

## Anatomy and Biomechanics of Elbow Joint

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### A : Anatomy

#### Osteology and Joint Structure

Distal humerus: trochlea and capitellum, trochlea has a 6-degree valgus inclination and 5 to 7-degree internal rotation, anteriorly 30-degree inclination

Proximal ulna: articulate with distal humerus, resist varus, valgus, and torsional loads  
articular surface of the proximal ulna is not continuous with hyaline cartilage but is void of articular surface in its midpoint

Proximal radius: articular margin of the radial head consists of approximately 280 degrees of articular cartilage and 80 degrees of nonchondral margin  
allow 160 to 170 degrees of forearm rotation

There is a 15 degree angle of the neck of the radius with respect to the long axis of the radius

Ulnohumeral joint - hinge joint

Radiohumeral and proximal radioulnar joint - pivot joint

Static axial load of the extended joint has revealed about 40 percent of forces through the radiohumeral joint and 60 percent through the ulnohumeral articulation

Carrying angle: from 11 degrees of valgus with the elbow in full extension to 6 degrees of varus with the elbow in full flexion

#### Ligament

1)medial ligament complex (MCL)

anterior bundle- largest, primary static restraint to valgus loads

posterior bundle- thinner, taut beyond 90 degrees of elbow flexion

transverse ligament

2)lateral ligament complex (LCL): providing stability to resist varus stress

radial collateral ligament, ulnar collateral ligament, annular ligament, accessory ligament

#### Muscle

elbow flexor: Brachialis(primary), Biceps

elbow extensor: Anconeus and medial head of Triceps

flexor pronator muscle group

The cubital tunnel; the major constraint of the ulnar nerve as it passes behind the medial epicondyle, vulnerable to nerve compression, entrapment, and stretch

**B : Biomechanics**

Trochoginglymoid joint (rolling and spinning)

Elbow flexion/extension ranges 0 to 150 degrees

Forearm rotation from 75 degrees of pronation to 85 degrees of supination

Most activities of daily living can be performed with an arc of flexion from 30 to 130 degrees, with a 100-degree arc of rotation divided equally between pronation and supination.

The axis of rotation of elbow in flexion and extension is through center of the arc formed by the trochlear sulcus and capitellum, colinear with distal anterior cortex of humerus

Capacity of the elbow joint is average 25ml. The maximum capacity occurs with the elbow at about 80 degrees flexion

Main functions of the elbow: positioning the hand in space, providing a stable axis for the forearm as a lever, functioning as a weight bearing joint.

Stability of the elbow joint is partly a function of its bony configuration(50%). The remaining 50% is a function of the anterior joint capsule, the MCL and LCL.

Primary static restraint to valgus loads: anterior bundle of MCL

Dynamic restraints to valgus dislocation: flexor pronator group, relatively unimportant

The maximum strength on flexion of the elbow occurs at 90 degrees and the maximum joint reaction force occurs at 30 to 60 degrees of flexion

Under static loading conditions, the forces can reach 3 times body weight

Dynamic loading, such as occurs in throwing and pounding, can generate 6 times body weight

Excision of radial head may result in greater stress in medial collateral ligament of up to 9 times body weight.