Muscle Terminology

• *Intrinsic* - pertaining usually to muscles within or belonging solely to body part upon which they act
  – Ex. small intrinsic muscles found entirely within the hand or feet
Muscle Terminology

- **Extrinsic** - pertaining usually to muscles that arise or originate outside of (proximal to) body part upon which they act
  - Ex. forearm muscles that attach proximally on distal humerus and insert on fingers
Muscle Terminology

• *Innervation* - segment of nervous system defined as being responsible for providing a stimulus to muscle fibers within a specific muscle or portion of a muscle
  
  – A muscle may be innervated by more than one nerve & a particular nerve may innervate more than one muscle or portion of a muscle
Muscle Terminology

• **Amplitude**
  – range of muscle fiber length between maximal & minimal lengthening

• **Gaster (belly or body)**
  – central, fleshy portion of the muscle that generally increases in diameter as the muscle contracts
  – the contractile portion of muscle
Muscle Terminology

• **Aponeurosis**
  – A tendinous expansion of dense fibrous connective tissue that is sheet- or ribbonlike in appearance and resembles a flattened tendon
  – Aponeuroses serve as a fascia to bind muscles together or as a means of connecting muscle to bone
Muscle Terminology

• **Fascia**
  
  – A sheet or band of fibrous connective tissue that envelops, separates, or binds together parts of the body such as muscles, organs, and other soft tissue structures of the body
  
  – In certain places throughout the body, such as around joints like the wrist & ankle, fascial tissue forms a **retinaculum** to retain tendons close to the body
Muscle Terminology

• **Origin**
  – Structurally, the proximal attachment of a muscle or the part that attaches closest to the midline or center of the body
  – Functionally & historically, the least movable part or attachment of the muscle
Muscle Terminology

• *Insertion*
  – Structurally, the distal attachment or the part that attaches farthest from the midline or center of the body
  – Functionally & historically, the most movable part is generally considered the insertion
Types of muscle contraction

• Muscle contractions can be used to *cause*, *control*, or *prevent* joint movement or
  – to initiate or accelerate movement of a body segment
  – to slow down or decelerate movement of a body segment
  – to prevent movement of a body segment by external forces

• All muscle contractions are either *isometric* or *isotonic*
Types of Muscle Contraction (Action)
Muscle tension = contraction

Isometric

Tension developed within the muscle, but the joint angles remain constant

Segment does not move = static tension or static contraction

Ex: to stabilize a segment from being moved by outside forces

Isotonic

Muscle developing tension to cause or control joint movement

Segment moves = dynamic tension or dynamic contraction
Types of muscle contraction

- **Isometric**
- **Isotonic**
  - **Concentric**
  - **Eccentric**
Functions of Muscular Isotonic Contractions

• Concentric Tension
• Eccentric Tension
Concentric Tension

- To act as a motive force to move a body part
- Type of dynamic tension
- Shortening of the muscle group
- “moving towards the center”
- Causing movement against gravity or resistance
- Force of muscle is greater than the resistance
- Movements caused by the muscle
  - hamstrings flex the knee
  - elbow extensors used during a push-up
Eccentric Tension

- To act as a resistive force to resist the movement of a body part
- Type of dynamic tension
- Lengthening tension of a muscle group
- “away from the center”
- With gravity or resistance
- Control speed and direction of movement caused by another force (gravity or other muscle’s force)
Types of muscle contraction

- Concentric contractions involve muscle developing tension as it shortens.
- Eccentric contractions involve the muscle lengthening under tension.
Determining if a muscle (or muscle group) is contracting and, if so, how?

Is Movement Occurring?

- Yes
  - Then is an external force (gravity, machine, inertia, etc.) causing the movement?
    - Yes
      - Is the joint moving Faster, Slower, or at the Same Speed that the external force would normally cause it to move?
        - Yes
          - Then internal force (muscle contraction) must be causing the movement which means the agonist muscle group is performing a **concentric** contraction to cause movement in the direction in which it is occurring.
        - No
          - Then there must be internal force generated by an **isometric** muscle contraction to maintain the current position of the joint.
    - No
      - If the sum of gravity & external forces were to cause the joint to move into **flexion** then the **extensors** must be contracting isometrically to maintain the position.
      - If the sum of gravity & external forces were to cause the joint to move into **extension** then the **flexors** must be contracting isometrically to maintain the position.
      - Respectively substitute adduction & **abductors** or **internal rotation** & **external rotators**

- No
  - Is the joint fully supported in its current position by external means?
    - Yes
      - Then **no contraction** is needed in any of the muscles to maintain the position, but muscle could be unnecessarily contracting isometrically.
    - No
      - If the sum of gravity & external forces were to cause the joint to move into **flexion** then the **extensors** must be contracting isometrically to maintain the position.
      - If the sum of gravity & external forces were to cause the joint to move into **extension** then the **flexors** must be contracting isometrically to maintain the position.
      - Respectively substitute abduction & **adductors** or **external rotation** & **internal rotators**

Faster
- Then the contraction is **concentric** because the movement is being accelerated (caused or enhanced) by the muscles that cause movement (agonists) in the same direction as the occurring movement.
- Contracting muscle is shortening

Slower
- Then the contraction is **eccentric** because the movement is being decelerated (controlled) by the muscles that oppose movement (antagonists) in the direction of the occurring movement.
- Contracting muscle is lengthening

Same Speed
- Then there is **no appreciable active contraction** in either the shortening or lengthening muscle groups. All movement is passive and caused by the external force(s).
- Contracting muscle is neither shortening or lengthening

Respectively substitute adduction & **abductors** or **internal rotation** & **external rotators**

Contracting muscle is neither shortening or lengthening
Types of muscle contraction

• *Isokinetics* - a type of dynamic exercise using concentric and/or eccentric muscle contractions
  – speed (or velocity) of movement is constant
  – muscular contraction (ideally maximum contraction) occurs throughout movement
  – not another type of contraction, as some have described
  – Ex. Biodex, Cybex, Lido
Role of Muscles

- **Stabilizers**
  - surround joint or body part
  - contract to fixate or stabilize the area to enable another limb or body segment to exert force & move
  - known as fixators
  - essential in establishing a relatively firm base for the more distal joints to work from when carrying out movements
  - Ex. biceps curl
    - muscles of scapula & glenohumeral joint must contract in order to maintain shoulder complex & humerus in a relatively static position so that the biceps brachii can more effectively perform curls
Role of Muscles

• *Helping synergists*
  – have an action in common but also have actions antagonistic to each other
  – help another muscle move the joint in the desired manner and simultaneously prevent undesired actions
  – Ex. Anterior & posterior deltoid
    • Anterior deltoid acts as an agonist in glenohumeral flexion, while posterior deltoid acts as an extensor
    • Helping each other, they work in synergy with middle deltoid to accomplish abduction
Role of Muscles

• **True synergists**
  – contract to prevent an undesired joint action of agonist and have no direct effect on agonist action
  – Ex. Finger flexors are provided true synergy by wrist extensors when grasping an object
    • Finger flexors originating on forearm and humerus are agonists in both wrist flexion & finger flexion
    • Wrist extensors contract to prevent wrist flexion by finger flexors
    • This allows finger flexors to utilize more of their force flexing the fingers
Role of Muscles

• **Neutralizers**
  – counteract or neutralize the action of another muscle to prevent undesirable movements such as inappropriate muscle substitutions
  – referred to as neutralizing
  – contract to resist specific actions of other muscles
  – Ex. when only supination action of biceps brachii is desired, the triceps brachii contracts to neutralize the flexion action of the biceps brachii
Role of Muscles

- Force Couples
  - Force couples occur when two or more forces are pulling in different directions on an object, causing the object to rotate about its axis.
  - Coupling of muscular forces together in the body can result in a more efficient movement.
Determination of Muscle Action

• Electromyography (EMG)
  – utilizes either surface electrodes which are placed over muscle or fine wire/needle electrodes placed into muscle
  – as subject moves joint & contracts muscles, EMG unit detects action potentials of muscles and provides an electronic readout of contraction intensity & duration
  – most accurate way of detecting presence & extent of muscle activity
Determination of Muscle Action

• Electrical muscle stimulation
  – reverse approach of electromyography
  – use electricity to cause muscle activity
  – surface electrodes are placed over muscle & the stimulator causes muscle to contract
  – joint actions may then be observed to see the effect of the muscle’s contraction
Active Insufficiency

2 joint muscles cannot exert enough tension to shorten enough to allow full ROM in both joints at the same time.
Passive Insufficiency

2 joint muscles cannot be stretched enough to allow full ROM in both joints at the same time.
Active & Passive Insufficiency

- Easily observed in either biarticular or multiarticular muscles when full range of motion is attempted in all joints crossed by the muscle
  - Ex. Rectus femoris contracts concentrically to both flex the hip & extend the knee
  - Can completely perform either action one at a time but actively insufficient to obtain full range at both joints simultaneously
Active & Passive Insufficiency

– Similarly, hamstrings can not usually stretch enough to allow both maximal hip flexion & maximal knee extension due passive insufficiency

• As a result, it is virtually impossible to actively extend the knee fully when beginning with the hip fully flexed or vice versa