CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Distal Triceps Repair

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 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 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 lateral epicondyle is the origin of the lateral extensor musculature [3].
- The origin of the lateral ulnar collateral ligament 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 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].

LIGAMENTS AND SOFT TISSUE

- The medial ulnar collateral ligament is comprised of the anterior bundle, posterior bundle, and transverse ligament [2].
- The anterior bundle of the medial ulnar collateral ligament is the strongest component and the primary restraint to valgus stress [2].
- The anterior bundle of the medial ulnar collateral ligament is subdivided into anterior and posterior bands that provide reciprocal function, with the anterior band tight in extension and the posterior band tight in flexion [2].
- The lateral ulnar collateral ligament origin center is 10.7 mm from the lateral epicondyle [2].
- The lateral ulnar collateral ligament insertion is 3.3 mm from the apex of the supinator crest [2].
- The triceps muscle insertions have three distinct insertional areas to the olecranon: posterior capsular insertion, deep muscular portion, and 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 [2].
- The triceps insertion is located 1.1 cm from the tip of the olecranon [2].
- The primary elbow extensor, the triceps, inserts on the olecranon process [4].
- The brachialis is the strongest elbow flexor and attaches to the coronoid 11 mm distal to the tip [4].
- The biceps brachii inserts at the ulnar margin of the radial tuberosity, with the long head inserting proximally and the short head distally [4].
- The biceps brachii is a powerful supinator of the forearm [4].
- The mobile wad consists of the brachioradialis, extensor carpi radialis longus, and extensor carpi radialis brevis [4].
- The flexor-pronator mass consists of the pronator teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, and flexor digitorum superficialis [4].
- Tensile forces are present at the medial elbow while compressive forces are present at the lateral elbow [4].
- The elbow capsule allows maximum distension at approximately 70 to 80 degrees of flexion [4].
- The anterior capsule attaches at a point approximately 6 mm distal to the tip of the coronoid [4].
- The coronoid tip is an intraarticular structure visualized during elbow arthroscopy [4].

- The medial or ulnar collateral ligament is the primary valgus stabilizer [4].
- The anterior bundle of the medial ulnar collateral ligament is the most important component for stability [4].
- The posterior bundle of the medial ulnar collateral ligament has the greatest change in length and becomes taut at flexion beyond 120 degrees [4].
- The lateral ulnar collateral ligament is the posterolateral stabilizer [4].
- Osborne's ligament stabilizes the ulnar nerve in the cubital tunnel [4].
- 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].

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].
- Secondary stabilizers of the elbow include the radiocapitellar articulation, the common flexor tendon, the common extensor tendon, and the joint capsule [1].

Investigations

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 [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 during the mid-arc of motion is more common with intrinsic disease and may not improve with contracture release alone [9].
- The ulnar nerve is of utmost importance in the physical examination due to 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, as subluxation is a relative contraindication for an arthroscopic procedure secondary to possible iatrogenic nerve injury [9].
- The soft tissue surrounding the elbow should be examined for previous skin incisions, grafts, eschar, or infection [9].

IMAGING

- Plain radiographs remain the hallmark and the best screening test for elbow evaluation [1].
- Standard radiographic views include AP, lateral, and oblique views [9].
- Serial radiography is used as follow-up when heterotopic ossification is present [9].
- Primary bony landmarks assessed 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].
- 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].
- 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.

[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.

[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.

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