# Chapter 8

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| Learning Outcomes: Students will be able to:   1. Describe the musculoskeletal anatomy of the elbow joint complex and associated connective tissues that support these joints. 2. Identify the functional design of each elbow complex joint and the normal osteokinematic and arthrokinematic movements. 3. Describe the origin, insertion, actions, and nerve innervation of the muscles that act on the joints of the elbow joint complex. 4. Identify how to strengthen and stretch each of the muscles/muscle groups that act upon the elbow and forearm joints. 5. Describe the mechanisms that can contribute to pathology of the elbow joint complex structures. 6. Demonstrate and describe the neural mobilization/flossing techniques of the median, ulnar, and radial nerves. |

The elbow joint complex includes three bones (humerus, ulna, radius), three joints (humeroulnar, humeroradial, radioulnar), three ligaments (ulnar collateral, radial collateral, annular), and one capsule. Collectively they comprise the elbow joint complex. All three of these articulations are enclosed in the joint capsule, but function as three separate joints.

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| **Humeroulnar Joint (ginglymus - uniaxial)** |
| Closed-Packed Position: Full extension with forearm supinated  Open-Packed Position: Elbow flexed 70º with 10º of supination  Ulnar collateral ligament: a triangular shaped ligament that attaches on the medial epicondyle of the humerus with the anterior part running obliquely to attach to the medial side of the coronoid process, the posterior part running obliquely to attach to the medial side of the olecranon process, and a third part running transversely between the two other parts. This ligament functions to stabilize the medial side of the elbow to prevent an abduction movement (or valgus forces). | Figure 1 |

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| **Humeroradial Joint (atypical ball and socket – biaxial)** |
| Closed-Packed Position: Flexed 90º with forearm supinated 5º  Open-Packed Position: Full extension with forearm supinated  Radial collateral ligament: a “V” shaped ligament that attaches from the lateral epicondyle of the humerus with the anterior part running obliquely to attach to the fibers of the annular ligament (that surrounds the radial head), and the posterior part running obliquely to attach to the lateral side of the proximal ulna. This ligament functions to stabilize the lateral side of the elbow to prevent adduction of the joint (or varus forces). |  |

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| **Proximal Radioulnar Joint (pivot - uniaxial)** |
| Closed-Packed Position: Full extension with forearm supinated 5º  Open-Packed Position: Flexed 70º with forearm supinated 35º  Annular ligament: Attaches from the anterolateral aspect of the coronoid process of the ulna to the posterolateral aspect of the ulna. This ligament encompasses the head of the radius and holds it against the ulna, allowing rotation in the radial notch of the ulna. |  |

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| Interosseus Membrane: Attaches to the interosseous crests of both the radius and ulna and helps to stabilize the two forearm bones. It also provides more surface area for muscle attachment. It serves to transfer force between the two bones as well. This is important when considering an activity like pushups where the compressive force needs to be transferred to the humerus and from there to the trunk. Because the radius is not the principal bone of the elbow joint, compressive forces on this bone must first be transferred to the ulna. This is accomplished via the interosseous membrane. |  |

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| Movements and Range of Motion |
| Humeroulnar joint  Flexion: 150°  Extension (hyperextension): 0°  Radioulnar Joint  Supination: 80° from neutral position  Pronation: 80° from neutral position  From Anatomical: 0°  supination,  180° pronation |  | Flexion - movement of the forearm   toward the shoulder (anterior  movement in the sagittal plane).  Extension - movement of the forearm  away from the shoulder  (posterior movement in the sagittal plane).  Supination - external rotary movement  of the radius on the ulna that results in  the hand moving from the palm-down to  the palm-up position.  Pronation - internal rotary movement  of the radius on the ulna that results in  the hand moving from the palm-up to  the palm-down position. |

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| Muscle Innervation & Cutaneous Distribution of Radial, Median and Ulnar Nerves |
| **Radial Nerve (B.E.A.S.T.)**   * Brachioradialis * Extensors * Anconeus, Abductor Pollicus Longus * Supinator * Triceps | Figure 6 |
| **Median Nerve**  All of the anterior forearm muscles   * Minus the Flexor Carpi Ulnaris (FCU) and the ulnar half of the Flexor Digitorum Profundus (FDP) * Plus the three thenar muscles (Opponens Pollicis, Abductor Pollicis Brevis, Flexor Pollicis Brevis) and lumbricles 1 & 2 – to the index and middle fingers | Figure 7 |
| **Ulnar Nerve**  All of the intrinsic muscles of the hand   * Minus the 3 thenar muscles and lumbricales 1-2 * Plus the Flexor Carpi Ulnaris (FCU) and the ulnar half of the Flexor Digitorum Profundus (FDP) | Figure 8 |

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| **Normal Elbow Angle Anatomy & Deviations** |
| Normal Cubitus: Carrying Angle = 5°- 15°               The carrying angle is formed by the intersection of two lines: one through the long axis of the humerus and the other through the long axis of the ulna. The carrying angle exists because the axis of the elbow joint is not horizontal, rather the medial lip of the trochlea extends further distally than does the lateral lip of the trochlea. This actually provides an advantage in carrying objects in that they are naturally held away from the body allowing the swing movement of the arm to “clear” the hips, especially in women who tend to have wider hips.  Cubitus Valgus: lateral forearm deviation beyond the normal cubitus carrying angle of 15°.  Cubitus Varus: medial forearm deviation to any degree beyond neutral.  Cubitus Recurvatum: hyperextension of the elbow joint. | Figure 9 |

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| Biceps Brachii  Origin:  Insertion:  Actions:  Nerve Innervation: |  |
| Brachialis  Origin:  Insertion:  Actions:  Nerve Innervation: |
| Brachioradialis  Origin:  Insertion:  Actions:  Nerve Innervation: |

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| Triceps Brachii  Origin:  Insertion:  Actions:  Nerve Innervation: |  |
| Anconeus  Origin:  Insertion:  Actions:  Nerve Innervation: |

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| Pronator Teres  Origin:  Insertion:  Actions:  Nerve Innervation: |  |
| Pronator Quadratus  Origin:  Insertion:  Actions:  Nerve Innervation: |
| Supinator  Origin:  Insertion:  Actions:  Nerve Innervation: |

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| **Common Elbow Pathologies** |
| Medial Epicondylitis (Golfer’s elbow or Little League Elbow): An inflammatory condition of the wrist flexor muscle group’s origin on the medial epicondyle of the humerus. Pain with resisted wrist flexion movements.  Mechanism of Injury (MOI): Repeated wrist flexion movements. Specific to little league elbow, the throwing motion places a valgus stress on the elbow causing lateral compression (capitulum-radial head) and medial distraction on the joint.  Test: Stabilize the proximal segment and with the wrist in the flexed position apply a force to cause wrist extension and instruct the patient to hold the joint in the wrist flexed position. | Figure 15 |
| Lateral Epicondylitis (Tennis elbow): An inflammatory condition of the wrist extensor muscle group’s origin on the lateral epicondyle of the humerus. Pain with resisted wrist extension movements or when gripping objects.  Mechanism of Injury (MOI): Repeated wrist extension movements, or an eccentric deceleration of wrist flexion movements.  Test: Stabilize the proximal segment and with the wrist in the extended position apply a force to cause flexion and instruct the patient to hold the joint in the wrist extended position. | Figure 16 |
| Nursemaid’s Elbow (Pulled Elbow): Subluxation and/or dislocation of the proximal radioulnar joint (radial head pulled out from the annular ligament).  Mechanism of Injury (MOI): A sudden and forcefull pull upward on a child’s arm. The annular ligament is not fully developed until 5-6 years of age, so children younger than 5 are at a higher risk. | Figure 17 |

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| Ulnar Nerve Entrapment at the elbow (Cubital Tunnel Syndrome): When the ulnar nerve becomes compressed or irritated (hit funny bone) as it runs posterior to the medial epicondyle of the humerus through a tunnel of tissue.  Symptoms: May have pain at the elbow but usually manifests as numbness or tingling in the ring and little fingers, with possible weakness of gripping and difficulty with finger coordination.  Mechanism of Injury (MOI):   * Hit to the “funny bone” area * Repetitive elbow flexing or keeping the elbow in flexed position for extended time * Leaning on medial elbow for prolonged time | Figure 18 |

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| Radial Nerve Entrapment (Radial Tunnel Syndrome): a condition thought to be a compressive injury to the radial nerve where it runs under the supinator muscle.  Symptoms: Pain is usually located on the posterior forearm (distal to the lateral epicondyle). Increased pain with resisted supination and finger extension. May have a random ache at night.  Mechanism of Injury (MOI): Repetitive motions such as pushing or twisting of the forearm or gripping with the hand. | Figure 19 |

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| Neural Flossing/Gliding: a technique used to release neural tension by performing specific movements that glide the nerve within it’s sheath and along surrouding tissue. |
| Ulnar Nerve | Position & Movements: |
| Median Nerve | Position & Movements: |
| Radial Nerve | Position & Movements: |

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| A Few Elbow Joint Complex Review Questions |

1. What are the arthrokinematics that would occur at the radioulnar joint when tightening a screw with a screwdriver? When performing a biceps curl? What muscles would be involved?
2. Which muscle of the palmar surface of the forearm does not cross the wrist joint?
3. When performing a pull-up, is the radial head moving on the capitulum, or is the capitulum moving on the radial head? In which direction is the movement occurring?
4. What two muscles connect the humerus to the ulna?
5. What movements are occurring at the elbow and forearm when you pick up a phone (lying face down) from the table and bring it to your ear? How about the shoulder joint?
6. If you are holding a hammer and your forearm is placed on a table (ulnar side down), and you move your right forearm so the hammer moves to the left, what are the involved muscles working during this movement?
7. You place your hand flat on a table in front of you and then lean forward, what arthrokinematic movements occur at the wrist?

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