CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Pronator and AIN Release

Anatomy & Pathophysiology

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 create the ulnohumeral, hinged, or trochoid portion of the elbow joint [3].
- The ulnohumeral articulation has highly congruent anatomy through almost 180° of articular contact, with the exception of the bare area of the greater sigmoid notch which is devoid of cartilage [3].
- The coronoid has a medial and lateral facet which buttresses the trochlea anteriorly [3].
- The sublime tubercle is located just distal and medial to the coronoid and provides the attachment site for the anterior bundle of the medial ulnar collateral ligament [3].
- The medial epicondyle forms the attachment site for the origins of the flexor pronator mass and is larger and more posteriorly oriented than the lateral epicondyle [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 area of the ulna which articulates with the margin of the radial head at the proximal radioulnar joint is known as the lesser sigmoid notch [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].

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- The axis of rotation is 5° to 7° angulated in the coronal plane to the epicondylar axis, with the medial side more distal than the lateral side [3].
- The angulation of the distal humeral articulation accounts for the change in a valgus carrying angle to a more varus position as the elbow is flexed [3].
- There is a high correlation between the size of the radius and capitellum on the left and right sides in the same individual [3].
- The olecranon allows for a broad attachment site of the triceps [3].
- The ulna medially bends approximately 8° at 8 cm from the tip of the olecranon [3].
- There is a slight anterior bow to the proximal ulna [3].
- The articulation to the tip of the coronoid is approximately 30° from the long axis of the ulna in the sagittal plane [3].

LIGAMENTS AND CAPSULE

- The medial ulnar collateral ligaments are areas of capsular thickening which provide stability to the medial side of the elbow joint [3].
- The medial ulnar collateral ligament is the primary valgus stabilizer [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 has the greatest change in length and becomes taut at flexion beyond 120 degrees [4, 5].
- The lateral ulnar collateral ligament is the 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 elbow capsule allows maximum distension at approximately 70 to 80 degrees of flexion [4, 5].
- The anterior capsule attaches at a point approximately 6 mm distal to the tip of the coronoid [4, 5].
- The coronoid tip is an intraarticular structure that is visualized during elbow arthroscopy [4, 5].
- Tensile forces are present at the medial elbow and compressive forces are present at the lateral elbow [4, 5].

MUSCLES

- 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, with the long head inserting proximally and the short head distally [4, 5].
- The biceps brachii is a powerful supinator of the forearm [4, 5].
- The triceps is the primary elbow extensor and inserts on the olecranon process [4, 5].
- The mobile wad consists of the brachioradialis, extensor carpi radialis longus, and extensor carpi radialis brevis [4, 5].

- The flexor-pronator mass consists of the pronator teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, and flexor digitorum superficialis [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].
- Elbow stability is determined by primary and secondary stabilizers [1].
- The three primary stabilizers of the elbow are the ulnohumeral articulation, the medial ulnar collateral ligament, and the lateral ulnar collateral ligament complex [1].
- The secondary stabilizers of the elbow are the radiocapitellar articulation, the common flexor tendon, the common extensor tendon, and the joint capsule [1].

Investigations

HISTORY AND 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].
- 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 assessment during the mid-arc or at the terminal ends of motion is required, with mid-arc pain being more common with intrinsic disease [9].
- The ulnar nerve is of utmost importance in the examination due to its anatomic proximity to the elbow [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, as subluxation is a relative contraindication for arthroscopic procedures due to the risk of iatrogenic nerve injury [9].
- The status of any prior ulnar nerve transposition should be verified if there is a history of previous surgical procedures [9].
- Patients with valgus extension overload syndrome report posteromedial elbow pain that occurs during the deceleration phase of throwing as the elbow reaches terminal extension [11].

- Crepitus and tenderness over the posteromedial olecranon may be noted in patients with valgus extension overload syndrome [11].
- Pain is reproduced when the elbow is forced into extension in patients with valgus extension overload syndrome [11].
- Elbow flexion contracture may be seen in patients with valgus extension overload syndrome [11].
- Patients with osteoarthritis of the elbow typically present with loss of terminal extension and flexion and painful catching, clicking, or locking of the elbow [13].
- Pain in osteoarthritis of the elbow is typically noted at the end ranges of motion and not through the midrange [13].
- Forearm rotation is relatively preserved until later in the disease process of osteoarthritis [13].
- Ulnar neuropathy is present in up to 50% of patients with osteoarthritis of the elbow [13].

IMAGING

- Plain radiographs remain the hallmark and the best screening test for elbow evaluation [1].
- AP, lateral, and oblique radiographs are standard for elbow evaluation [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 elbow 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].
- AP, lateral, oblique, and axillary views of the elbow may reveal posteromedial olecranon osteophytes and/or loose bodies in valgus extension overload syndrome [11].
- 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].
- Radiographs typically show osteophyte formation at the coronoid process, coronoid fossa, radial fossa, radial head, olecranon tip, and olecranon fossa in osteoarthritis [13].
- Joint spaces at the ulnohumeral joint are usually preserved in osteoarthritis [13].
- Joint spaces at the radiocapitellar joint are mildly narrowed in osteoarthritis [13].
- Loose bodies may be evident on radiographs, which typically underestimate the number present in osteoarthritis [13].

- CT may be useful for surgical planning in osteoarthritis, allowing a detailed assessment of osteophytes and the presence of loose bodies [13].
- 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].

References

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

[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.

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