ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 7, Issue – 6, November – 2022 , Page No. : 180 – 186

Imaging of the Distal Humerus

[1]Dr. Kshitij Z Badade, MBBS, MS Orthopaedics, Assistant Professor Orthopaedics Department MGM Medical College & Hospital, Navi Mumbai, Maharashtra, India.

[2]Dr Varun Wade, Orthopaedics Department , MGM Medical College & Hospital, Navi Mumbai, Maharashtra, India

Corresponding Author: Dr. Kshitij Z Badade, MBBS, MS Orthopaedics, Assistant Professor Orthopaedics Department MGM Medical College & Hospital, Navi Mumbai, Maharashtra, India.

Citation this Article: Dr. Kshitij Z Badade, Dr Varun Wade, “Imaging of the Distal Humerus”, IJMSIR- November - 2022, Vol – 7, Issue - 6, P. No. 180 – 186.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

The medial and lateral humeral condyles are formed at the distal end of the humeral shaft. The trochlea and capitulum are the articular parts of these condyles. A semicircular groove, or trochlear sulcus, divides the spool-shaped trochlea.

The trochlea connects to the ulna and is located on the medial side of the distal humerus. On the lateral aspect, the radius articulates with the rounded capitulum, also known as the capitellum.

In close proximity to the trochlea and capitulum, respectively, are the medial and lateral epicondyles. Three depressions or fossae serve as landmarks for the distal humerus.

At complete elbow flexion, the radial head and ulnar coronoid process are received anteriorly by the coronoid and radial fossa. At elbow extension, the ulnar olecranon process enters the olecranon fossa posteriorly.

Keywords: Radial Fossa, Olecranon Fossa, Humerus, PUDA.

Introduction

These views can considerably aid fluoroscopic vision of anatomical fracture reduction and proper implant placement for the distal humerus.

Standard views

- AP view of the distal humerus
- Lateral view of the elbow

Additional views

1. Oblique view of the distal humerus
2. Axial view of the distal humerus

The following represent ideal imaging with the patient placed in the supine position.

The posture of the arm and forearm remain the same for patients in lateral decubitus and prone positions.

The orientation of the C-arm has to be adjusted accordingly.

3. AP view of the distal humerus

Positioning for optimal view

1. Shoulder in 90° abduction and neutral rotation
2. The elbow is flexed 20-30°
3. The forearm is fully supinated
4. The beam is placed perpendicular to the humerus (and in the plane created by the humerus and the forearm)

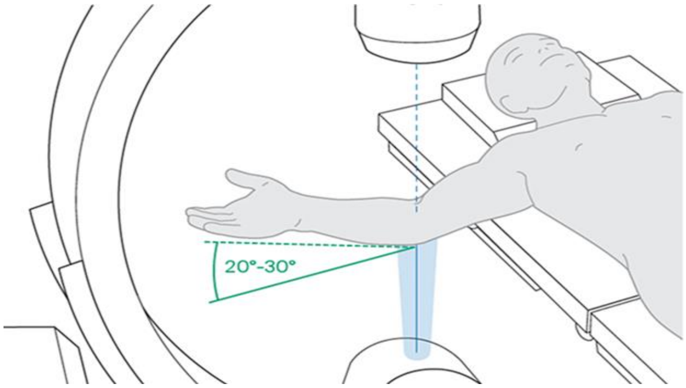

Fig 1: Positioning for optimal AP view

Verification of optimal view

The optimal view is obtained when:

1. The optimal outline of medial and lateral epicondyles is demonstrated.
2. The tip of the olecranon is centred in the olecranon fossa.

The anterior and posterior articular margins of the medial trochlear ridge are aligned.

Fig 2: Optimal AP view

Anatomical landmarks and lines

The following lines and landmarks can be observed:

1. Distal joint line of humerus
2. Lateral epicondyle
3. Medial epicondyle
4. The medial border of the ulnar trochlea
5. Olecranon
6. Olecranon fossa

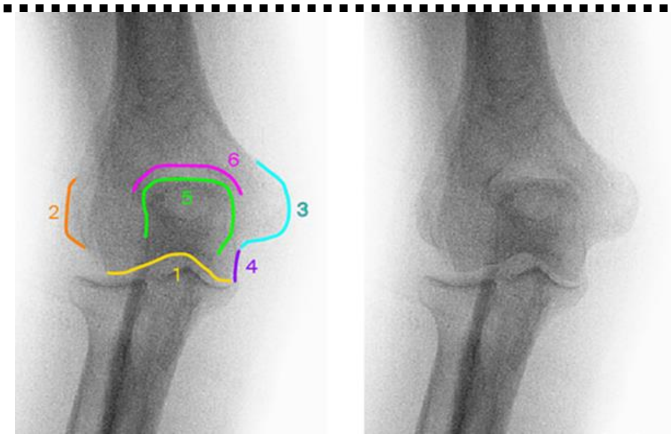

Fig 3: Anatomical landmarks and lines in AP view

What can be observed?

This view is particularly useful to identify:

1. Fractures and mal-aligment of the lateral or medial (epi) condyle, distal joint line or olecranon
2. Implant malposition Ing

B. Lateral view of the elbow

Positioning for optimal view

1. The shoulder in 90° abduction and 90° internal or external rotation (in cases with restricted shoulder motion, the beam can be rotated as needed)
2. The elbow is flexed 90°
3. The forearm is in neutral rotation
4. The beam is placed perpendicular to the plane created by the humerus and the forearm

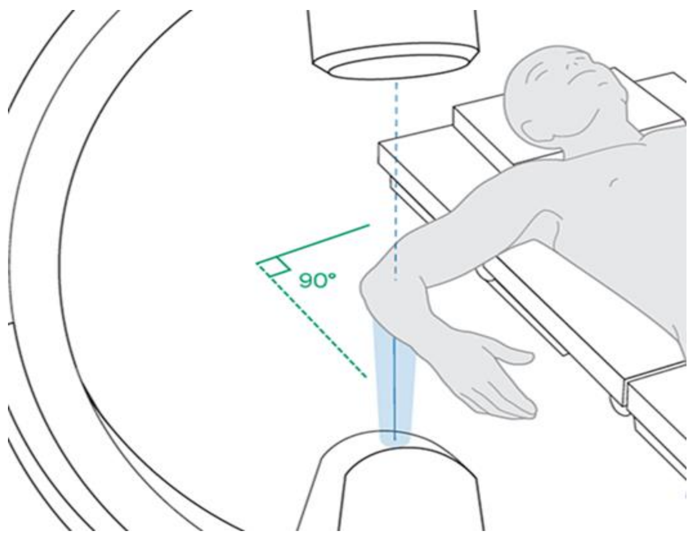

Fig 4: Positioning for optimal lateral view of distal humerus

Verification of optimal view

The optimal view is obtained when

1. The ulno-humeral joint is congruent without the "drop sign"
2. Radial head and coronoid process are aligned
3. The axis of the proximal radial shaft is aligned with the centre of the capitellum
4. The PUDA is present

Fig 5: Optimal lateral view of distal humerus

Drop sign

The 'drop sign' is the term given to the appearance of an abnormal relationship between the trochlea of the distal humerus and the trochlear notch of the ulna (dotted line) when there is excessive laxity of the capsular soft issues of the ulno-humeral joint, permitting the ulna to 'drop' away from the humerus.

In this case a dislocation of the joint has occurred after fixation: the implication of the presence of a 'drop sign' is that capsular disruption (including disruption of the named ligaments) remains a problem to be assessed.

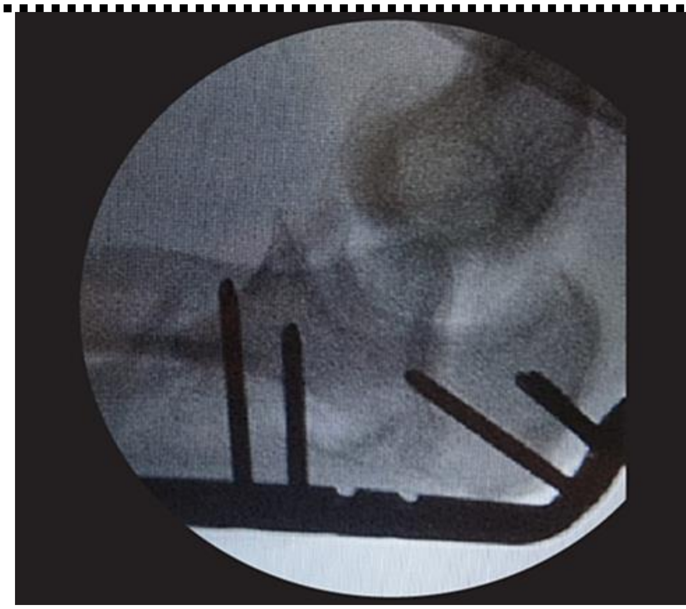

Fig 6: Drop sign

Anatomical landmarks and lines

The following lines and landmarks are seen:

1. Joint line of radial head
2. Joint line of coronoid process
3. Proximal ulnar dorsal angle (PUDA)
4. The anterior cortex of humerus bisects the circular projection of the trochlea
5. The axis of the proximal radial shaft is aligned with the Center of the capitellum

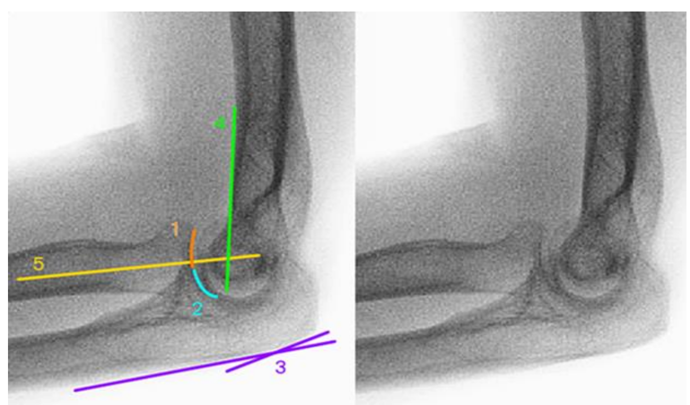

Fig 7: Anatomical landmarks and lines AP view of distal humerus

What can be observed?

This view is particularly useful to identify:

1. Distal humeral fracture mal-reduction

2. Joint laxity with "drop sign" or mal-alignment of axis of the radial shaft with the capitellum
3. Implant mal-positioning

C. Oblique view of the distal humerus

Positioning for optimal view

1. Shoulder in 90° abduction and 20-30° extension (the beam needs to be 60-70° to the axis of the humerus)
2. The humerus is rotated externally 45°

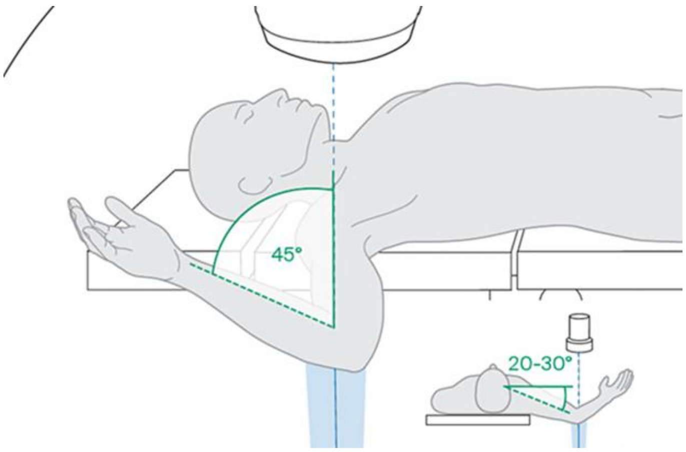

Fig 8: Positioning for optimal oblique view

1. The elbow is flexed 30-45°
2. The forearm is in neutral rotation

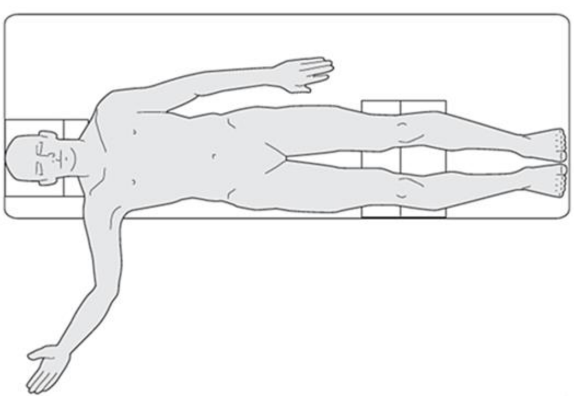

Fig 9: Positioning for optimal oblique view

Verification of optimal view

The humerus is rotated externally until the three overlapping circular images of the capitellum and medial and lateral trochlear margins are seen.

Overlap of the ulna and radial head should be avoided.

Fig 10: Verification of optimal oblique view

Anatomical landmarks and lines

The following lines and landmarks can be observed:

1. Anterior articular margin of the capitellum
2. Lateral margin of trochlea
3. Medial margin of trochlea

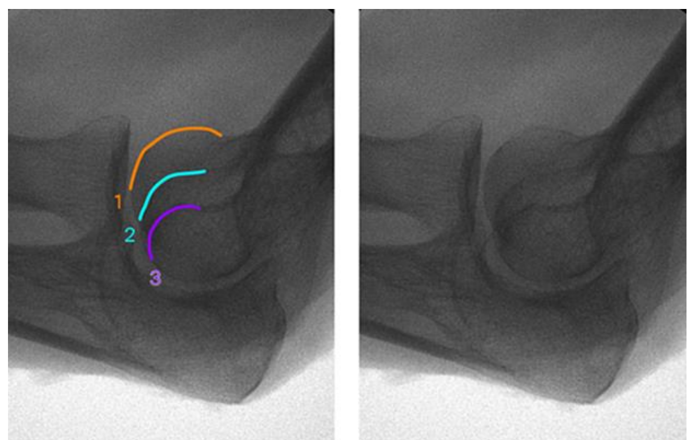

Fig 11: Anatomical landmarks and lines in the oblique view

What can be observed?

This view is particularly useful to identify:

1. Shear fractures of capitellum and anterior trochlea
2. Distal humeral fracture malreduction
3. Screw penetration and implant malposition Ing

D. Axial view of the distal humerus

Positioning for optimal view

1. Shoulder in 90° abduction and neutral rotation
2. The elbow is flexed as much as possible
3. The forearm is in neutral position

4. The beam is placed perpendicular to the humerus (and in the plane created by the humerus and the forearm)

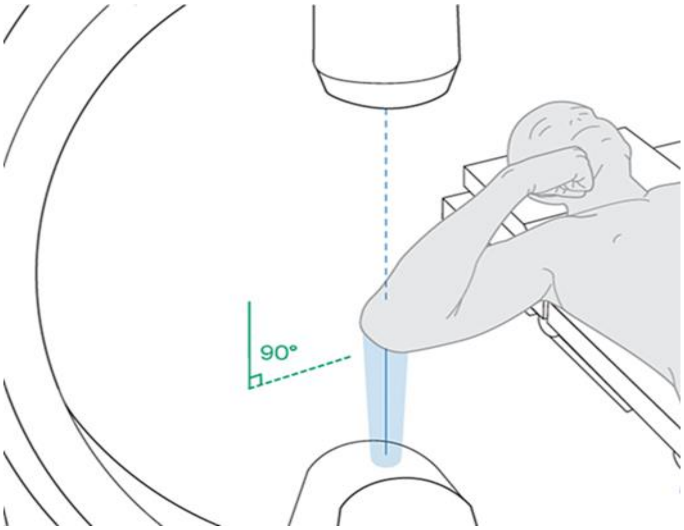

Fig 12: Positioning for optimal axial view

Verification of optimal view

The optimal view is obtained when the

1. Elbow is completely flexed
2. Olecranon tip is centred and congruent with the distal humeral joint line

Fig 13: Verification of optimal axial view

Anatomical lines and landmarks

The following lines and landmarks can be observed:

1. Posterior trochlear articular margin
2. Olecranon tip
3. Medial epicondyle
4. Bony margin of the cubital tunnel

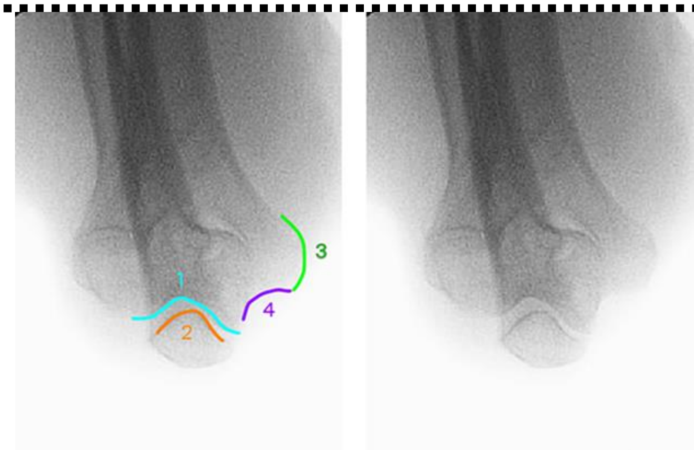

Fig 14: Anatomical landmarks and lines in the axial view

What can be observed?

This view is particularly useful to identify:

1. Fractures and mal-alignment of the olecranon tip and posterior trochlea
2. Screw penetration
3. Implant malposition Ing

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Declarations

Informed consent

Informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed.

“Institutional Ethical Committee Approval”

Taken from Institutional Ethical Approval Committee, MGM Medical College & Hospital, Navi Mumbai, Maharashtra, India.

Availability of data and materials

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