Cameroon Upper Extremity Rehabilitation Project

section 1

Anatomy
Anatomy Terms

Anterior = the front of the body

Posterior = the back of the body

Superior = towards the head

Inferior = away from the head
Anatomy Terms

Medial = toward the middle of the body

Lateral = away from the middle of the body

Proximal = towards the center of the body

Distal = away from the center of the body
Anatomy Terms

Dorsal = the back (posterior) of the hand

Palmar or Volar = the front (anterior) of the hand, the palm
Flexion

= bending motion that decreases the angle between bones of a joint

Extension

= a straightening motion that increases the angle between bones of a joint

Wrist Flexion

Wrist Extension
Anatomy Movements

Pronation

=  
Turning to palm of the hand down to face the floor

Supination

=  
Turning to palm of the hand to up to face the ceiling

Radial Deviation

=  
Turning to hand toward the thumb

Ulnar Deviation

=  
Turning to hand toward the little finger
Forward Elevation

= 

Lifting the arm from the **shoulder** joint forward above the head
**Anatomy Movements**

**Thumb Movements**

**Flexion**
Bending the thumb down towards the middle of the palm of the hand.

**Extension**
Moving the thumb away from the fingers, in the same plane as the fingers (also called radial abduction).

**Abduction**
Moving the thumb away from the fingers, perpendicular to the fingers.

**Adduction**
Moving the thumb back towards the fingers, in the same plane as the fingers.

**Opposition**
Bringing the thumb out and across the fingers (i.e. the thumb is now opposite the fingers).
Anatomy Movements

Finger Movements

Abduction

Moving the *fingers* away from each other (i.e. spreading the fingers)

Adduction

Moving the *fingers* towards each other
Skeletal System (Bones)

Anterior (front) View
Anterior (front or volar or palmar) View

MCP = Metacarpal-Phalangeal Joint
PIP = Proximal Inter-Phalangeal Joint
DIP = Distal Inter-Phalangeal Joint

Physiotherapists Like Shoulders
(pisiform) (Triquetrum) (Lunate) (Scaphoid)

That They Can Heal!
(Trapezium) (Trapezoid) (Capitate) (Hamate)
Posterior (back) View

Muscular System

- Levator scapulae
- Rhomboid minor
- Rhomboid major
- Supraspinatus
- Deltoid
- Infraspinatus
- Teres major
- Teres minor
- Erector spinae
- External intercostal
- Internal abdominis oblique
- Gluteus medius
- Gluteus maximus
- Adductor magnus
- Gracilis
- Biceps femoris
- Gastrocnemius
- Soleus
- Tendo calcaneus (Achilles tendon)

- Occipitalis
- Sternoleidomastoideus
- Splenius capitis
- Trapezius
- Latissimus dorsi
- Biceps brachii
- Triceps brachii
- Brachioradialis
- Anconeus
- Extensor carpi ulnaris
- Extensor carpi radialis longus
- External abdominis oblique
- Flexor carpi ulnaris
- Extensor digitorum
- Lumbar triangle
- Iliotibial tract
- Semimembranosus
- Semitendinosus
- Gastrocnemius
- Soleus
- Tendo calcaneus (Achilles tendon)
The main function of skeletal muscle is to cause movement by contracting (shortening) and relaxing (becoming longer). Muscle is attached to bone by tendons.

The place where the muscle attaches to bone that stays relatively still is the **origin** of the muscle. The place where the muscle attaches to the bone that moves is called the **insertion** of the muscle.
Isometric Muscle Contractions

Isometric muscle contraction is when a muscle increases tension but the actual length of the muscle does not change. This means that the joint that the muscle works on does not move.

Imagine holding your elbow at 90° and then somebody puts a heavy weight in your hand. This is an isometric muscle contraction.

Another example is the muscles of the neck that contract isometrically to keep the head up.

Isotonic Muscle Contractions

Isotonic muscle contractions enable us to move around. There are two types of isotonic muscle contractions:

1. Concentric
2. Eccentric
Isotonic Muscle Contractions: Concentric

In concentric muscle contractions, the muscle origin and insertion move closer together to cause movement at the joint. Muscles shorten in concentric muscle contractions.

An example is doing a sit up – the abdominal muscles contract to lift the torso off the ground.

Another example is contraction of the biceps to move the hand towards the shoulder.
An eccentric contracture occurs when muscles slow down movements which gravity would normally cause to be too fast. For example, lowering an object in the hand down to your side or sitting down into a chair both require eccentric muscle contractions. Muscles actually lengthen in eccentric contractions.
Group Actions of Muscles

Muscles work together or against each other to cause movement. What one muscle can do, another muscle can undo. Muscles can also provide added support or stability to allow movements to occur elsewhere.

There are 4 functional groups of muscles:

1. Prime Mover or Agonist
2. Antagonist
3. Synergist
4. Fixator

1. Prime Mover or Agonist

This is a muscle that contracts to cause movement. For example, biceps is the prime mover for elbow flexion. There are other muscles that assist the prime mover but with less effect or strength; these are called assistant or secondary movers.

2. Antagonist

The muscle on the opposite side of a joint to the prime mover is called the antagonist. The antagonist must relax to allow the prime mover to contract. For example, in order for the biceps to flex the arm at the elbow, the triceps on the back of the arm must relax to allow this movement to occur.
3. Synergist

Synergist muscles help to prevent any unwanted movements that might occur as the prime mover contracts. This is very important when a prime mover crosses two joints because it can cause movements at both joints, unless another muscle helps to stabilize one of the joints. For example, the muscles that flex the fingers cross both the wrist and finger joints, potentially causing movement at both joints. But because there are other muscles (synergists) that help to stabilize the wrist joint, you can flex the fingers without also flexing the wrist at the same time.

4. Fixator

A fixator or stabilizer helps to immobilize the bone of the prime mover’s origin. For example, there are muscles (fixators) that stabilize the scapular during movements of the arm.
The nervous system contains a network of cells called neurons that coordinate actions and transmit signals. The nervous system consists of two parts: the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS consists of the brain and spinal cord. The PNS consists of all other nerves outside of the brain and spinal cord. The function of the PNS is to connect the CNS to the limbs and organs and to send sensory information from the body back to the spinal cord. It is the PNS that we will focus on.

The nerve cell and the muscle cells it makes contact with are called a motor unit. The nerve transmits a signal to cause the motor unit to contract.
Another way of thinking about the PNS

The brain is the power plant. It sends electricity to the houses (the muscles) and turns the lights on. If the electrical line is cut at a certain point, the houses down the street will have no power and lights will not turn on.

Peripheral nerves can regenerate at 1 mm per day or 1 inch per month or 1 foot per year. By knowing the order of innervation of muscles, we can tell where the nerve has regenerated to and thus which muscles will work and which muscles will not work.
The Brachial Plexus

The brachial plexus is a network of nerve fibers that proceeds through the neck, the axilla (armpit) and into the arm and hand. The brachial plexus is responsible for all the cutaneous (skin) and muscular innervation of the upper limb (except the trapezius muscle).
The median nerve innervates the following muscles, in this order:

1. Pronator Teres  
2. Flexor Carpi Radialis  
3. Palmaris Longus  
4. Flexor Digitorum Superficialis  

Anterior Interosseous Nerve (median nerve)  
5. Flexor Digitorum Profundus (index and middle)  
6. Flexor Pollicis Longus  
7. Pronator Quadratus  

Palmar Recurrent Motor Branch (median)  
8. Abductor Pollicis Brevis  
9. Opponens Pollicis  
10. Flexor Pollicis Brevis  

Common Palmar Digital Nerve (median)  
11. Lumbricals 1 & 2
The Radial Nerve

The radial nerve innervates the following muscles, in this order:

1. Triceps
2. Anconeus
3. Brachioradialis
4. Extensor Carpi Radialis Longus
5. Extensor Carpi Radias Brevis
6. Supinator

Posterior Interosseous Nerve (radial nerve)
7. Extensor Digitorum (Communis)
8. Extensor Digiti Minimi
9. Extensor Carpi Ulnaris
10. Abductor Pollicis Longus
11. Extensor Pollicis Longus
12. Extensor Pollicis Brevis
13. Extensor Indicus
The Ulnar Nerve

The Ulnar nerve innervates the following muscles, in this order:

1. Flexor Carpi Ulnaris (FCU)
2. Flexor Digitorum Profundus (ring and small fingers)

Deep Branch of Ulnar Nerve:
3. Abductor Digiti Minimi
4. Opponens Digiti Minimi
5. Flexor Digiti Minimi
6. 3rd and 4th Lumbricals
7. Dorsal Interossei
8. Palmar Interossei
9. Flexor Pollicis Brevis
10. Adductor Pollicis
Pronator Teres

Origin: Medial epicondyle of humerus and ulna

Insertion: Middle of lateral surface of radius

Action: Pronates forearm. Helps flex elbow also.

Nerve: Median nerve
Flexor Carpi Radialis

**Origin:** Medial epicondyle of humerus

**Insertion:** Base of 2\textsuperscript{nd} and 3\textsuperscript{rd} metacarpal bones

**Action:** Flexes hand at wrist. Helps with radial deviation.

**Nerve:** Median nerve
Palmaris Longus

**Origin:** Medial epicondyle of humerus

**Insertion:** Flexor retinaculum and palmar aponeurosis

**Action:** Flexes hand at wrist. Tightens palmar aponeurosis

**Nerve:** Median nerve
**Flexor Digitorum Superficialis**

**Origin:** Medial epicondyle of humerus and ulna

**Insertion:** 4 tendons attach to the middle phalanges of index, middle, ring and little fingers

**Action:** Flexes proximal interphalangeal joints

**Nerve:** Median nerve
Flexor Digitorum Profundus

**Origin:** Anterior and medial aspect of ulna

**Insertion:** 4 tendons attach to base of distal phalanges of index to little fingers

**Action:** Flexes distal interphalangeal joints

**Nerve:** Median nerve innervates the index and middle fingers (anterior interosseous branch)
Muscles innervated by the Median Nerve

**Flexor Pollicis Longus**

**Origin:** Anterior aspect of radius and interosseous membrane

**Insertion:** Base of distal phalanx of thumb

**Action:** Flexes distal phalanx of thumb

**Nerve:** Median nerve (anterior interosseous branch)
**Pronator Quadratus**

**Origin:** Medial aspect of distal part of ulna

**Insertion:** Distal part of lateral border of radius

**Action:** Pronates hand

**Nerve:** Median nerve (anterior interosseous branch)
Abductor Pollicis Brevis

**Origin:** Flexor retinaculum and scaphoid and trapezium

**Insertion:** Base of proximal phalanx of thumb

**Action:** Abducts thumb at carpo-metacarpal and metacarpo-phalangeal joints

**Nerve:** Median nerve (palmar recurrent motor branch)
Opponens Pollicis

**Origin:** Flexor retinaculum and trapezium

**Insertion:** Lateral side of 1st metacarpal (thumb)

**Action:** Opposes thumb to fingers

**Nerve:** Median nerve (palmar recurrent motor branch)
Flexor Pollicis Brevis

**Origin:** 2 heads:
1) Superficial: flexor retinaculum and trapezium and
2) Deep: floor of carpal bones

**Insertion:** Lateral side of 1st metacarpal and base of proximal phalanx of thumb

**Action:** Flexes proximal phalanx of thumb at metacarpo-phalangeal joint

**Nerve:** Superficial head is innervated by the median nerve (palmar recurrent motor branch)
Lumbricals 1 and 2

**Origin:** Tendons of flexor digitorum profundus of index and middle fingers

**Insertion:** Lateral side of extensor expansions of index and middle finger

**Action:** Flex the metacarpo-phalangeal joints and extend the inter-phalangeal joints of index and middle fingers

**Nerve:** Median nerve (common palmar digital nerve)
Triceps

**Origin:** Scapula and humerus

**Insertion:** Olecranon process of the ulna

**Action:** Extends the elbow joint

**Nerve:** Radial nerve
**Anconeus**

**Origin:** Lateral epicondyle of humerus

**Insertion:** Olecranon of ulna and body of ulna

**Action:** Extends the elbow joint and helps to abduct ulna during pronation movement

**Nerve:** Radial nerve
Brachioradialis

**Origin:** Lateral ridge of distal humerus

**Insertion:** Lateral aspect of distal radius

**Action:** Helps to flex elbow

**Nerve:** Radial nerve
Extensor Carpi Radialis Longus

**Origin:** Lateral ridge of humerus

**Insertion:** Base of 2\textsuperscript{nd} metacarpal

**Action:** Extends and abducts (radial deviation) hand at wrist

**Nerve:** Radial nerve
Extensor Carpi Radialis Brevis

Origin: Lateral epicondyle of humerus
Insertion: Base of 3rd metacarpal bone
Action: Extends and abducts (radially deviates) hand at wrist
Nerve: Radial nerve
Muscles innervated by the Radial Nerve

Supinator

**Origin:** Scapula and humerus

**Insertion:** Olecranon process of the ulna

**Action:** Extends the elbow joint

**Nerve:** Radial nerve
Extensor Digitorum (Communis)

**Origin:** Lateral epicondyle of humerus

**Insertion:** Extensor expansions of index to little fingers

**Action:** Extends metacarpo-phalangeal and inter-phalangeal joints

**Nerve:** Radial nerve (posterior interosseous branch)
Extensor Digiti Minimi

**Origin:** Lateral epicondyle of humerus

**Insertion:** Extensor expansions of little finger

**Action:** Extends metacarpo-phalangeal and inter-phalangeal joints of little finger

**Nerve:** Radial nerve (posterior interosseous branch)
Extensor Carpi Ulnaris

**Origin:** Lateral epicondyle of humerus and ulna

**Insertion:** Base of 5th metacarpal

**Action:** Extends and adducts hand at wrist

**Nerve:** Radial nerve (posterior interosseous branch)
Abductor Pollicis Longus

**Origin:** Posterior aspect of radius, ulna and interosseous membrane

**Insertion:** Base of 1st metacarpal (thumb)

**Action:** Abducts, extends and rotates thumb at carpo-metacarpal joint

**Nerve:** Radial nerve (posterior interosseous branch)
Extensor Pollicis Longus

**Origin:** Posterior surface middle of ulna and interosseous membrane

**Insertion:** Base of distal phalanx of thumb

**Action:** Extends distal phalanx of thumb

**Nerve:** Radial nerve (posterior interosseous branch)
Extensor Pollicis Brevis

**Origin:** Posterior surface radius and interosseous membrane

**Insertion:** Base of proximal phalanx of thumb

**Action:** Extends proximal phalanx of thumb at metacarpo-phalangeal joint

**Nerve:** Radial nerve (posterior interosseous branch)
Extensor Indicis

**Origin:** Posterior surface of ulna and interosseous membrane

**Insertion:** Extensor expansion of 2\textsuperscript{nd} digit (index finger)

**Action:** Extends all joints of index finger

**Nerve:** Radial nerve (posterior interosseous branch)
Flexor Carpi Ulnaris

Origin: Medial epicondyle and olecranon of ulna and posterior ulna

Insertion: Pisiform bone, hook of hamate and base of 5th metacarpal

Action: Flexes and adducts (ulnar deviates) hand at wrist

Nerve: Ulnar nerve
Flexor Digitorum Profundus

- **Origin:** Anterior and medial aspect of ulna
- **Insertion:** 4 tendons attach to the bases of the distal phalanges of index to little finger
- **Action:** Flexes distal interphalangeal joints of index to little finger
- **Nerve:** Ulnar nerve innervates the ring and small fingers
Abductor Digiti Minimi

Origin: Pisiform and tendon of flexor carpi ulnaris muscle

Insertion: Medial side of the base of the proximal phalanx of 5th digit

Action: Adducts 5th digit

Nerve: Deep branch of ulnar nerve
Opponens Digiti Minimi

**Origin:** Hook of hamate and flexor retinaculum

**Insertion:** Body of 5\textsuperscript{th} metacarpal

**Action:** Opposes 5\textsuperscript{th} metacarpal for cupping of hand

**Nerve:** Deep branch of ulnar nerve
Flexor Digiti Minimi

**Origin:** Hook of hamate bone and flexor retinaculum

**Insertion:** Medial side of the base of the proximal phalanx of 5th digit

**Action:** Flexes proximal phalanx of 5th digit at metacarpo-phalangeal joint

**Nerve:** Deep branch of ulnar nerve
Lumbricals 3 and 4

**Origin:** Tendons of flexor digitorum profundus of middle, ring and little fingers

**Insertion:** Lateral side of extensor expansions of ring and small finger

**Action:** Flex the metacarpo-phalangeal joints and extend the inter-phalangeal joints of ring and little fingers

**Nerve:** Deep branch of ulnar nerve
Dorsal Interossei (4)

**Origin:** 4 dorsal interossei originate at 2 heads from both sides of metacarpal bones

**Insertion:** Base of proximal phalanx and extensor expansions of index to ring fingers

**Action:** Abducts fingers and also flex fingers at metacarpo-phalangeal joints and extends fingers at inter-phalangeal joints

**Nerve:** Deep branch of ulnar nerve
Muscles innervated by the Ulnar Nerve

Palmar Interossei (3)

**Origin:** 3 palmar interossei originate from metacarpal bones of index, ring and little fingers

**Insertion:** Extensor expansions of digits and bases of proximal phalanges of index, ring and little fingers

**Action:** Adduct fingers at metacarpo-phalangeal joint

**Nerve:** Deep branch of ulnar nerve
Flexor Pollicis Brevis

**Origin:**
2 heads:
1) Superficial: flexor retinaculum and trapezium and
2) Deep: floor of carpal bones

**Insertion:**
Lateral side and base of proximal phalanx of thumb

**Action:**
Flexes proximal phalanx of thumb at metacarpo-phalangeal joint

**Nerve:**
Deep head is innervated by deep branch of ulnar nerve
Adductor Pollicis

**Origin:**
- 2 heads:
  - 1) base of metacarpals 2 and 3 and capitate bone
  - 2) body of 3rd metacarpal bone

**Insertion:**
- Base of proximal phalanx of thumb

**Action:**
- Adduct proximal phalanx of thumb towards middle finger

**Nerve:**
- Deep branch of ulnar nerve