Chapter 10: The Muscular System

Muscle Organization and Function

- Muscle organization affects power, range, and speed of muscle movement
- Muscle cells (fibers) are organized in bundles (fascicles)
- Fibers run parallel within fascicle
- Fascicles can be arranged in 4 different patterns with respect to each other and tendons

Organization of Skeletal Muscle Fibers

- 4 patterns of fascicle organization:
  - Parallel (and fusiform)
  - Convergent (triangular)
  - Pennate
  - Circular

Parallel (Fusiform) Muscles

(Figure 11-1a)
**Parallel (Fusiform) Muscles**

- Fibers parallel to the long axis of muscle
- Most skeletal muscles arranged this way
- The center or body of the muscle thickens when parallel muscle contracts
- Parallel muscles contract extensively (~30%)

**Convergent (Triangular) Muscles**

- A broad area converges on attachment site (tendon, aponeurosis, or raphe)
- Muscle fibers pull in different directions, depending on stimulation
Pennate Muscles

• **Unipennate:**
  - fibers angled on 1 side of tendon
  - e.g., extensor digitorum

• **Bipennate:**
  - fibers angled on both sides of tendon
  - e.g., rectus femoris

• **Multipennate:**
  - tendon branches within muscle
  - e.g., deltoid

Pennate Muscles

• Pennate = “feather-like”
• Form an angle with the tendon
• Do not move as far as parallel muscles
• Contain more myofibrils than parallel muscles
• Develop more tension than parallel muscles

Circular Muscles

• Also called sphincters
• Concentric arrangement of fascicles
• Open and close to guard entrances of body
• e.g., obicularis oris
Skeletal Motion

- Skeletal muscles attach to skeleton, produce motion
- Type of muscle attachment affects power, range, and speed of muscle movement

Levers

- Mechanically, each bone is a lever (a rigid, moving structure):
  - and each joint a fulcrum (a fixed point)
- Muscles provide effort or applied force (AF):
  - required to overcome resistance (R)

Functions of a Lever

- To change:
  - direction of an AF
  - distance and speed of movement produced by an AF
  - effective strength of an AF

3 Classes of Levers

- Depend on the relationship between applied force, fulcrum, and resistance:
  - first class
  - second class
  - third class

PLAY First, Second, and Third-Class Levers
First-Class Levers

- Seesaw is an example
- Center fulcrum between applied force and resistance
- Force and resistance are balanced

Second-Class Levers

- Wheelbarrow is an example
- Center resistance between applied force and fulcrum
- A small force moves a large weight
Third-Class Levers

- Most common levers in the body
- Center applied force between resistance and fulcrum
- Greater force moves smaller resistance
- Maximizes speed and distance traveled

Origins and Insertions

- Muscles have 1 fixed point of attachment (origin) and 1 moving point of attachment (insertion)
- Most muscles originate or insert on the skeleton
- Origin is usually proximal to insertion

Actions

- Movements produced by muscle contraction
- Body movements - e.g., flexion, extension, adduction, etc.
- Described in terms of bone, joint, or region
Muscle Terminology
Based on Function

• Agonist (prime mover):
  - produces a particular movement

• Antagonist:
  - opposes movement of a particular agonist

• Synergist:
  - a smaller muscle that assists a larger agonist
  - helps start motion or stabilize origin of agonist

Muscle Opposition

• Agonists and antagonists work in pairs:
  - when 1 contracts, the other stretches
  - e.g., flexors-extensors, abductors-adductors

Names of Skeletal Muscles

• Correct names of muscles include the term muscle

• Exceptions:
  - platysma
  - diaphragm

Descriptive Names for Skeletal Muscles

1. Location in the body
2. Origin and insertion
3. Fascicle organization
4. Relative position
5. Structural characteristics
6. Action
   Usually multiple naming schemes are used (e.g., flexor carpi ulnaris)
Location in the Body

- Identifies body regions:
  - *e.g.*, temporalis muscle

Origin and Insertion

- First part of name indicates origin
- Second part of name indicates insertion:
  - *e.g.*, sternocleidomastoid muscle
  - origin = manubrium of sternum and medial clavicle
  - insertion = mastoid process

Fascicle Organization

- Describes fascicle orientation within muscle:
  - *e.g.*, rectus (straight), oblique (angle)

Relative Position

- Externus (superficialis):
  - visible at body surface
- Internus (profundus):
  - deep muscles
- Extrinsic:
  - muscles outside an organ
- Intrinsic:
  - muscles inside an organ
Structural Characteristics

- Number of tendons:
  - bi = 2, tri = 3
- Shape:
  - trapezius (trapezoid), deltoid (triangle), soleus (fish)
- Size

Names for Muscle Size

- Longus = long
- Longissimus = longest
- Teres = long and round
- Brevis = short
- Magnus = large
- Major = larger
- Maximus = largest
- Minor = small
- Minimus = smallest

Action

- Movements:
  - e.g., flexor, extensor, retractor
- Occupations or habits:
  - e.g., risor = laughter

Integration with Other Systems

- Cardiovascular system:
  - delivers oxygen and fuel
  - removes carbon dioxide and wastes
- Respiratory system:
  - responds to oxygen demand of muscles
- Integumentary system:
  - disperses heat from muscle activity
- Nervous and endocrine systems:
  - direct responses of all systems