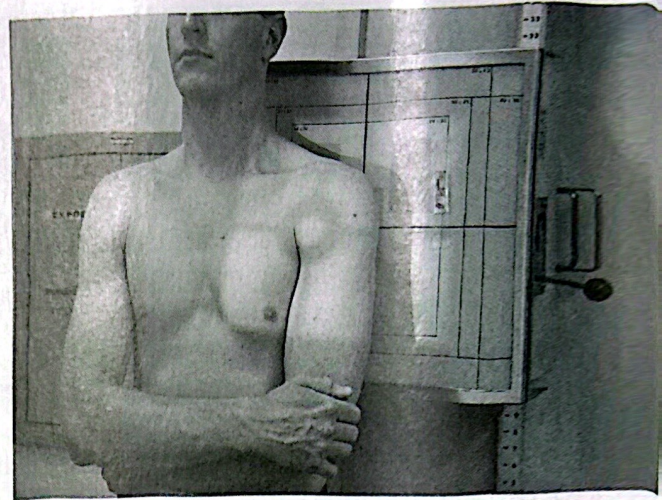


Fig. 13.82 Shoulder. Position for AP projection, when acute injury is suspected.



Fig. 13.83 Shoulder. AP projection, demonstrating surgical neck fracture of humerus (arrow).

Clavicle

Examina- n of the clavicle is rou- and PA- al projections to keep the IR a- sible. If the patient

ACUTE EXAMINATION

The rou- e examination of the upright l- and PA- and projec- and AP a- l projections.

18- Pos- ioned by manufac- urer for paper support. display 10.75-12- inches (24.3-30.5 cm) of

Fig. 13.84 Shoulder. Position for transthoracic lateral projection, used when acute injury is suspected.



comfortable when the clavicle is in these circumstances, AP and lateral projections are performed.

SID: 40-45 cm minimum

Body position:

Carry the arm of the patient's right hand with the hand parallel to the IR. Head turned away from the patient. Arm is abducted (Figs. 13.84 and 13.85).

Reclined: Slightly (15-30 and 15-30)

Part position: Shoulder is at 90° (C7-12)

Central ray:

AP and PA: Perpendicular to midclavicle.

Distal: 15 to 30 degrees

Distal: 15 to 30 degrees

Collimation: Adjust light field to include the entire shoulder and the collar of the humerus. Light field.

Patient instruction: Stop breath.

Shoulder is at 90° (C7-12) and 15-30

- Acromion process
- Humeral head
- Greater tubercle
- Surgical neck
- Thoracic vertebra
- Humeral shaft

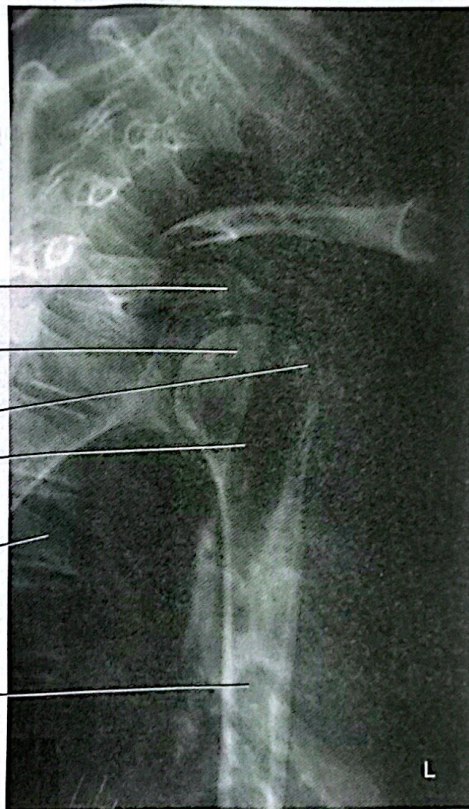


Fig. 13.85 Shoulder. Transthoracic lateral projection.

Fig. 13.81 Clavicle. Position for AP axial projection, patient reclined.

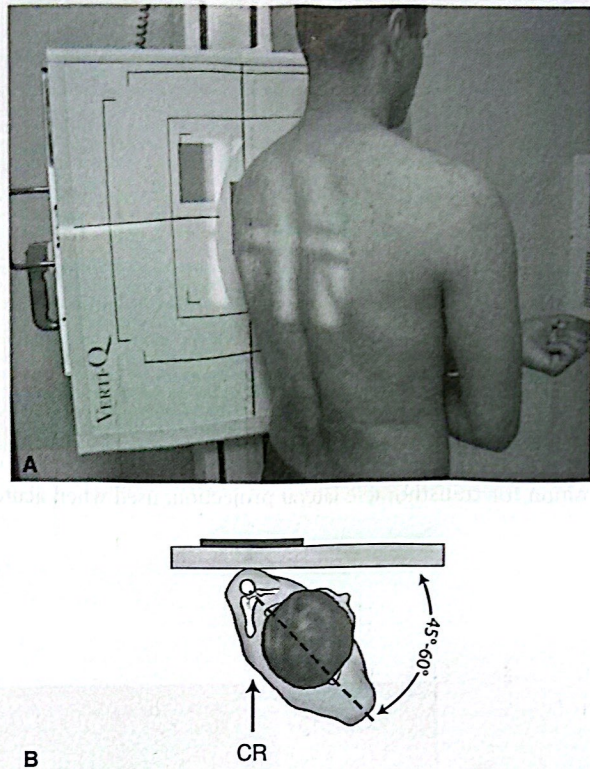


Fig. 13.86 Shoulder. (A) Position for PA oblique projection (scapular Y). (B) Top view of same position as in (A). *CR*, Computer radiography.

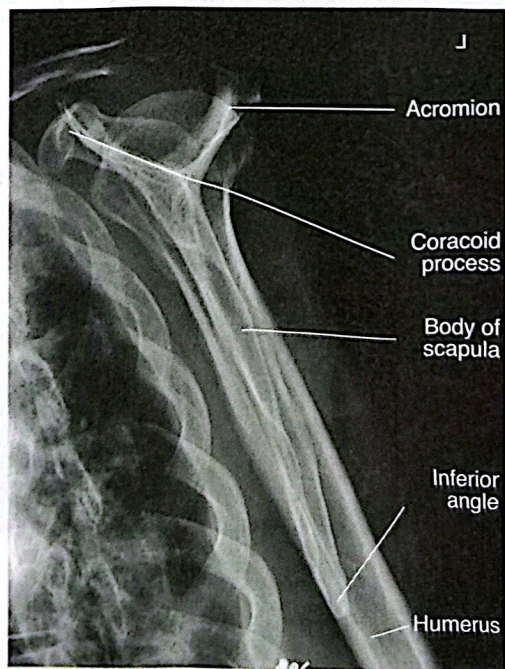


Fig. 13.87 Shoulder. PA oblique projection (scapular Y).

Clavicle

Examination of the clavicle is routinely done in the PA and PA axial projections to keep the clavicle as close to the IR as possible. If the patient is recumbent, however,

a supine position is more comfortable when the clavicle has been injured. Under these circumstances, AP and AP axial projections are performed.

ROUTINE EXAMINATION

The routine examination of the clavicle includes the upright PA and PA axial projections, or recumbent AP and AP axial projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) crosswise

Grid: Yes

SID: 40 inches minimum

Body position:

Upright: Standing or seated facing Bucky with coronal plane parallel to IR. Head turned away from side of interest. Arm at side (Figs. 13.88 and 13.89).

Recumbent: Supine (Figs. 13.90 and 13.91).

Part position: See body position.

Central ray:

PA or AP: Perpendicular to midclavicle.

PA axial: 15 to 30 degrees caudad to midclavicle.

AP axial: 15 to 30 degrees cephalad to midclavicle.

Collimation: Adjust light field to 8 × 12 inches (18 × 30 cm) on the collimator. Place side marker in the collimated light field.

Patient instruction: Stop breathing. Do not move.

Structures seen: Entire clavicle and its articulations (Figs. 13.92 and 13.93).

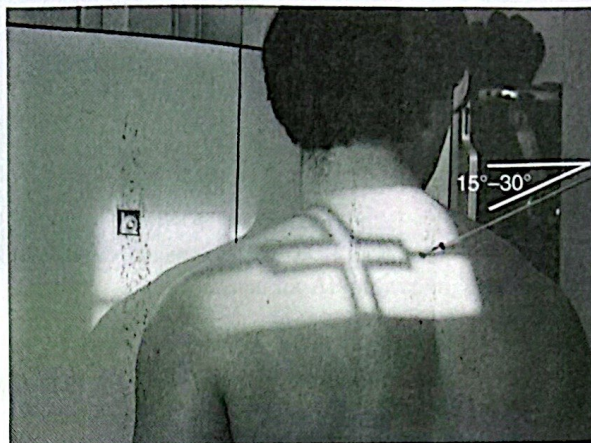


Fig. 13.89 Clavicle. Position for PA axial projection, patient upright.

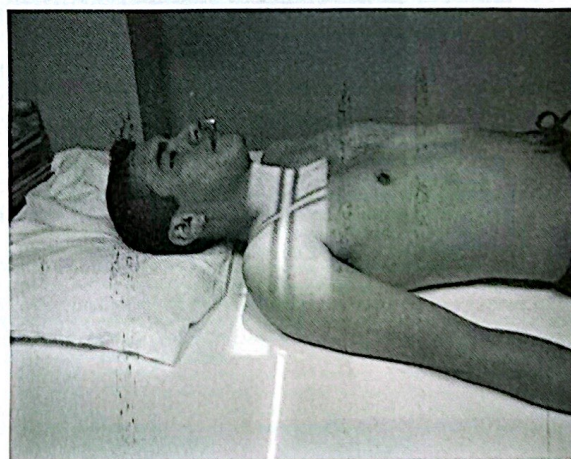


Fig. 13.90 Clavicle. Position for AP projection, patient recumbent.



Fig. 13.88 Clavicle. Position for PA projection, patient upright.

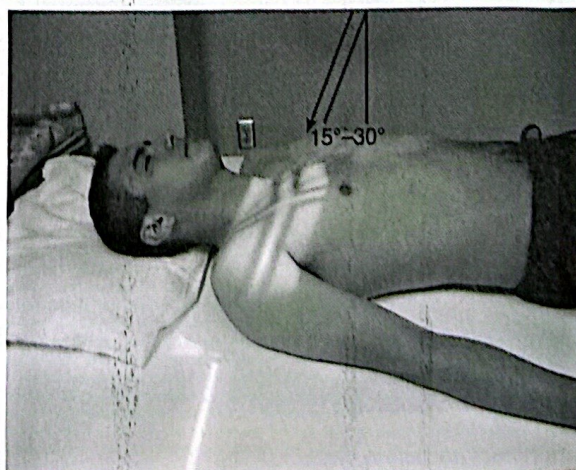


Fig. 13.91 Clavicle. Position for AP axial projection, patient recumbent.

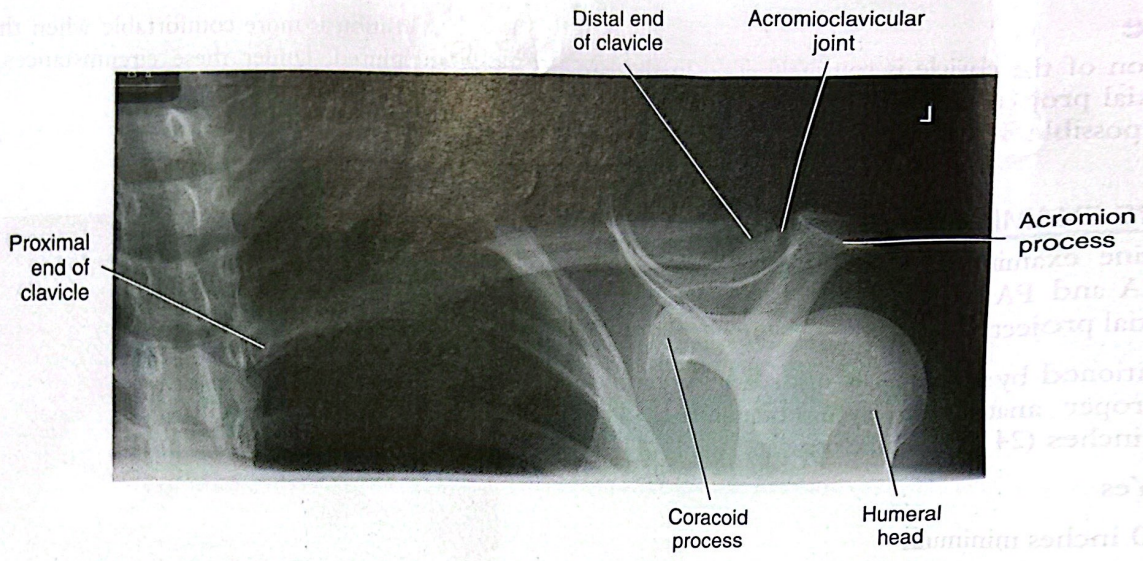


FIG. 13.92 Clavicle. PA projection.



Fig. 13.93 Clavicle. PA axial projection.

Scapula

ROUTINE EXAMINATION

The routine examination of the scapula includes the AP and lateral projections.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 10 × 12 inches (24 × 30 cm) lengthwise

Grid: Yes

SID: 40 inches minimum

Body position: Standing or seated at upright Bucky or grid cabinet, or recumbent on table.

Part position:

AP: Arm abducted so that humerus is perpendicular to long axis of body. Elbow flexed 90 degrees. When patient is upright, patient may support position by grasping a pole (Figs. 13.94 and 13.97).

Upright lateral: Anterior oblique body position with affected side nearest IR. Adjust rotation of body (45 to 60 degrees) so that blade (body) of scapula is perpendicular to IR. Patient's forearm is positioned behind back with elbow flexed 90 degrees (Fig. 13.96). Alternatively, arm may be positioned over head or across chest, depending on structures of interest and patient's ability to comply (Fig. 13.95).

Recumbent lateral: Posterior oblique body position with unaffected side in contact with table. Rotation of body adjusted (45 to 60 degrees) so that blade (body) of scapula is perpendicular to IR. Patient's arm may be positioned across chest (Fig. 13.98).

TIP: To ensure that the body of the scapula is perpendicular to the IR, grasp the lateral and medial border between the thumb and index finger. Rotate patient's body until a line between the finger and thumb is perpendicular to the IR.

Central ray: Perpendicular to midscapula. For the AP, this point is approximately 2 inches (5 cm) inferior to the coracoid process. For the lateral, this point is the middle of the medial border of the scapular body.

Collimation: Adjust light field to 10 × 12 inches (24 × 30 cm) on the collimator. Place side marker in the collimated light field.

Patient instruction: Stop breathing. Do not move.

Structures seen: Entire scapula and its articulations with clavicle and humerus. AP projection demonstrates portions of scapula not obscured by ribs and clavicle (Fig. 13.99). Lateral projections demonstrate body of scapula free of superimposition by ribs, acromion, and coracoid process. Position of arm will determine portion of scapula obscured by proximal humerus (Fig. 13.100).

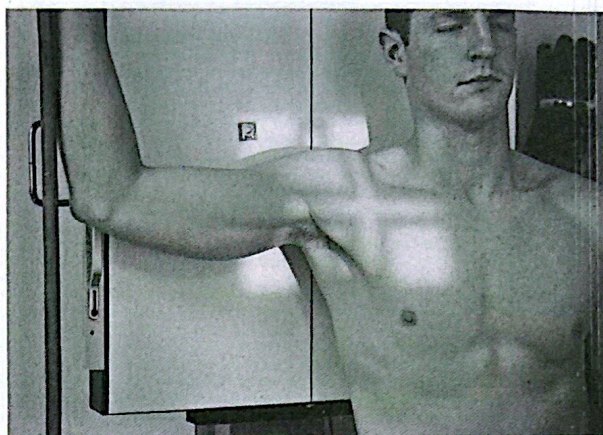


Fig. 13.94 Scapula. Position for AP projection, patient upright.



Fig. 13.95 Scapula. Position for lateral projection (anterior oblique position), arm across chest, patient upright.



Fig. 13.96 Scapula. Position for lateral projection (anterior oblique position), forearm behind back, patient upright.



Fig. 13.97 Scapula. Position for AP projection, patient recumbent.

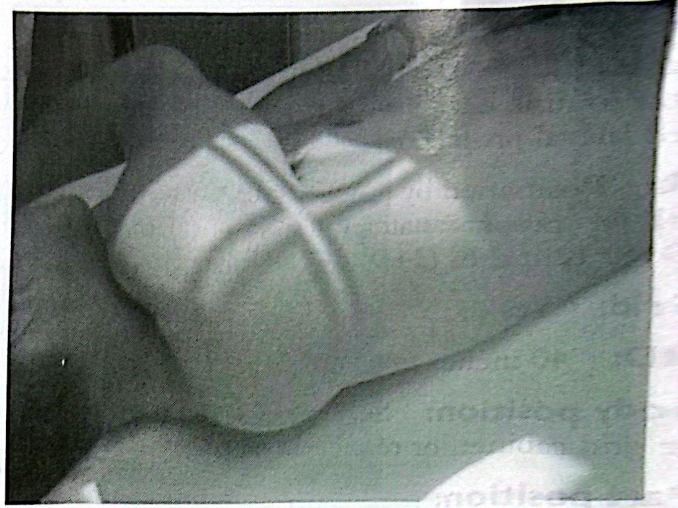


Fig. 13.98 Scapula. Position for lateral projection (posterior oblique position), patient recumbent.

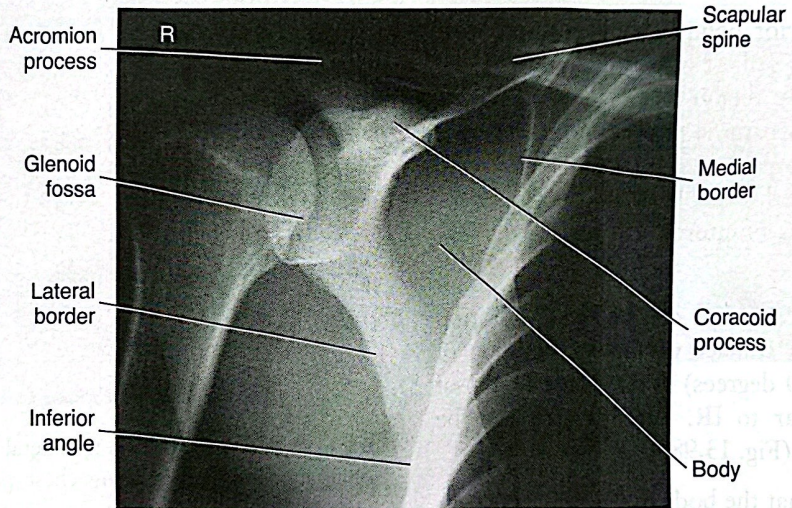


Fig. 13.99 Scapula. AP projection.

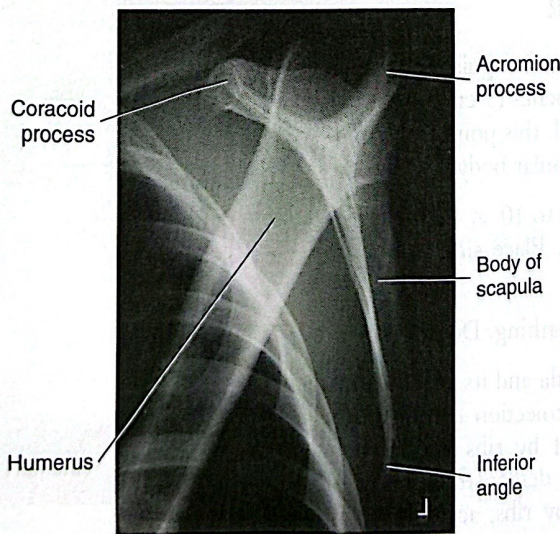


Fig. 13.100 Scapula. Lateral projection, forearm behind back.

Acromioclavicular Joints

ROUTINE EXAMINATION

The routine examination of the AC joints includes bilateral AP projections, both with and without weights. The purpose is to determine ligament integrity by demonstrating change in relative positions of the acromion and clavicle when under stress.

IR: Positioned by manufacturer or department protocol for proper anatomy display orientation; CR plate: 14 × 17 inches (35 × 43 cm) crosswise or two 10 × 12 inches (24 × 30 cm) lengthwise—one for each shoulder

Grid: Not required but may be used

SID: 40 inches minimum (or more as needed for wide shoulders)

Body position: Standing with back to IR(s).

Part position:

First exposure (no weights): Back of shoulders against lower half of IR(s). Arms relaxed at sides in neutral position (Fig. 13.101).

Second exposure (weights): Back of shoulders against upper half of IR(s). Arms at sides with 5- to 10-lb sandbag attached to each wrist (Figs. 13.102 and 13.104).

Central ray: Perpendicular to midline at level of acromion processes. Exposure field collimated to cover half of the IR (see Fig. 13.101).

TIPS:

- If the two sides are exposed separately, which is acceptable, patient must have sandbags on wrists for both weight-bearing radiographs.
- When the patient's shoulders are too wide to fit on a 35 × 43 cm IR, two 24 × 30 cm IRs can be placed side by side in the cassette holder (Fig. 13.103).
- Instruct the patient to stand tall but relax shoulders to allow weights to pull them down. This will result in best demonstration of AC joint separation.

Collimation: Adjust light field to 6 × 17 inches (15 × 43 cm) on collimator for large, single IR.

Adjust light field to 6 × 8 inches (15 × 20 cm) for two smaller IRs. Place side marker in the collimated light field.

Patient instruction: Stop breathing. Do not move.

Structures seen: Both AC joints for comparison to evaluate ligament integrity (Fig. 13.105).

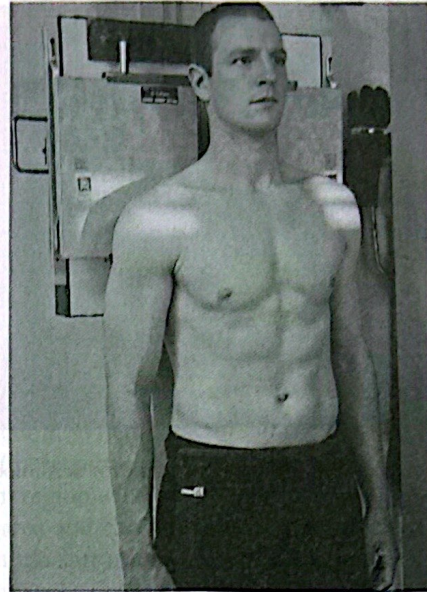


Fig. 13.101 Acromioclavicular joints. Position for bilateral AP projections, without weights.

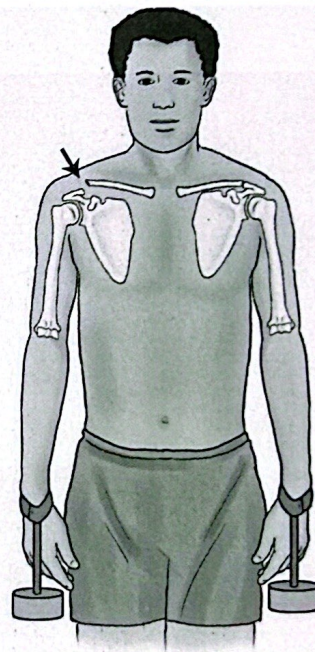


Fig. 13.102 Acromioclavicular (AC) joints. Weights should be attached to wrists as shown and not held in hands. Note how separation of the right AC joint is shown by pulling of weights (arrow).

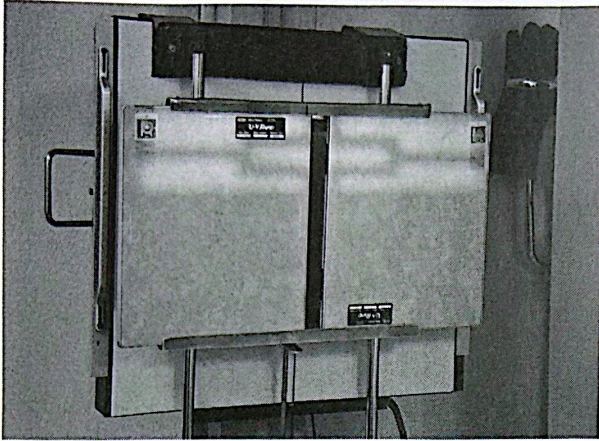


Fig. 13.103 Image receptor (IR) placement for acromioclavicular joint study using two IRs, no grid.



Fig. 13.104 Close-up of sandbag affixed to wrist. This is the ideal way to apply weight to the shoulders.

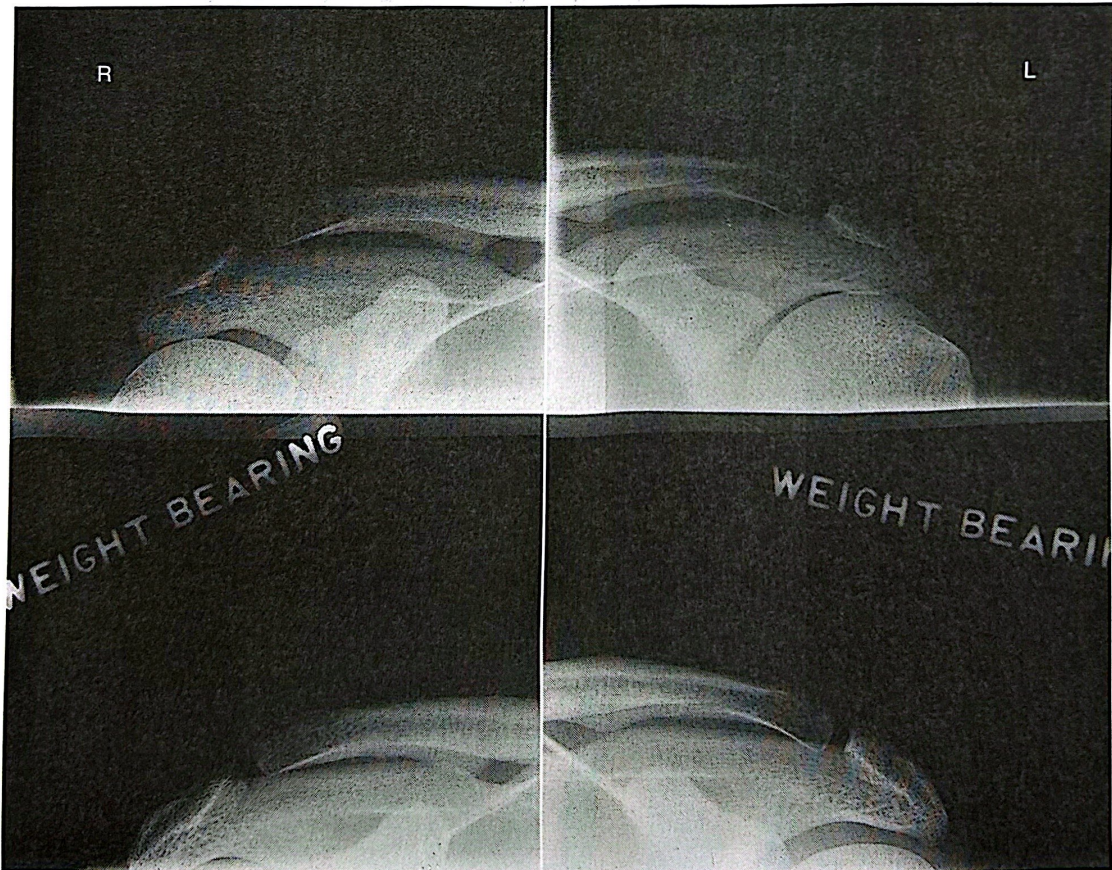


Fig. 13.105 Bilateral AP projections of acromioclavicular joints, with and without weights, using two image receptors and nongrid holder.

PATHOLOGY

Probably the most significant pathology affecting the upper limb is trauma. Fractures and other injuries to this portion of the anatomy may vary greatly, and a sample of those seen with radiography is discussed here.

Common Fractures

The boxer's fracture is a common fracture of the fifth metacarpal, usually caused when the patient strikes a solid object with a closed fist (Fig. 13.106).

An important carpal bone injury is a fracture of the scaphoid (navicular), often caused by a fall on an outstretched arm. When they are new, scaphoid fractures may be occult, that is, very subtle or completely invisible on a radiograph. Special projections are often necessary to demonstrate this fracture, or it may be necessary to have the patient return for another radiographic examination after about 10 days (Fig. 13.107). It is especially important

to identify these fractures because the scaphoid has a relatively inefficient blood supply, and there is a strong possibility of necrosis if the fracture is not identified early and treated correctly (Fig. 13.108). Necrosis of the scaphoid causes impairment of wrist function.

A Colles fracture (Fig. 13.109) is a common fracture of the distal radius, accompanied by posterior and medial displacement. A Monteggia fracture consists of a fracture of the ulna and dislocation of the radial head (Fig. 13.110).

The most common elbow fracture is a fracture of the radial head, which may occur as the result of a fall on an outstretched arm (Fig. 13.111). It is particularly important to demonstrate the soft tissue of the elbow joint in the lateral projection. When a fracture at the elbow causes **joint effusion** (increased fluid in the joint capsule), the fat pad in the joint region will be displaced. It moves upward from the joint area and can be seen radiographically as a dark shadow in the soft tissue anterior or sometimes posterior to the humerus. This **fat pad sign** (Fig. 13.112) may be the only radiographic indication of a fracture involving the elbow joint.



Fig. 13.106 Boxer's fracture (arrow).



Fig. 13.107 Scaphoid fracture at injury and 3 weeks later (arrow).

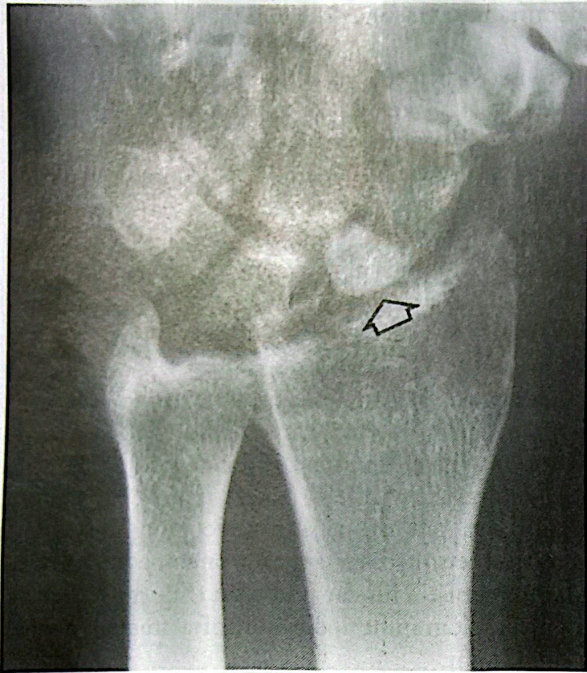


Fig. 13.108 Avascular necrosis of scaphoid (*open arrow*).



Fig. 13.109 Colles fracture (*arrows*).

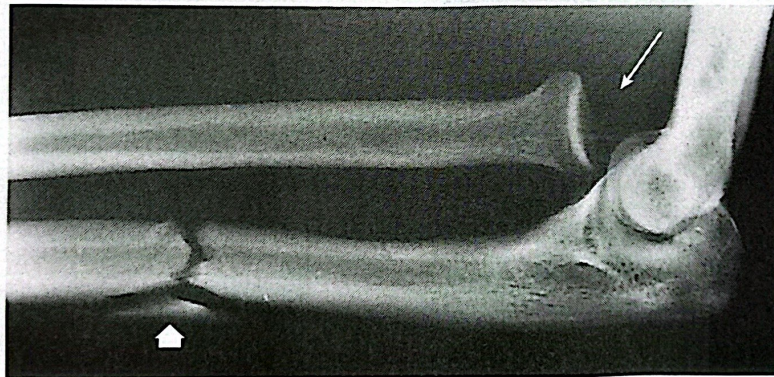


Fig. 13.110 Monteggia fracture. Fracture of the ulnar shaft (*arrowhead*) and dislocation of the radial head (*arrow*).



Fig. 13.111 Radial head fractures (*arrows*).



Fig. 13.112 Fat pad sign (arrow).

The humerus is most commonly fractured at its weak point, the surgical neck. An example is seen in the positioning section of this chapter (see Fig. 13.83).

Fractures of the clavicle are frequently seen, especially in children (Fig. 13.113).

Other Trauma Conditions

Dislocation of the shoulder (glenohumeral) joint is a fairly common injury. The humeral head may be displaced from the glenoid fossa either anteriorly or posteriorly (Fig. 13.114).

Injuries that introduce foreign bodies into the soft tissues may also be evaluated radiographically. In the upper limb, this is most commonly seen in the hand.

Nontraumatic Conditions

Chronic irritation to a bursa may lead to a condition called **bursitis**, inflammation of the bursa. Bursitis may cause calcific (calcium) deposits in the soft tissue of the joint region that are visible on radiographs. The shoulder is a very common site for calcific bursitis (Fig. 13.115). Inflammation of a tendon, called **tendinitis** or **tendonitis**, may occur at any tendon attachment in the body. It is

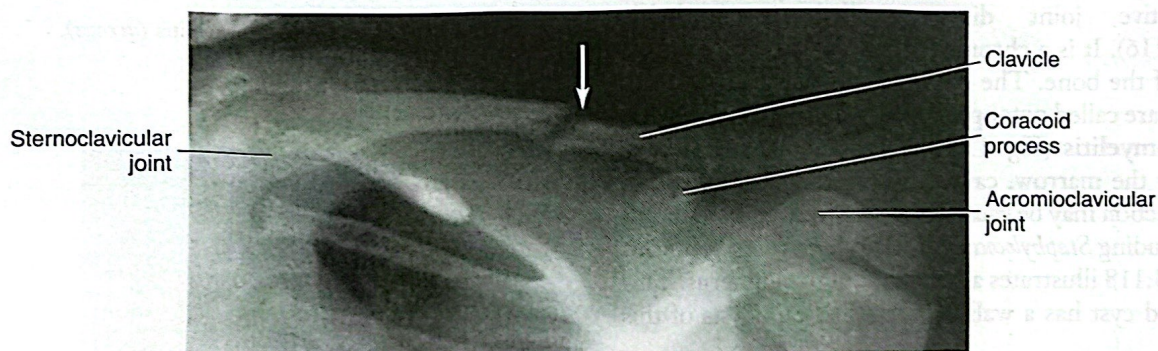


Fig. 13.113 Clavicle fracture in a small child (arrow).

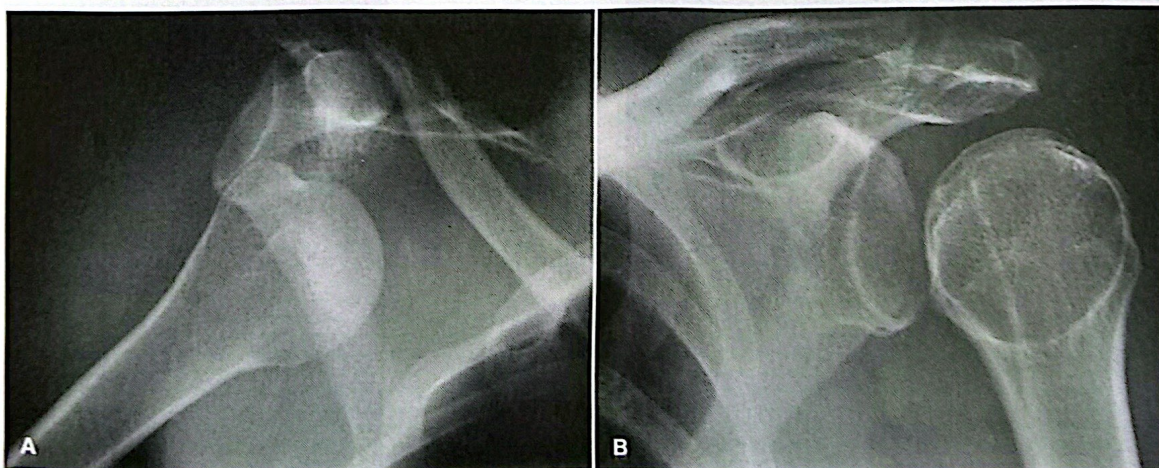


Fig. 13.114 Shoulder (glenohumeral) dislocations. (A) Anterior: humeral head inferior to coracoid process. (B) Posterior: humeral head trapped behind edge of glenoid process.

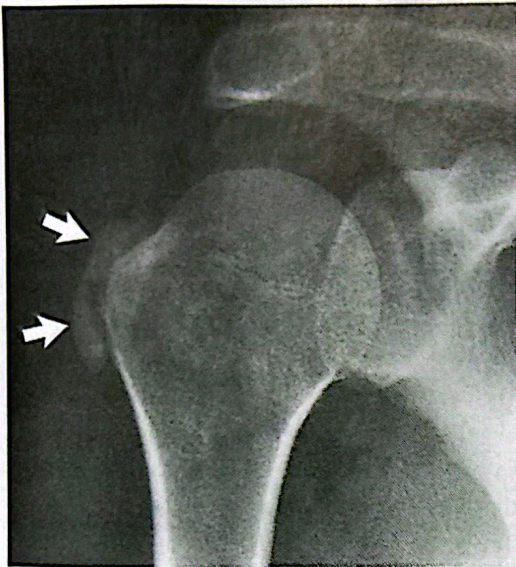


Fig. 13.115 Calcific bursitis (arrows).

common at the shoulder and in the wrist. Tendinitis may also produce calcific deposits in the soft tissues.

Arthritis (joint inflammation) may affect any part of the body, and there are a number of different types. Rheumatoid arthritis (see Fig. 12.40) is a crippling disease that often involves the hands and is a common reason for radiography. The most common type of arthritis is a degenerative joint disease called **osteoarthritis** (Fig. 13.116). It is a chronic condition that causes hypertrophy of the bone. The enlarged, deformed portions of the bone are called **osteophytes**.

Osteomyelitis (Fig. 13.117) is inflammation of bone, especially the marrow, caused by a pathogenic organism. Bone infection may be caused by a number of different bacteria, including *Staphylococcus* and *Mycobacterium tuberculosis*.

Fig. 13.118 illustrates a bone cyst of the humerus. This fluid-filled cyst has a wall of fibrous tissue. Cysts of this



Fig. 13.116 Osteoarthritis of fingers, with obliteration of interphalangeal joint spaces and osteophyte formation.

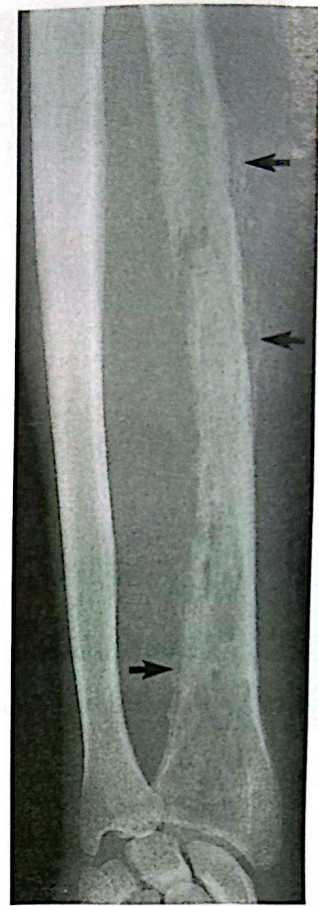


Fig. 13.117 Osteomyelitis (arrows).



Fig. 13.118 Bone cyst in humerus (dark expanded area).

type have no symptoms and are usually discovered only when they have weakened the bone sufficiently to cause a fracture. Fractures caused by underlying disease are called *pathologic fractures*. The cyst is actually a type of benign neoplasm. Other types of neoplasm and metastatic bone diseases may also affect the bones of the upper limb. They are called **osteoblastic** if they result in increased bone formation and **osteolytic** if they cause destruction of the bone.

SUMMARY

The bones of the hand and wrist include the phalanges, metacarpals, and carpals. The radius and ulna form the forearm, articulating at the wrist and the elbow. The humerus articulates with the forearm at the elbow and forms the shoulder joint where it articulates with the scapula. The scapula, clavicle, and upper humerus form the

shoulder girdle. Important palpable bony prominences include the styloid processes of the distal radius and ulna, the olecranon process of the proximal ulna, the epicondyles and greater tuberosity of the humerus, and the acromion and coracoid processes of the scapula.

Radiography of the hand, fingers, thumb, wrist, forearm, and elbow is performed on the tabletop, without a grid. The patient is usually seated at the end of the table. Examinations of the humerus and shoulder girdle, on the other hand, are done using a grid. The patient may be recumbent or upright. Examination of the AC joints requires a rather unusual combination of methods to produce bilateral projections taken with and without weights.

A variety of pathologies affect the upper limb, including trauma (fractures and dislocations) and nontraumatic conditions, such as arthritis, bursitis, tendinitis, infection, and neoplasia. Radiography has an important role in diagnosis of these conditions.