FOREARM FLEXOR REGION & SUPERFICIAL PALM

OBJECTIVES:

After studying the material of this lecture, the student will:

1. Compare and contrast the courses, branches and relationships of the ulnar and radial arteries in the forearm.
2. Discuss the course and branches of the median and ulnar nerves as they pass through the forearm.
3. Describe the osteology of the forearm, wrist and hand.
4. Discuss the layering of muscles in the flexor compartment of the forearm.
5. Name the muscles in each layer, important features of attachments, innervation and principal actions.

Text References  Moore & Agur 3rd ed. p 408-412, 413, 439-442, 442-453, 454-455, 469
Neurovascular Considerations
Grant's Atlas 12th ed. Table 6.9
Moore's 3rd ed. p439-442,
p426 Fig 6.4, Table 6.4

The *brachial artery* enters the forearm and divides in the cubital fossa into the more superficial *radial artery* (positioned laterally) and the deeper *ulnar artery* (positioned medially). Moore's 3rd ed p454-455 Fig 6.24, Table 6.10. Grants 12th ed 6.55

A. The *radial artery* passes down the forearm along the ulnar border of the brachioradialis. Just above the wrist, where the radial pulse is palpated, the artery lies between the tendons of the brachioradialis and the flexor carpi radialis.

B. The *ulnar artery* passes to ulnar side of the forearm deep to the superficial anterior compartment muscles of the forearm. It joins the ulnar nerve at the middle of the forearm. The *ulnar artery* and *nerve* continue down the forearm between the flexor carpi ulnaris (superficially) and the ulnar side of the flexor digitorum profundus (remember these are the only forearm muscles innervated by the ulnar nerve).

As the ulnar artery passes deep to flexor digitorum superficialis, it gives off three vessels. The (1) *superior* and (2) *inferior ulnar recurrent arteries* and the much larger (3) *common interosseus artery*. The *ulnar recurrent arteries* run “distal to proximal” at the medial aspect of the arm and form an anastomotic network of vessels at the elbow. Careful dissection demonstrates the continuity of the *ulnar recurrences* with the brachial artery (yes, we often tag these on the test). The recurrences are named by where they arise from the brachial artery (i.e. superior is more proximal, inferior more distal; the distinction is obvious in an atlas or anatomical specimen). Grants 12th ed 6.55, 6.7
The common interosseus artery passes deep and divides almost immediately into the anterior and posterior interosseus arteries. The anterior interosseus artery runs along the anterior surface of the interosseus membrane, the posterior interosseus artery runs along the posterior surface of the interosseus membrane. Each interosseus artery is accompanied by a companion interosseous nerve. Grant's Atlas 12th ed 6.55.

C. The median nerve leaves the antecubital fossa by passing between the superficial and deep heads of the pronator teres. Nerve function may be compromised if it becomes entrapped in this space. After giving off an anterior interosseous nerve (do not fail to remember this nerve, it is a great test question) that supplies the deep anterior compartment muscles of the forearm it runs down the median line of the forearm in the plane between the flexors digitorum superficialis and profundus. Grant's Atlas 12th ed. 6.3, 6.58; Moores 3rd ed p441, 453 Table 6.9.

D. The radial nerve enters the forearm in a groove that exists between brachialis and brachioradialis muscle. It divides into a superficial and deep branch. The superficial branch passes anterior to pronator teres and deep to brachioradialis, ultimately passing onto the dorsum of the hand. The deep branch of the radial nerve enters the supinator and winds around the radius and becomes the posterior interosseous nerve. Grant's Atlas 12th ed.: 6.3; Moores 3rd ed p441, 453 Table 6.9.

Osteology:

Grants 12th ed 6.56,6.62,6.80,6.81

Wrist
1. The radius normally extends distal beyond the ulna and bears weight at the wrist.

2. The irregularly-shaped carpal bones are arranged in two rows.

   a. Proximal row (from radial to ulnar): scaphoid (S), lunate (L), triquetral (T), pisiform (P)

   b. Distal row (from radial to ulnar): trapezium (Tm)*, trapezoid (Td), capitate (C), hamate (H).

Note: Don’t just memorize the mnemonic without memorizing the name of the structures (in this case carpal bones) that it represents. For example, you can’t name a carpal bone accurately without knowing that the C in can’t in the classic mnemonic stands for capitate. Note to remember think M.D. = trapezium & trapezoid to remember the order of these bones.
3. The carpal bones form a transverse arch with a palmar concavity that is maintained partly by the shapes of the carpals and partly by the flexor retinaculum, which extends from the pisiform and hamate medially to the scaphoid and trapezium laterally and thereby creates a **carpal tunnel.** Grant's Atlas 12th 6.92, Moores 3rd ed p413 Fig. 6.7

4. The radiocarpal and intercarpal joints permit flexion and extension, abduction (radial deviation) and adduction (ulnar deviation), and circumduction.

5. The **lunate** is wedge-shaped with the narrow part of the wedge oriented dorsally. Therefore, a fall on the extended hand may cause forward dislocation of the lunate or backward dislocation of the rest of the carpus. The dislocated lunate may encroach upon the contents of the carpal tunnel (not good).

6. In a high percentage of the population the blood supply enters the **scaphoid** ("navicular") distal to the bone. A scaphoid fracture may compromise this vessel, resulting in avascular necrosis of the proximal fragment. See Moores 3rd ed. p409: Fractures in the Hand.

**Hand**

Moores 3rd ed p. 409-411, Fig. 6.6

1. Two bones comprise the skeleton of the thumb: the **proximal phalanx** and the **distal phalanx** (pleural: **phalanges**).

2. Each finger contains a **proximal**, a **middle**, and a **distal** phalanx.

3. Joints between the phalanges of the fingers are **proximal** (PIP) and **distal interphalangeal** (DIP) joints.
Muscles of the Anterior Compartment


General overview. The anterior compartment of the forearm is subdivided into a superficial and a deep compartment. The superficial compartment has one muscle that does not cross the wrist (pronator teres) and four that do cross the wrist. The deep compartment has one muscle that does not cross the wrist (pronator quadratus) and two that do cross the wrist (see schematic at right). Grants 12th Atlas ed 6.10

Muscles of the Superficial compartment

Superficial anterior compartment muscles mostly arise from the medial epicondyle of the humerus. Repetitive wrist flexion may result inflammation of the tendon, medial epicondylitis.

Note: The muscles of the anterior (flexor) compartment of the forearm are all innervated by the median nerve except the flexor carpi ulnaris and ulnar half of the flexor digitorum profundus which are innervated by the ulnar nerve. To remember this innervation pattern just think about where the ulnar nerve enters the forearm compartment, it passes between these muscles as it enters the forearm and literally lies on the ulnar half of the flexor digitorum profundus.

See Moores 3rd ed for a particularly helpful visualization of these muscles p469 SA6.4

1. **Pronator teres** (this muscle does not reach or act on the wrist) flexes the elbow and by its lateral radial attachment pronates the forearm. The deep head of this muscle arises from the ulna. The median nerve enters the forearm between deep and superficial heads. Grant's Atlas 12th ed.: 6.57, 6.58

2. **Flexor carpi radialis** flexes and weakly abducts the wrist by a distal attachment to the base of the second and third metacarpals. Grant's Atlas 12th ed.: 6.57

3. **Palmaris longus** is a flexor of the wrist by its insertion into the palmar aponeurosis. Grant's Atlas 12th ed.: 6.57, 6.58

4. **Flexor carpi ulnaris**, flexes and adducts the wrist by its attachments through the pisiform bone, the hamate and the base of the fifth metacarpal. An extensive second origin is from the shaft of the ulna. The ulnar nerve passes between the two origins as it enters the forearm. Grant's Atlas 12th 6.57, 6.58
5. **Flexor digitorum superficialis** lies slightly deeper than the above muscles and also has an origin from the radius. By its attachment to the middle phalanges of the ulnar four digits it flexes the proximal interphalangeal joints and contributes to metacarpophalangeal and wrist flexion. Grant's Atlas 12th ed.: 6.58

Note: Realize that the superficial and deep muscle groups of the anterior compartment are “separated” from one another by the ulnar nerve and ulnar artery. The superficial muscles lie superficial to the neurovascular bundle composed of the ulnar nerve and artery, the deep muscles lie deep to this landmark. Not a difficult concept, but…the neurovascular bundle marks the plane that separates the two compartments.

**Muscles of Deep anterior Compartment**

Grant's Atlas 12th ed.: 6.59, 6.60.

1. **Flexor digitorum profundus** arises from the ulna and inserts on the distal phalanx of the ulnar four digits. It flexes the distal interphalangeal joints and contributes to flexion in all the more proximal joints it crosses. Grant's Atlas 12th ed.: 6.59, 6.60.

2. **Flexor pollicis longus** arises from the radius and inserts into the distal phalanx of the thumb. It flexes the interphalangeal joint of the thumb and contributes to flexion of all the proximal joints it crosses. Grant's Atlas 12th ed.: 6.60
3. **Pronator quadratus**, arises from the distal ulna and inserts on the radius, as a result it is a strong pronator. *It does not cross the wrist.* Grant's Atlas 12th ed.: 6.60