

# Olecranon Fracture Fixation (ORIF)

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## Anatomy & Pathophysiology

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### BONY ANATOMY

- The elbow is a trocho-ginglymoid joint consisting of medial and lateral articulations that provide bony stability [3].
- The trochlea articulates with the ulna within the greater sigmoid notch to form the ulnohumeral, hinged, or trochoid portion of the elbow joint [3].
- The ulnohumeral articulation provides highly congruent anatomy through almost 180° of articular contact [3].
- The greater sigmoid notch of the ulna contains a bare area devoid of cartilage [3].
- The coronoid process has medial and lateral facets that buttress the trochlea anteriorly [3].
- The sublime tubercle is located just distal and medial to the coronoid and serves as the attachment site for the anterior bundle of the medial ulnar collateral ligament [3].
- The medial epicondyle is larger and more posteriorly oriented than the lateral epicondyle [3].
- The medial epicondyle forms the attachment site for the origins of the flexor pronator mass [3].
- The capitellum and radial head form the radiocapitellar joint [3].
- The radius is held in close approximation to the ulna at the proximal radioulnar joint by the annular ligament [3].
- The lesser sigmoid notch is the area of the ulna that articulates with the margin of the radial head at the proximal radioulnar joint [3].
- The radial head is a concave elliptical structure covered with articular cartilage along the radiocapitellar joint and approximately 270° of the articular margin [3].
- The radial head articulates with both the capitellum and the lesser sigmoid notch [3].
- The lateral epicondyle is the origin of the lateral extensor musculature [3].
- The origin of the lateral ulnar collateral ligamentous complex is located just distal to the lateral epicondyle at the geometric center of the radiocapitellar articulation [3].
- The distal humeral articulation is angled 30° from the longitudinal axis [3].

- The anterior humeral line should pass through the center of the axis of rotation [3].
- The axis of rotation is angulated 5° to 7° in the coronal plane relative to the epicondylar axis, with the medial side more distal than the lateral side [3].
- The olecranon provides a broad attachment site for the triceps [3].
- The ulna bends approximately 8° medially at 8 cm from the tip of the olecranon [3].
- The articulation to the tip of the coronoid is approximately 30° from the long axis of the ulna in the sagittal plane [3].
- There is a high correlation between the size of the radial head and capitellum on the left and right sides of the same individual [2, 3].

## LIGAMENTS AND SOFT TISSUE

- Elbow stability is determined by primary stabilizers, which include the ulnohumeral articulation, the medial ulnar collateral ligament, and the lateral ulnar collateral ligament complex [1].
- Secondary stabilizers of the elbow include the radiocapitellar articulation, the common flexor tendon, the common extensor tendon, and the joint capsule [1].
- The medial ulnar collateral ligament is the primary valgus stabilizer of the elbow [4, 5].
- The anterior bundle of the medial ulnar collateral ligament is the most important component for stability [4, 5].
- The posterior bundle of the medial ulnar collateral ligament becomes taut at flexion beyond 120 degrees [4, 5].
- The lateral ulnar collateral ligament acts as a posterolateral stabilizer [4, 5].
- Osborne's ligament stabilizes the ulnar nerve in the cubital tunnel [4, 5].
- The ligament of Struthers is a variant anatomy arising from the supracondylar process to attach to the medial epicondyle and is a potential site of median nerve compression [4, 5].
- The anterior capsule attaches at a point approximately 6 mm distal to the tip of the coronoid [4, 5].
- The joint capsule allows maximum distension at approximately 70 to 80 degrees of flexion [4, 5].
- Tensile forces are present at the medial elbow and compressive forces at the lateral elbow [4, 5].
- The triceps muscle has three distinct insertional areas to the olecranon: the posterior capsular insertion, the deep muscular portion, and the superficial tendinous portion [2].
- The deep muscular head of the triceps corresponds to the medial head of the triceps [2].
- The superficial tendinous portion of the triceps corresponds to the long and lateral heads [2].
- The width of the triceps insertion is 2.6 cm and is located 1.1 cm from the tip of the olecranon [2].
- The brachialis is the strongest elbow flexor and attaches to the coronoid 11 mm distal to the tip [4, 5].
- The biceps brachii inserts at the ulnar margin of the radial tuberosity [4, 5].
- The primary elbow extensor, the triceps, inserts on the olecranon process [4, 5].

## BIOMECHANICS AND MOTION

- The normal elbow has a range of motion from 0° to 140° from extension to flexion [1].
- The normal elbow has a range of motion of 75° in pronation and 85° in supination [1].
- A functional arc for flexion and extension is 100° [1].
- A functional arc for forearm rotation is 100° [1].
- The angulation of the distal humeral articulation accounts for the change from a valgus carrying angle to a more varus position as the elbow is flexed [3].

## Investigations

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### PHYSICAL EXAMINATION

- The physical examination of the elbow is directed by the history and the location of the patient's pain in the anterior, posterior, medial, or lateral aspect of the elbow [1].
- Pathologic entities associated with these discrete compartments aid the examiner in detecting pathologic conditions [1].
- The soft tissue surrounding the elbow should be examined for previous skin incisions, grafts, eschar, or infection [9].
- Active and passive flexion, extension, supination, and pronation should be evaluated using a goniometer for accurate measurement [9].
- The contralateral elbow should be examined for comparison during range of motion assessment [9].
- If the elbow has less than 90° to 100° of flexion, the posterior bundle of the medial collateral ligament is contracted and must be released to restore flexion [9].
- Pain should be assessed during the mid-arc or at the terminal ends of motion [9].
- Mid-arc range of motion pain is more common with intrinsic disease and may not improve with contracture release alone [9].
- The ulnar nerve is of utmost importance during examination because of its anatomic proximity to the elbow [9].
- The posterior bundle of the medial collateral ligament forms the floor of the cubital tunnel along the course of the ulnar nerve [9].
- Electromyography and nerve conduction velocity studies should be performed if there is any question about neurologic dysfunction [9].
- An assessment for ulnar nerve subluxation should be performed [9].
- Subluxation of the ulnar nerve is a relative contraindication for an arthroscopic procedure secondary to possible iatrogenic nerve injury [9].
- The presence of a prior ulnar nerve transposition should be verified if there is a history of prior surgical procedures [9].

## IMAGING

- Plain radiographs remain the hallmark and the best screening test for elbow evaluation [1].
- AP, lateral, and oblique radiographs are standard for elbow imaging [9].
- Serial radiography is used as follow-up when heterotopic ossification is present [9].
- Primary bony landmarks identified on radiographs include the ulnohumeral joint, coronoid process, radial head, capitellum, radiocapitellar joint, olecranon tip, coronoid/olecranon fossae, and trochlear ridge [9].
- CT is helpful when assessing for malunion architecture and the location and pattern of osteophytes and/or loose bodies [9].
- Three-dimensional CT is used to check for heterotopic ossification [9].
- CT is not necessary when the stiffness is entirely soft-tissue related [9].
- CT is beneficial if any joint incongruity or abnormal bony anatomy is present [9].
- MRI can be used to evaluate ligaments and tendons, but it is rarely indicated for elbow stiffness [9].
- CT with two-dimensional reconstruction and three-dimensional surface rendering best visualizes the pathology of valgus extension overload syndrome [11].
- MRI may be most helpful in evaluating associated injuries including partial or complete tears of the medial collateral ligament in valgus extension overload syndrome [11].
- Radiographic evaluations are essential when diagnosing an osteochondritis dissecans lesion of the elbow [12].
- Important aspects of osteochondritis dissecans lesions may be better seen with MRI [12].
- Standard AP and lateral radiographs typically show osteophyte formation at the coronoid process, coronoid fossa, radial fossa, radial head, olecranon tip, and olecranon fossa in elbow osteoarthritis [13].
- Joint spaces at the ulnohumeral joint are usually preserved in elbow osteoarthritis [13].
- Joint spaces at the radiocapitellar joint are mildly narrowed in elbow osteoarthritis [13].
- Loose bodies may be evident on radiographs, which typically underestimate the number present [13].
- CT may be useful for surgical planning in elbow osteoarthritis, allowing a detailed assessment of osteophytes and the presence of loose bodies [13].

## References

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- [1] Orthopaedic Knowledge Update 13 Ebook Without Multimedia. Anatomy, Biomechanics, Physical Examination, and Imaging of the Elbow > Summary and Conclusions.
- [2] Orthopaedic Knowledge Update 13 Ebook Without Multimedia. Anatomy, Biomechanics, Physical Examination, and Imaging of the Elbow > Annotated References.
- [3] Orthopaedic Knowledge Update 13 Ebook Without Multimedia. Anatomy, Biomechanics, Physical Examination, and Imaging of the Elbow > Anatomy > Bony Anatomy.

- [4] Miller S Review Of Orthopaedics. SECTION 16 PATELLAR TRACKING IN TOTAL KNEE ARTHROPLASTY > TABLE 2.3 Shoulder Spaces.
- [5] Miller S Review Of Orthopaedics. Genetics of musculoskeletal conditions and abnormalities are summarized in Table 1.27 > TABLE 2.3 Shoulder Spaces.
- [9] Aaos Comprehensive Orthopaedic Review 3. Elbow Stiffness\* > IV. Evaluation.
- [11] Aaos Comprehensive Orthopaedic Review 3. Elbow Injuries in the Athlete\* > III. Valgus Extension Overload Syndrome and Posterior Impingement.
- [12] Orthopaedic Knowledge Update. Osteochondritis Dissecans of the Knee and Elbow\* > Summary.
- [13] Aaos Comprehensive Orthopaedic Review 3. Arthritis and Arthroplasty of the Elbow > I. Osteoarthritis.