Chapter 10
Lecture Outline

See separate PowerPoint slides for all figures and tables pre-inserted into PowerPoint without notes.
Introduction

- Muscles constitute nearly half of the body’s weight and are of central interest in several fields of health care and fitness

Figure 10.5a
The Structural and Functional Organization of Muscles

• Expected Learning Outcomes
  – Describe the varied functions of muscles.
  – Describe the connective tissue components of a muscle and their relationship to the bundling of muscle fibers.
  – Describe the various shapes of skeletal muscles and relate this to their functions.
  – Explain what is meant by the origin, insertion, belly, action, and innervation of a muscle.
The Structural and Functional Organization of Muscles

(Continued)

– Describe the ways that muscles work in groups to aid, oppose, or moderate each other’s actions.
– Distinguish between intrinsic and extrinsic muscles.
– Describe, in general terms, the nerve supply to the muscles and where these nerves originate.
– Explain how the Latin names of muscles can aid in visualizing and remembering them.
The Structural and Functional Organization of Muscles

- About 600 human skeletal muscles
- Constitute about half of our body weight
- Three kinds of muscle tissue
  - Skeletal, cardiac, smooth
- Specialized for one major purpose
  - Converting the chemical energy in ATP into the mechanical energy of motion
- Myology—the study of the muscular system
The Functions of Muscles

• Muscle functions include: movement, stability, control of openings, heat production, and glycemic control

• Movement
  – Move from place to place; move body parts; move body contents in breathing, circulation, and digestion
  – In communication: speech, writing, facial expressions and other nonverbal communications

• Stability
  – Maintain posture by preventing unwanted movements
  – Antigravity muscles: prevent us from falling over
  – Stabilize joints by maintaining tension
The Functions of Muscles

• Control of openings and passageways
  – Sphincters: internal muscular rings that control the movement of food, blood, and other materials within body

• Heat production by skeletal muscles
  – As much as 85% of our body heat

• Glycemic control
  – Muscles absorb and store glucose which helps regulate blood sugar concentration within normal range
Connective Tissues and Fascicles

• **Endomysium**
  – Thin sleeve of loose connective tissue around each fiber
  – Allows room for capillaries and nerve fibers
  – Provides chemical environment for muscle fiber

• **Perimysium**
  – Thicker layer of connective tissue that wraps fascicles
    • **Fascicles**: bundles of muscle fibers wrapped together
  – Carries nerves, blood vessels, and stretch receptors

• **Epimysium**
  – Fibrous sheath surrounding entire muscle
  – Outer surface grades into fascia; inner surface projections form perimysium

• **Fascia**
  – Sheet of connective tissue that separates neighboring muscles or muscle groups from each other and the subcutaneous tissue
Connective Tissues and Fascicles

Figure 10.1c
• Strength of a muscle and the direction of its pull are determined partly by the orientation of its fascicles
Fascicles and Muscle Shapes

• **Fusiform muscles**—thick in the middle and tapered at each end
• **Parallel muscles**—uniform width and parallel fascicles
• **Triangular (convergent) muscles**—broad at one end and narrow at the other
• **Pennate muscles**—feather shaped
  - Unipennate—fascicles approach tendon from one side
  - Bipennate—fascicles approach tendon from both sides
  - Multipennate—bunches of feathers converge to single point
• **Circular muscles (sphincters)**—form rings around body openings
Muscle Compartments

- **Muscle compartment**—a group of functionally related muscles enclosed by fascia
  - Also contains nerves and blood vessels that supply the muscle group
- **Intermuscular septa** are very thick fascia that separate one compartment from another
Muscle Attachments

• **Indirect attachment** to bone
  – **Tendons** connect muscle to bone
    • Collagen fibers of the endo-, peri-, and epimysium continue into the tendon and from there into periosteum and matrix of bone
    • **Aponeurosis**—tendon is a broad, flat sheet (palmar aponeurosis)
    • **Retinaculum**—connective tissue band that tendons from separate muscles pass under

• **Direct (fleshy) attachment** to bone
  – Little separation between muscle and bone
  – Muscle seems to emerge directly from bone
Muscle Origins and Insertions

• **Origin**
  – Bony attachment at stationary end of muscle

• **Belly**
  – Thicker, middle region of muscle between origin and insertion

• **Insertion**
  – Bony attachment to mobile end of muscle
Muscle Origins and Insertions

• Some anatomists prefer nontraditional descriptions of attachments by proximal vs. distal or superior vs. inferior

• Some muscles insert not on bone but on the fascia or tendon of another muscle or on collagen fibers of the dermis
  – Example: many facial muscles insert in the skin
Functional Groups of Muscles

- **Action**—effect produced by a muscle to produce or prevent movement

- **Four categories of muscle action:** prime mover, synergist, antagonist, and fixator
  - **Prime mover (agonist)**
    - Muscle that produces most of force during a particular joint action
  - **Synergist**: muscle that aids the prime mover
    - May contribute additional force, modify the direction of movement, or stabilize a nearby joint
Functional Groups of Muscles

(Continued)

- **Antagonist**: opposes the prime mover
  - Prevents excessive movement
  - Sometimes relaxes to give prime mover control over an action
  - **Antagonistic pairs**—muscles that act on opposite sides of a joint
- **Fixator**: muscle that prevents movement of bone
Functional Groups of Muscles

For elbow flexion:
- **Prime mover**—brachialis
- **Synergist**—biceps brachii
- **Antagonist**—triceps brachii
- **Fixator**—muscle that holds scapula firmly in place
  - Rhomboids
Intrinsic and Extrinsic Muscles

- **Intrinsic muscle**—entirely contained within a region, such as the hand
  - Both origin and insertion there

- **Extrinsic muscle**—acts on a designated region, but has its origin elsewhere
  - Fingers: extrinsic muscles in the forearm

![Diagram of intrinsic and extrinsic muscles](image-url)
Muscle Innervation

- **Innervation** of a muscle—refers to the identity of the nerve that stimulates it
  - Knowing innervation enables diagnosis of nerve, spinal cord, and brainstem injuries from muscle tests

- **Spinal nerves** arise from the spinal cord
  - Emerge through intervertebral foramina
  - Immediately branch into posterior and anterior rami
  - Innervate muscles below the neck
  - **Plexus**: web-like network of spinal nerves adjacent to the vertebral column
Muscle Innervation

• **Cranial nerves** arise from the base of the brain
  – Emerge through skull foramina
  – Innervate the muscles of the head and neck
  – Numbered CN I to CN XII
Blood Supply

• Muscular system receives about 1.24 L of blood per minute at rest (one-quarter of the blood pumped by the heart)

• During heavy exercise, total cardiac output rises and the muscular system’s share is more than three-quarters (11.6 L/min)

• Capillaries branch extensively through the endomysium to reach every muscle fiber
How Muscles Are Named

• Latin names
  – *Depressor labii inferioris, flexor digiti minimi brevis*

• Describes distinctive aspects of the structure, location, or action of a muscle

• Footnotes throughout chapters show interpreted names of muscles

• Pronunciation of muscles available online at www.aprevealed.com
The Muscular System

Figure 10.5a

Figure 10.5b
A Learning Strategy

• Examine models, cadavers, dissected animals, or a photographic atlas
• Palpate muscles on yourself if possible
• Locate origins and insertions of muscles on an articulated skeleton
• Study derivation of each muscle name
  – Usually describes the muscle’s location, appearance, origin, insertion, or action
• Say the names aloud to yourself or study partner, and spell them correctly
Muscles of the Head and Neck

• **Expected Learning Outcomes**
  – Name and locate the muscles that produce facial expression.
  – Name and locate the muscles used for chewing and swallowing.
  – Name and locate the neck muscles that move the head.
  – Identify the origin, insertion, action, and innervation of any of these muscles.
Muscles of Facial Expression

- Muscles that insert in the dermis and subcutaneous tissues
- Tense the skin and produce facial expressions
- Innervated by facial nerve (CN VII)
- Paralysis causes face to sag
- Found in scalp, forehead, around the eyes, nose, and mouth, and in the neck
Muscles of Facial Expression

Figure 10.8a
Muscles of Chewing and Swallowing

- **Extrinsic muscles of the tongue**
  - Tongue is very agile organ
  - Pushes food between molars for chewing (mastication)
  - Forces food into the pharynx for swallowing (deglutition)
  - Crucial importance to speech

- **Intrinsic muscles of tongue**
  - Vertical, transverse, and longitudinal fascicles
Muscles of Chewing and Swallowing

- Four pairs of muscles produce biting and chewing movements of the mandible
  - Depression: to open mouth
  - Elevation: biting and grinding
  - Protraction: incisors can cut
  - Retraction: make rear teeth meet
  - Lateral and medial excursion: grind food

- Temporalis, masseter, medial pterygoid, and lateral pterygoid

- Innervated by mandibular nerve, a branch of the trigeminal (CN V)

Figure 10.10a,b
Muscles of Chewing and Swallowing

- **Hyoid muscles**—suprahyoid group
- Aspects of chewing, swallowing, and vocalizing
- Eight pairs of hyoid muscles associated with hyoid bone
- **Digastric**—opens mouth widely
- **Geniohyoid**—depresses mandible
- **Mylohyoid**—elevates floor of mouth at beginning of swallowing
- **Stylohyoid**—elevates hyoid

![Figure 10.11a](image-url)
Muscules of Chewing and Swallowing

- **Hyoid muscles**—infrahyoid group
- **Fix hyoid bone from below, allowing suprathyroid muscles to open mouth**
- **Omothyroid**—depresses hyoid after elevation
- **Sternothyroid**—depresses larynx after elevation
- **Thyrothyroid**—depresses hyoid and elevates larynx

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Muscles of Chewing and Swallowing

- **Pharynx**: three pairs pharyngeal constrictors
  - Encircle pharynx forming a muscular funnel
  - During swallowing, drive food into the esophagus
Muscles Acting on the Head

• Originate on vertebral column, thoracic cage, and pectoral girdle
• Insert on the cranial bones
• Actions
  – Flexion (tipping head forward)
  – Extension (holding the head erect)
  – Lateral flexion (tipping head to one side)
  – Rotation (turning the head to the left and right)
Muscles Acting on the Head

• **Neck flexors**
  – Sternocleidomastoid
  – Scalenes

• **Neck extensors**
  – Trapezius
  – Splenius capitis
  – Semispinalis capitis

Figure 10.12
Muscles Acting on the Head

• May cause contralateral movement: movement of the head toward the opposite side

• May cause ipsilateral movement: movement of the head toward the same side
Muscles of the Trunk

• **Expected Learning Outcomes**
  – Name and locate the muscles of respiration and explain how they affect airflow and abdominal pressure.
  – Name and locate the muscles of the abdominal wall, back, and pelvic floor.
  – Identify the origin, insertion, action, and innervation of any of these muscles.
Muscles of the Trunk

• Three functional groups
  – Muscles of respiration
  – Muscles that support abdominal wall and pelvic floor
  – Movement of vertebral column
Muscles of Respiration

• Breathing requires the use of muscles enclosing thoracic cavity
  – Diaphragm, external intercostal, internal intercostal, and innermost intercostal muscles

• Inspiration—air intake

• Expiration—expelling air
Muscles of Respiration

• Other muscles of chest and abdomen that contribute to breathing
  – Sternoclavicular, scalenes of neck
  – Pectoralis major and serratus anterior of chest
  – Latissimus dorsi of back
  – Abdominal muscles: internal and external obliques, and transverse abdominis
  – Even some anal muscles
Muscles of Respiration

- **Diaphragm**—muscular dome between thoracic and abdominal cavities
- Muscle fascicles extend to a fibrous **central tendon**
- **Contraction** flattens diaphragm
  - Enlarges thoracic cavity (inspiration)
- In **relaxation** of diaphragm it rises
  - Shrinks the thoracic cavity (expiration)

![Figure 10.13b](image)
Muscles of Respiration

• **External intercostals**
  - Elevate ribs
  - Expand thoracic cavity
  - Create partial vacuum causing inflow of air

• **Internal intercostals**
  - Depresses and retracts ribs
  - Compresses thoracic cavity
  - Expelling air

• **Innermost intercostals**
  - Same action as internal intercostals

Figure 10.13a
Muscles of the Anterior Abdominal Wall

- **Internal abdominal oblique**
  - Intermediate layer of lateral abdominal muscles
  - Unilateral contraction causes ipsilateral rotation of waist
  - Aponeurosis
    - Tendons of oblique and transverse muscles
    - Broad, fibrous sheets

![Figure 10.15b]

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Muscles of the Anterior Abdominal Wall

- **Transverse abdominal**
  - Deepest of lateral abdominal muscles
  - Horizontal fibers
  - Compresses abdominal contents
  - Contributes to movements of vertebral column
Muscles of the Anterior Abdominal Wall

- **Rectus abdominis**
  - Flexes lumbar region of vertebral column
  - Produces forward bending at the waist
  - Extends from sternum to pubis
  - Rectus sheath encloses muscle
  - Three transverse tendinous intersections divide rectus abdominis into segments, sometimes called a “six pack”
Muscles of Back

- Back muscles extend, rotate, and laterally flex vertebral column
- Most prominent superficial back muscles: latissimus dorsi and trapezius
- Upper limb movement

Figure 10.17
Muscles of the Back

- **Deep muscles**
- **Erector spinae**
  - *Iliocostalis, longissimus, spinalis*
  - From cranium to sacrum
  - Extension and lateral flexion of vertebral column

- **Semispinalis thoracis**
  - Extension and contralateral rotation of vertebral column
Muscles of the Back

(Continued)

• **Quadratus lumborum**
  – Aids respiration
  – Ipsilateral flexion of lumbar vertebral column

• **Multifidus**
  – Stabilizes adjacent vertebrae
  – Maintains posture
Muscles of the Pelvic Floor

- **Layers of muscles and fasciae that span pelvic outlet**
  - Penetrated by anal canal, urethra, and vagina

- **Perineum**—diamond-shaped region between the thighs
  - Bordered by four bony landmarks
    - Pubic symphysis anteriorly
    - Coccyx posteriorly
    - Ischial tuberosities laterally
  - Urogenital triangle: anterior half of perineum
  - Anal triangle: posterior half of perineum
Muscles of the Pelvic Floor

• Layers or compartments of the perineum
  – Superficial perineal space
    • Ischiocavernosus, bulbospongiosus
  – Deep perineal space
    • Deep transverse perineal, compressor urethrae
  – Anal triangle
    • External anal sphincter
  – Pelvic diaphragm: deepest (most superior) layer
    • Levator ani
Muscles of the Pelvic Floor

- **Superficial perineal space**
  - **Ischiocavernosus**—maintains erection
  - **Bulbospongiosus**—aids in erection, expels remaining urine
Muscles of the Pelvic Floor

- **Deep perineal space**
  - **Urogenital triangle**—contains deep transverse perineal muscle and *compressor urethrae in females*
- **Anal triangle**—external anal sphincter
Muscles of the Pelvic Floor

- **Pelvic diaphragm**: deepest compartment of the perineum
  - **Levator ani**: supports viscera and defecation
  - **Coccygeus muscle(s)**

Figure 10.20c
Hernias

- **Hernia**—any condition in which the viscera protrudes through a weak point in the muscular wall of the abdominopelvic cavity

- **Inguinal hernia**
  - Most common type of hernia (rare in women)
  - Viscera enter inguinal canal or even the scrotum

- **Hiatal hernia**
  - Stomach protrudes through diaphragm into thorax
  - Overweight people over 40

- **Umbilical hernia**
  - Viscera protrude through the navel

Figure 10.21
Muscles Acting on the Shoulder and Upper Limb

• Expected Learning Outcomes
  – Name and locate the muscles that act on the pectoral girdle, shoulder, elbow, wrist, and hand.
  – Relate the actions of these muscles to the joint movements described in chapter 9.
  – Describe the origin, insertion, and innervation of each muscle.
Muscles Acting on the Shoulder and Upper Limb

- Compartments—spaces where muscles are separated by fibrous connective tissue sheets (fasciae)
  - Each compartment contains one or more functionally related muscles along with their nerve and blood supplies
- Muscles of upper limbs divided into anterior and posterior compartments
- Intermuscular septa (thick fascia) separates compartments
- Compartment syndrome—one of the muscles or blood vessels in a compartment is injured
Compartment Syndrome

• If a blood vessel in a compartment is damaged, blood and tissue fluid accumulate
• Fasciae enclose muscle compartments snugly and prevent expansion
• Compartment syndrome—mounting pressure triggers a sequence of degenerative events
  – Blood flow to compartment is obstructed by pressure
  – If ischemia (poor blood flow) persists for more than 2 to 4 hours, nerves begin to die
  – After 6 hours, muscles begin to die
• Nerves can regenerate after pressure relieved, but muscle damage is permanent
• Myoglobin in urine indicates compartment syndrome
• Treatment: immobilization of limb and fasciotomy (incision to relieve compartment pressure)
Muscles Acting on the Shoulder and Upper Limb

• Upper limb is used for a broad range of powerful and subtle actions
  – Climbing, grasping, throwing, writing, playing musical instruments, and manipulating small objects
• Muscles that act on the scapula
• Muscles that act on the humerus and shoulder joint
• Muscles that act on the forearm and elbow joint
• Muscles that act on the wrist, hand, and fingers
Muscles Acting on the Shoulder

• A group of muscles originate on the axial skeleton and insert on clavicle or scapula

• Scapula loosely attached to thoracic cage
  – Capable of great movement
  – Rotation, elevation, depression, protraction, retraction

• Clavicle braces the shoulder and moderates movements
Muscles Acting on the Scapula

Figure 10.22
Muscles Acting on the Shoulder

- **Anterior group of muscles of pectoral girdle**

- **Pectoralis minor**
  - Ribs 3–5 to coracoid process of scapula
  - Draws scapula laterally

- **Serratus anterior**
  - All ribs to medial border of scapula
  - Draws scapula laterally and forward; prime mover for reaching and pushing

Figure 10.15b
Muscles Acting on the Shoulder

- Posterior group of muscles of pectoral girdle
  - Four muscles of posterior group
    - **Trapezius**: superficial
    - Levator scapulae, Rhomboid minor, and Rhomboid major: deep

- **Trapezius**
  - Stabilizes scapula and shoulder
  - Elevates and depresses shoulder apex
Muscles Acting on the Shoulder

(Continued from slide 170)

• **Levator scapulae**
  – Elevates scapula
  – Flexes neck laterally

• **Rhomboid minor**
  – Retracts scapula and braces shoulder

• **Rhomboid major**
  – Same as Rhomboid minor
Muscles Acting on the Shoulder

- Posterior scapular muscles
Muscles Acting on the Arm

- Nine muscles cross the shoulder joint and insert on humerus
- Two are axial muscles originating on axial skeleton
  - Pectoralis major: flexes, adducts, and medially rotates humerus
  - Latissimus dorsi: adducts and medially rotates humerus
Anterior View of Cadaver Chest

Figure 10.24a

(a) Anterior view

Deltoid
Pectoralis major
Biceps brachii:
  Long head
  Short head
Serratus anterior
External abdominal oblique

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Back Muscles of Cadaver

Figure 10.24b
Muscles Acting on the Arm

- **Seven muscles with scapular origin**
  - **Deltoid**
    - Rotates and abducts arm
    - Intramuscular injection site
  - **Teres major**
    - Extension and medial rotation of humerus
  - **Coracobrachialis**
    - Flexes and medially rotates arm
  - **Remaining four form the rotator cuff that reinforce the shoulder joint**

*Figure 10.23a*

*Figure 10.23b*
Muscles Acting on the Arm

- Rotator cuff muscles
- Tendons of the remaining four scapular muscles form the rotator cuff
- Acronym “SITS muscles”
  - Supraspinatus
  - Infraspinatus
  - Teres minor
  - Subscapularis
- Tendons of these muscles merge with the joint capsule of the shoulder as they cross it in route to the humerus
- Holds head of humerus into glenoid cavity
- Supraspinatus tendon easily damaged
Rotator Cuff Muscles

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Figure 10.25

Rotator cuff (SITS) muscles:
- Supraspinatus
- Infraspinatus
- Teres minor
- Subscapularis

Anterior | Posterior

Clavicle
Acromion
Coracoid process
Glenoid cavity
Inferior angle
Muscles Acting on the Forearm

• Elbow and forearm capable of flexion, extension, pronation, and supination
  – Carried out by muscles in both brachium (arm) and antebrachium (forearm)

• Muscles with bellies in the arm (brachium)
  – Principal elbow flexors: anterior compartment
    • Brachialis and biceps brachii
      – Brachialis produces 50% more power than biceps brachii
      – Brachialis is prime mover of elbow flexion
  – Principal elbow extensor: posterior compartment
    • Triceps brachii
      – Prime mover of elbow extension
Muscles Acting on the Forearm

- **Principal flexor**
  - Brachialis

- **Synergistic flexors**
  - Biceps brachii
  - Brachioradialis

- **Principal extensor**
  - Triceps brachii
Muscles Acting on the Forearm

• Muscles with bellies in the forearm (antebrachium)
  – **Brachioradialis**: flexes elbow
  – **Anconeus**: extends elbow
  – **Pronator quadratus**: prime mover in forearm pronation
  – **Pronator teres**: assists pronator quadratus in pronation
  – **Supinator**: supinates the forearm
Muscles Acting on the Forearm

- **Supination**
  - **Supinator** muscle
  - Palm facing anteriorly or superiorly

- **Pronation**
  - **Pronator quadratus** and **pronator teres**
  - Palm faces posteriorly or inferiorly
Muscles Acting on the Wrist and Hand

• Anterior group
• Extrinsic muscles of the forearm
• Intrinsic muscles in the hand itself
• Extrinsic muscle actions
  – Flexion and extension of wrist and digits
  – Radial and ulnar flexion
  – Finger abduction and adduction
  – Thumb opposition

Figure 10.28a,b,c
Muscles Acting on the Wrist and Hand

- Anterior (flexor) compartment—superficial layer
  - Flexor carpi radialis
  - Flexor carpi ulnaris
  - Flexor digitorum superficialis
  - Palmaris longus

- Anterior (flexor) compartment—deep layer
  - Flexor digitorum profundus
  - Flexor pollicis longus
Cross Section of Upper Limb

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- Deltoid
- Pectoralis major
- Biceps brachii:
  - Short head
  - Long head
- Coracobrachialis
- Humerus
- Latissimus dorsi tendon
- Teres major
- Triceps brachii:
  - Medial head
  - Long head
  - Lateral head
- Pronator teres
- Brachioradialis
- Brachialis
- Biceps brachii:
  - Lateral head
  - Long head
- Triceps brachii:
  - Medial head
  - Long head
  - Lateral head
- Flexor carpi radialis
- Flexor carpi ulnaris
- Palmaris longus
- Flexor digitorum superficialis
- Flexor digitorum profundus
- Ulna
- Anconeus
- Supinator
- Radius
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris

Key:
- Anterior (flexor) compartment, superficial
- Anterior (flexor) compartment, deep
- Posterior (extensor) compartment
- Other muscles

Figure 10.27a,b,c
Muscles Acting on the Wrist and Hand

- Posterior group
- Extension of wrist and fingers, adduct/abduct wrist
- Extension and abduction of thumb (pollicis)
- *Brevis* means “short,” *ulnaris* indicates “on ulna side of forearm”
Muscles Acting on the Wrist and Hand

- **Posterior (extensor) compartment—superficial layer**
  - Extensor carpi radialis longus
  - Extensor carpi radialis brevis
  - Extensor digitorum
  - Extensor digiti minimi
  - Extensor carpi ulnaris

- **Posterior (extensor) compartment—deep layer**
  - Abductor pollicis longus
  - Extensor pollicis brevis
  - Extensor pollicis longus
  - Extensor indicis
Carpal Tunnel Syndrome

- **Flexor retinaculum**—bracelet-like fibrous sheet, passed under by flexor tendons crossing the wrist

- **Carpal tunnel**—tight space between the flexor retinaculum and the carpal bones
  - Flexor tendons passing through the tunnel are enclosed in tendon sheaths
    - Enable tendons to slide back and forth quite easily
Carpal Tunnel Syndrome

- **Carpal tunnel syndrome**—prolonged, repetitive motions of wrist and fingers cause tissues in the carpal tunnel to become inflamed, swollen, or fibrotic
  - Puts pressure on median nerve of wrist that passes through the carpal tunnel along with flexor tendons
  - Tingling and muscular weakness in the palm and medial side of the hand
  - Pain may radiate to arm and shoulder
  - Treatment: anti-inflammatory drugs, immobilization of the wrist, and sometimes surgery to remove part or all of flexor retinaculum
Carpal Tunnel Syndrome

Repetitive motions cause inflammation and pressure on median nerve

(b) Palmar dissection, superficial
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Figure 10.31b

Figure 10.31a
Intrinsic Muscles of the Hand

• Thenar group—form thick, fleshy mass at base of thumb
  – Adductor pollicis
  – Abductor pollicis brevis
  – Flexor pollicis brevis
  – Opponens pollicis

• Hypothenar group—fleshy base of the little finger
  – Abductor digiti minimi
  – Flexor digiti minimi brevis
  – Opponens digiti minimi

• Midpalmar group—hollow of palm
  – Dorsal interosseous muscles (4)
  – Palmar interosseous muscles (3)
  – Lumbricals (4 muscles)
Muscles Acting on the Hip and Lower Limb

• **Expected Learning Outcomes**
  – Name and locate the muscles that act on the hip, knee, ankle, and toe joints.
  – Relate the actions of these muscles to the joint movements described in chapter 9.
  – Describe the origin, insertion, and innervation of each muscle.
Muscles Acting on the Hip and Lower Limb

- Body’s largest muscles found in lower limb
- Less for precision, more for strength needed to stand, maintain balance, walk, and run
- Several cross and act on two or more joints
- Leg—the part of the limb between the knee and ankle
- Foot—includes tarsal region (ankle), metatarsal region, and the toes
Muscles Acting on the Hip and Femur

• **Anterior muscles of the hip**
  – **Iliacus**
    • Flexes thigh at hip
    • Iliacus portion arises from iliac crest and fossa
  – **Psoas major**
    • Flexes thigh at hip
    • Arises from lumbar vertebrae
  – They share a common tendon on the femur

Figure 10.32

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Muscles Acting on the Hip and Femur

- **Lateral and posterior muscles of the hip**
  
  - **Tensor fasciae latae**
    - Extends knee, laterally rotates knee
  
  - **Gluteus maximus**
    - Forms mass of the buttock
    - Prime hip extensor
    - Provides most of lift when you climb stairs
  
  - **Gluteus medius** and **minimus**
    - Abduct and medially rotate thigh

*Figure 10.33*
Muscles Acting on the Hip and Femur

• Posterior group
• Lateral rotators—six muscles inferior to gluteus minimus
• Deep to the two other gluteal muscles
  – Gemellus superior
  – Gemellus inferior
  – Obturator externus
  – Obturator internus
  – Piriformis
  – Quadratus femoris
Muscles Acting on the Hip and Femur

- **Medial (adductor) compartment of thigh**
- **Five muscles act as primary adductors of the thigh**
  - Adductor brevis
  - Adductor longus
  - Adductor magnus
  - Gracilis
  - Pectineus
Muscles Acting on the Knee and Leg

- **Anterior (extensor) compartment of the thigh**
  - Contains large *quadriceps femoris* muscle
    - Prime mover of knee extension
    - Most powerful muscle in the body
    - Has four heads—*rectus femoris, vastus lateralis, vastus medialis*, and *vastus intermedius*
      - All converge on single quadriceps (patellar) tendon
      - Extends to patella
      - Then continues as patellar ligament
      - Inserts on tibial tuberosity

- **Sartorius**: longest muscle in the body
  - “Tailor’s muscle”
Muscles Acting on the Knee and Leg
Muscles Acting on the Knee and Leg

- Posterior (flexor) compartment of the thigh
  - Contains hamstring muscles
  - From lateral to medial:
    Biceps femoris
    Semitendinosus
    Semimembranosus

Figure 10.33
**Muscles Acting on the Foot**

Crural muscles, acting on the foot, are separated into three compartments

- Anterior compartment (red)
- Fibular (lateral) compartment (green)
- Posterior compartments (superficial = pink) (deep = purple)

![Diagram of muscles acting on the foot](image-url)
Muscles Acting on the Foot

- **Anterior (extensor) compartment of the leg**
  - Dorsiflex the ankle
  - Prevent toes from scuffing ground when walking
  - **Fibularis (peroneus) tertius**
  - **Extensor digitorum longus**
  - **Extensor hallucis longus**
  - **Tibialis anterior**
Muscles Acting on the Foot

- **Posterior compartment**—three muscles of the superficial group
  - **Gastrocnemius**: plantar flexes foot, flexes knee
  - **Soleus**: plantar flexes foot
  - **Plantaris**: weak synergist of triceps surae
- **Triceps surae**—collective name for *gastrocnemius* and *soleus*
  - Inserts on calcaneus by way of the calcaneal (Achilles) tendon
  - Strongest tendon in the body
Muscles Acting on the Foot

- **Posterior compartment**—four muscles in the deep group
  - **Flexor digitorum longus**: flexes phalanges
  - **Flexor hallucis longus**: flexes great toe
  - **Tibialis posterior**: inverts foot
  - **Popliteus**: acts on knee
Muscles Acting on the Foot

- Lateral (fibular) compartment—two muscles
  - Fibularis longus
  - Fibularis brevis

- Both plantar flex and evert the foot

- Provide lift and forward thrust

Figure 10.39a
Intrinsic Muscles of Foot

- **One dorsal muscle**
  - Extensor digitorum brevis extends toes

- **Four ventral muscle layers**
  - Support arches
  - Abduct and adduct the toes
  - Flex the toes

![Figure 10.41](image)

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Common Athletic Injuries

• Muscles and tendons are vulnerable to sudden and intense stress
• Proper conditioning and warm-up needed
• Common injuries include:
  – Compartment syndrome
  – Shin splints
  – Pulled hamstrings
  – Tennis elbow
  – Pulled groin
  – Rotator cuff injury

• Treat with rest, ice, compression, and elevation
• “No pain, no gain” is a dangerous misconception