Muscular System

LEARNING OBJECTIVES
You will be able to do the following after completing this chapter:

Key Terms
1. Define, appropriately use, and spell all the Key Terms for this chapter.

Function and Structure of Muscles
2. State the three functions of muscle and explain the importance of each.
3. Explain the basic structure of muscle.
4. Describe the structure and function of tendons.

Muscle Contraction and Muscle Tissue
5. Explain how a muscle contracts.
6. Identify and define the two types of muscle.
7. Briefly describe the three types of muscle tissue.
8. List four characteristics of muscle tissue.

Principal Skeletal Muscles
9. List seven ways muscles can be named.
10. Locate and identify the main skeletal muscles of the body.

Diseases and Disorders of the Muscular System
11. List seven common signs and symptoms of muscular system disorders.
12. List two common diagnostic tests for muscular disease and describe the use of each.
13. State the two most common muscular disorders seen in the physician’s office.
14. List two muscular diseases and briefly describe the etiology, signs and symptoms, diagnosis, therapy, and interventions for each.

Patient-Centered Professionalism
15. Analyze a realistic medical office situation and apply your understanding of the muscular system to determine the best course of action.
16. Describe the impact on patient care when medical assistants have a solid understanding of the structure and function of the muscular system.

KEY TERMS
The Key Terms for this chapter have been organized into sections so that you can easily see the terminology associated with each aspect of the muscular system.

Muscle Function
- adenosine triphosphate (ATP)
- lactic acid
- antagonistic
- muscle tone
- atonic
- synergistic
- flaccid
- tonus

Continued
FUNCTION AND STRUCTURE OF MUSCLES

Knowing the function and structure of muscles in the body allows you to better understand the problems that can affect the muscular system.

Muscle Function

The three main functions of muscles are to (1) cause movement, (2) provide support, and (3) produce heat and energy.

Movement

Our bodies move in many ways. Types of body movements include moving from place to place (conscious or voluntary), reaction of the pupil to light (unconscious or involuntary), and even internal movement such as digestion, respiration, and heartbeat (unconscious or involuntary).

Muscles are specialized and contract when stimulated. When a muscle contracts, its fibers shorten; this produces movement. Muscles can only pull bones; they cannot push them. Most of the muscles of the body are arranged in antagonistic pairs, meaning that when one muscle moves in one direction (prime mover), its antagonist causes movement in the opposite direction (e.g., biceps versus triceps). Muscles can also be arranged in synergistic pairs. The muscles in either of these muscle pairs work together to bring about movement.

Support

Even when people are not moving, their muscles are in a state of partial contraction known as muscle tone. Muscle tone is an unconscious action resulting from nerve stimulation that keeps muscles in a state of readiness. A person’s muscle tone dictates his or her posture. Muscle tone allows the abdominal muscles to hold the internal organs in place so that posture can be maintained for long periods with little or no evidence of fatigue. Tonus is the slight tension in the muscle that is always present, even when at rest. A person is said to be flaccid or atonic when muscle tone is lacking. Flaccid muscles do not...
provide the necessary support and ability of movement that is needed for the body to respond to stimuli.

**Heat Production**

Our bodies maintain an average body temperature of 98.6°F or 37°C. Temperatures above or below this range may indicate illness. The contraction of muscles that produces a person’s body heat occurs in the following two ways:

- Chemical energy is used to make muscles contract. Some of this energy is lost as heat.
- The *aerobic* (occurring or living only in the presence of oxygen) and *anaerobic* (living in the absence of oxygen) reactions in muscles also produce heat.

Before a muscle contracts, it receives a nerve impulse. Skeletal muscles require energy to move, and *adenosine triphosphate* (ATP) is used for this process. When ATP generated in cellular respiration breaks down, the muscle fibers shorten. When a muscle runs out of ATP, the buildup of *lactic acid* (waste product) causes the tired and sometimes burning feeling of muscle fatigue.

**Structure of Muscles and Tendons**

You first learned about cells and tissues in Chapter 11. This section discusses the specific tissue types that make up muscles and tendons.

**Muscle Structure**

Skeletal muscles are bundles of long muscle fibers (muscle cells). They are specialized to *contract* (shorten) when given a stimulus and to *relax* (return to their original position) when the stimulus subsides. The larger the muscle, the greater is the number of fibers involved. Each group of fibers is held together and protected by connective tissue, which is covered by a fibrous sheath called *fascia* that covers, supports, and separates muscles. The fascia contains the muscle’s blood, lymph, and nerve supply. Muscles are red because they contain *myoglobin*, a red pigment, and have a rich blood supply.

**Tendon Structure**

A *tendon* is a white cordlike structure made up of collagenous fibers that connects muscles to bone. Tendons are strong and very flexible. There are many tendons in the body; several important ones are listed here. Severe damage to major tendons can necessitate surgical repair.

- The *Achilles tendon*, the strongest tendon in the body, attaches the calf muscle to the calcaneus.
- The *hamstrings* are tendons located behind the knee. They are responsible for extending (straightening) the hips and flexing (bending) the knees.
- The *aponeurosis* is a wide, flat connective tissue that connects muscle to bone.

**Muscle Contraction**

Muscle contraction enables movement, posture, and heat production. Some muscles contract and relax on our command (voluntary muscles); others do this independent of the person’s control (involuntary muscles).

When one or more muscles in a group contract, or pull, the other muscles of the group relax. This contraction produces movement. When the bone is ready to be pulled back to the original position, the muscles switch roles: the contracting muscles relax and the previously relaxed muscles contract.

Before a skeletal muscle can contract, the muscle must be stimulated by nerve impulses. Where the muscle fiber and the nerve ending meet is called a *neuromuscular junction* (area where *synapse* occurs). *Acetylcholine* is released at this junction. This chemical is used by the nerve endings to send an impulse across the synapse to the muscle, which causes the next muscle to contract. The enzyme *cholinesterase* breaks down excess acetylcholine and thus stops the overstimulation of the muscle.

Contraction is controlled by the central nervous system (CNS), which includes the brain and the spinal cord. Voluntary muscle contractions are initiated in the brain while the spinal cord initiates involuntary movement. Skeletal muscles are able to produce varying levels of contractile force, thus preventing the muscle fibers from tearing. Smooth muscles contract in response to calcium levels.

**PATIENT-CENTERED PROFESSIONALISM**

- Why is it important for the medical assistant to understand the structure and function of the muscular system?
- Why is it important to understand the function of tendons?

**Types of Contractions**

To be effective, muscles must contract in a smooth and sustained movement. When an individual lifts a heavy object, the muscles shorten and thicken as they contract. This is known as *isotonic contraction* (Figure 19-1, A). If that same individual pushed against the wall or tried to move an immovable object, no movement would occur. In this situation, muscle length would not change, but muscle tension would increase. This type of muscle contraction is known as *isometric contraction* and is often used to strengthen muscles (Figure 19-1, B).

Abnormal contractions are not smooth or sustained and are not useful.

- A *twitch* is a jerky response to a stimulus. If our muscles only twitched instead of moving smoothly, we would not be able to perform many fine motor tasks such as writing, buttoning, or zipping.
- A *tetany* is another form of abnormal contraction. This type of contraction is caused when the muscle is stimulated in a series of “rapid fire” impulses. In this situation each muscle fiber is not working with other fibers to respond to the stimulus but instead is working...
Muscular System

CHAPTER 19

TYPES OF MUSCLE AND MUSCLE TISSUE

There are two main categories of muscles:

1. Voluntary
2. Involuntary

Voluntary and involuntary muscles are made up of one of the three types of muscle tissue (Figure 19-2):

1. Skeletal, also called “striated” or “voluntary”
2. Smooth, also called “involuntary” or “visceral”
3. Cardiac, striated in appearance but involuntary or smooth muscle in function

Voluntary Muscles

Voluntary muscles are so named because people can move these muscles when they want or can choose to hold them still. People have conscious (voluntary) control over these muscles. For example, you can voluntarily flex the biceps and triceps of your upper arm.

Skeletal muscles are voluntary muscles that attach to the bones of the skeleton and allow body movement. Under the microscope these muscle tissues appear striated, or “zebra striped,” because they have light and dark bands of muscle fibers. These bands act to reinforce the tissue so that the fibers do not rupture during heavy lifting.

Involuntary Muscles

Involuntary muscles are muscles that people cannot control. These muscles work on their own without conscious stimulus. The diaphragm, a respiratory muscle of breathing, and the myocardium, the main muscle of the heart, are examples of involuntary muscles. They contract involuntarily in a rhythmic pattern to maintain breathing and heartbeat.

There are two types of involuntary muscle tissue: cardiac and smooth.

- Smooth muscle tissue (visceral muscle tissue) is nonstriated and is involuntary. This type of muscle makes up most of the organs of the body. For example, your stomach muscle is composed of smooth muscle tissue. They work without you thinking about them.
- Cardiac muscle has the same action as smooth muscle, so it is also involuntary. However, its microscopic appearance is striated. Cardiac muscle differs from the other muscles because microscopically it appears to be growing branches. The only place cardiac muscle is

Figure 19-1  Muscle contraction types. A, Isotonic contractions produce movement. B, Isometric contractions do not produce movement. (Modified from Thibodeau GA, Patton KT: The human body in health and disease, ed 4, St Louis, 2005, Mosby.)
found is in the walls of the heart. The cardiac muscle must function as a complete unit instead of individual fibers. This is accomplished because of the *intercalated discs* that connect its fibers. When one fiber contracts, all connected fibers contract.

### Characteristics of Muscle Tissue

Muscle tissue is unique in its structure and function and has the following four major characteristics:

1. **Contractility**, the ability of a muscle to shorten and thicken when given proper stimulation.
2. **Extensibility**, the ability of a muscle to stretch.
3. **Elasticity**, the ability of a muscle to return to its original length after stretching.
4. **Irritability**, the ability of a muscle to respond to stimulation.

### PRINCIPAL SKELETAL MUSCLES

You need to become familiar with the major skeletal muscles and groups. To better understand these muscles, it helps to understand why muscles are named the way they are.

### Naming of Muscles

Every muscle in your body has a name. Four general categories are used to name the types of muscle, as follows:

1. The **prime mover**, or agonist, is the muscle responsible for movement when a group of muscles is contracting at the same time.
2. **Antagonists** are muscles that oppose or reverse the movement of the prime mover.
3. **Synergists** are muscles that help prime movers by stabilizing the movement.
4. **Fixators** are specialized synergists that stabilize the origin (nonmoving bone or muscle) of a prime mover so more tension is used to move the insertion bone.

In addition to names for “types” or “categories” of muscles, individual muscles all have names based on one or more characteristics of their function or structure.

### Origin and Insertion

Muscles can be named for their origin and insertion. Where a muscle begins or is attached to a bone is its **origin**. Where it ends is its **insertion** point. Muscle origin is a fixed attachment, meaning it does not move, and muscle insertion is more movable. For example, the sternocleidomastoid muscle helps to rotate the head. It starts at the sternum and clavicle (origin) and ends at the mastoid process of the temporal bone (insertion) (Figure 19-3).

### Location and Associated Bone

Muscles can also be named for their location, or the bone with which they are associated. Muscles are named by their location according to where the muscle is located in the body or near what organ. For example, the frontalis muscles overlie the frontal bones of the skull.

### Size

Muscles named for their size indicate if they are large or small, narrow or wide. One example is the gluteus maximus, or...
buttock muscle. The gluteus maximus is the largest muscle in the body; the word maximus is Latin for “large.”

**Shape**

Some muscle shapes are represented in their name. For instance, the deltoid muscle of the shoulder looks like an upside-down Greek letter D, called delta (δ).

**Fiber Direction**

Muscles may also be named for the direction of their fibers. Fiber direction can be vertical, horizontal, slanted, or crosswise (oblique), and the muscle group’s name reflects the direction. The external oblique, a slanted muscle across and to the side of the abdomen and torso, is an example.

**Number of Attachment Points**

Muscles can be named for their number of attachment points, or origins (Figure 19-4). Naming of this type identifies how well the muscle is anchored to the bone. A prefix may be used to indicate the number of attachments. Examples include the biceps brachii (bi = two attachments), triceps brachii (tri = three attachments), and quadriceps femoris (quad = four attachments).

**Use and Action**

Finally, muscles can be named for the action of the muscle. For example, the flexors are responsible for flexing or bringing a body part toward the body. Muscles can also be named for their common use (Figure 19-5).

Actions of a muscle are typically indicated by the suffix -or. Examples are as follows:

- **Abductors** move a bone away from the midline. Deltoid moves the arm out to the side.
- **Adductors** move a bone toward the midline. Pectoralis major of the chest and latissimus dorsi of the back are used in swimming.
- **Levators** lift a bone. Levator labii superioris elevates the upper lip.

**Location of Major Muscles**

Figure 19-6 illustrates the main muscles of the body from both the anterior view (A) and the posterior view (B).

**Muscles of the Head**

The main muscles of the head are those of facial expression and chewing (Table 19-1).

- **Muscles of expression** control a person’s reaction to fear, joy, pain, and grief.
- **Muscles of chewing or mastication** control the lower jaw (mandible).

**Muscles of the Neck**

The neck muscles are slanted or diagonal and extend upward and downward. These muscles allow for rotation, flexion, and extension of the head and scapula (see Table 19-1).

**Muscles of the Chest**

The chest muscles control breathing. Table 19-1 highlights the thoracic wall muscles.
Kissing muscle (orbicularis oris)

Smiling muscle (zygomaticus)

Toe dancer’s muscles (gastrocnemius and soleus)

Tailor’s muscle (sartorius)

Swimmer’s muscle (latissimus dorsi)

Achilles tendon

Surprised! muscle (frontalis)

Trumpeter’s muscle (buccinator)

Hamstrings

Praying muscle (sternocleidomastoid)

Swimmer’s muscle (latissimus dorsi)

FIGURE 19-5 A variety of special muscles named for their common use. (Modified from Herlihy B, Maebius NK: The human body in health and illness, ed 3, St Louis, 2007, Saunders.)
### Skeletal Muscles

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Description</th>
<th>Origin to Insertion</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontalis</td>
<td>Flat muscle that covers forehead</td>
<td>Cranial aponeurosis to eyebrows</td>
<td>Raises eyebrows</td>
</tr>
<tr>
<td>Orbicularis oculi</td>
<td>Circular muscle around eye</td>
<td>Maxilla and frontal bones to eyelid</td>
<td>Blinks and closes eyes</td>
</tr>
<tr>
<td>Orbicularis oris</td>
<td>Circular muscle of mouth</td>
<td>Maxilla and mandible to lips</td>
<td>Closes and protrudes lips</td>
</tr>
<tr>
<td>Buccinator</td>
<td>Horizontal cheek muscle</td>
<td>Mandible and maxilla to skin around mouth</td>
<td>Flattens cheek</td>
</tr>
<tr>
<td>Zygomaticus</td>
<td>Diagonally from corner of mouth to cheekbone</td>
<td>Zygomatic bone to corner of mouth</td>
<td>Raises corner of mouth</td>
</tr>
</tbody>
</table>

### Muscles of Facial Expression

- **Frontalis**: Flat muscle that covers forehead. Cranial aponeurosis to eyebrows. Raises eyebrows.
- **Orbicularis oculi**: Circular muscle around eye. Maxilla and frontal bones to eyelid. Blinks and closes eye.
- **Orbicularis oris**: Circular muscle of mouth. Mandible and maxilla to skin around mouth. Closes and protrudes lips.
- **Buccinator**: Horizontal cheek muscle. Mandible and maxilla to skin around mouth. Flattens cheek.
- **Zygomaticus**: Diagonally from corner of mouth to cheekbone. Zygomatic bone to corner of mouth. Raises corner of mouth.

### Muscles of Mastication

- **Temporalis**: Fan-shaped muscle over temporal bone. Temporal bone to mandible. Closes jaw.
- **Masseter**: Covers lateral aspect of jaw. Zygomatic arch to mandible. Closes jaw.

### Neck Muscles

- **Sternocleidomastoid**: Striplike muscle of neck. Sternum and clavicle to temporal bone. Flexes neck; rotates head.
- **Trapezius**: Large triangular muscle on posterior neck and shoulder. Occipital bone and spines of thoracic vertebrae to scapula. Extends neck; moves scapula.

### Thoracic Wall Muscles

- **External intercostals**: Short muscles between ribs in the intercostal spaces. Ribs to rib below origin. Inspiration.
- **Internal intercostals**: Short muscles between ribs in the intercostal spaces. Ribs to rib above origin. Forced expiration.
- **Diaphragm**: Dome-shaped muscle between thorax and abdomen. Interior body wall to diaphragm. Inspiration.
### TABLE 19-1
#### Skeletal Muscles—cont’d

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Description</th>
<th>Origin to Insertion</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abdominal Wall Muscles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External oblique</td>
<td>Largest superficial abdominal wall muscle</td>
<td>Last eight ribs to iliac crest</td>
<td>Compresses abdomen</td>
</tr>
<tr>
<td>Internal oblique</td>
<td>Under external oblique</td>
<td>Iliac crest to lower ribs</td>
<td>Compresses abdomen</td>
</tr>
<tr>
<td>Rectus abdominis</td>
<td>Long straight muscle</td>
<td>Pubic bone to sternum and fifth to seventh ribs</td>
<td>Flexes vertebral column</td>
</tr>
<tr>
<td><strong>Shoulder and Arm Muscles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trapezius</td>
<td>Muscle on posterior neck and shoulder</td>
<td>Occipital bone to scapula</td>
<td>Adducts, elevates, and rotates scapula</td>
</tr>
<tr>
<td>Pectoralis major</td>
<td>Fan-shaped muscle that covers anterior chest</td>
<td>Sternum and clavicle to humerus</td>
<td>Adducts and flexes arm</td>
</tr>
<tr>
<td>Latissimus dorsi</td>
<td>Large, flat muscle of lower back region</td>
<td>Vertebral to humerus</td>
<td>Adducts and rotates arm</td>
</tr>
<tr>
<td>Deltoid</td>
<td>Thick muscle that forms contour of shoulder</td>
<td>Clavicle and scapula to humerus</td>
<td>Adducts arm</td>
</tr>
<tr>
<td>Rotator cuff</td>
<td>Four muscles that form cuff over proximal humerus</td>
<td>Scapula to humerus</td>
<td>Rotates arm</td>
</tr>
<tr>
<td>Triceps brachii</td>
<td>Posterior compartment of arm that has three heads of origin</td>
<td>Humerus and scapula to ulna</td>
<td>Extends forearm</td>
</tr>
<tr>
<td>Biceps brachii</td>
<td>Anterior compartment of arm</td>
<td>Scapula to radius</td>
<td>Flexes and supinates forearm</td>
</tr>
<tr>
<td><strong>Lower Extremity Muscles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iliopsoas</td>
<td>Located in groin</td>
<td>Ilium and lower vertebral to femur</td>
<td>Flexes hip</td>
</tr>
<tr>
<td>Gluteus maximus</td>
<td>Largest and most superficial muscle of buttocks</td>
<td>Ilium, sacrum, and coccyx to femur</td>
<td>Extends thigh</td>
</tr>
<tr>
<td>Gluteus minimus</td>
<td>Smallest and deepest of buttock muscles</td>
<td>Ilium to femur</td>
<td>Abducts and rotates thigh</td>
</tr>
<tr>
<td>Adductor muscles</td>
<td>Form muscle mass at medial side of each thigh</td>
<td>Pubis to femur</td>
<td>Adduct thigh</td>
</tr>
<tr>
<td><strong>Knee Joint Muscles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sartorius</td>
<td>Long, straplike muscle that lies oblquely across thigh; longest muscle in body</td>
<td>Ilium to medial tibia</td>
<td>Flexes thigh; rotates leg</td>
</tr>
<tr>
<td>Quadriceps femoris</td>
<td>Group of four muscles that forms fleshy mass of anterior thigh</td>
<td>Femur, except for rectus femoris, which originates on ilium to tibial tuberosity through patellar tendon</td>
<td>Extends knee; rectus femoris also flexes thigh</td>
</tr>
<tr>
<td><strong>Hamstrings:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biceps femoris</td>
<td>Large fleshy muscle mass in posterior thigh; can be felt at back of knee</td>
<td>Ischial tuberosity to proximal tibia</td>
<td>Flexes leg; extends thigh</td>
</tr>
<tr>
<td>Semimembranosus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semitendinosus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ankle and Foot Muscles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tibialis anterior</td>
<td>Superficial muscle of anterior leg</td>
<td>Tibia to first metatarsal</td>
<td>Dorsiflexes foot</td>
</tr>
<tr>
<td>Soleus</td>
<td>Forms curved calf of leg</td>
<td>Tibia and fibula to Achilles tendon by way of calcaneaus</td>
<td>Plantar-flexes foot</td>
</tr>
</tbody>
</table>

FIGURE 19-6  Muscles of the body:  A, anterior view;  B, posterior view.
Muscles of the Abdomen
Muscles of the abdomen control the movement of the abdominal wall and the pelvis. The abdominal muscles also assist in peristalsis, digestion, and elimination. Table 19-1 lists the three major muscles of the abdomen.

Muscles of the Upper Extremities
The muscles of the upper extremities move the shoulder, arm, forearm, wrist, hand, and fingers (see Table 19-1).

Muscles of the Lower Extremities
The lower extremity muscles assist in moving the thigh, knee, leg, ankle, foot, and toes (see Table 19-1).

Patient-Centered Professionalism
Muscle names are not chosen at random. There are many factors associated with naming muscles, including their shape, location, closeness to bones, action, and size.

- Why is it important for the medical assistant to learn about the relationship between the muscle and these factors?

Diseases and Disorders of the Muscular System
Muscle disorders disrupt normal movement of the body. Several types of physicians treat muscle disorders. An orthopedist specializes in bone, joint, and muscle disorders. A rheumatologist diagnoses and treats diseases of the connective tissue and muscles. A physiatrist specializes in rehabilitative medicine, often needed after sports injuries. Muscle injuries (sprains and strains) and inflammatory conditions are some of the most common disorders seen in the medical office. Aging also causes a progressive loss of skeletal muscle and a decrease in strength, therefore making elderly persons more susceptible to falls. Box 19-1 provides information about this age-related muscle loss.

For Your Information
Aging affects the muscular system dramatically. There is a significant reduction in the size and strength of skeletal muscle because muscle fibers decrease in number and are smaller in diameter as we age. Muscle fibers contain less ATP, glycogen reserves, and myoglobin. Blood flow to active muscles decreases because the cardiovascular performance decreases.

Muscle Injuries and Infection
Injuries to the skeletal muscles can result from overuse or trauma. Two common injuries are sprains and strains. People often use the terms interchangeably, but they are actually two different types of injuries. Muscle strains involve overstretching or tearing of muscle fibers. A sprain is an injury involving the stretching or tearing of a ligament or joint. Inflammation can be associated with these types of injuries. Inflammation may respond to treatment quickly, but a tear in the muscle may require several weeks of healing before the muscle repairs itself, often with fibrous tissue and thus forming scars.

- Stress-induced muscle tension can result in myalgia and stiffness in the neck.
- A hernia develops when a visceral organ (e.g., stomach or intestines) bulges (protrudes) through a weakness in the muscular wall (abdominal or inguinal). Surgical repair is required, or blood circulation to the intestines may be impaired, resulting in tissue necrosis (death).
- Torticollis (wryneck) is a condition in which a shortened sternocleidomastoid muscle can cause the head to tilt to the affected side (Figure 19-7). Torticollis may result from a congenital defect, birth canal trauma, a CNS disorder, or an accident.

Tetanus and trichinosis are two muscle diseases caused by organisms that enter the body through open wounds or improperly cooked meat.

- Tetanus ("lockjaw") is caused by the bacterium Clostridium tetani, which enters the body through a
Muscular System

Chapter 19

Figure 19-7  Torticollis. (From Zitelli BJ, Davis HW: Atlas of pediatric physical diagnosis, ed 4, St Louis, 2002, Mosby.)

| TABLE 19-2  
| Muscle Drug Classifications  
<table>
<thead>
<tr>
<th>Drug Classification</th>
<th>Common Generic (Brand) Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analgesics/antiinflammatories</td>
<td>oxycodone ASA (Percodan)</td>
</tr>
<tr>
<td>Treat pain and inflammation</td>
<td>hydrocodone APAP (Vicodin)</td>
</tr>
<tr>
<td></td>
<td>diclofenac sodium (Voltaren)</td>
</tr>
<tr>
<td></td>
<td>etodolac (Lodine)</td>
</tr>
<tr>
<td>Skeletal muscle relaxants</td>
<td>cyclobenzaprine (Flexeril)</td>
</tr>
<tr>
<td>Treat localized spasms from muscle injury</td>
<td>carisoprodol (Soma)</td>
</tr>
<tr>
<td>Anticholinesterase</td>
<td>ambenonium (Mytelase)</td>
</tr>
<tr>
<td>Inhibits release of cholinesterase, allowing acetylcholine to accumulate; this increases muscle strength and function</td>
<td>neostigmine (Prostigmin)</td>
</tr>
</tbody>
</table>

Figure 19-7  Torticollis. (From Zitelli BJ, Davis HW: Atlas of pediatric physical diagnosis, ed 4, St Louis, 2002, Mosby.)

Deep, open wound. The organisms release a toxin that causes stiffness and rigidity of the muscles, especially in the jaw.

- *Trichinosis* is caused by a parasite found in uncooked meat, especially pork. The parasite enters the digestive tract and deposits larvae into the muscle tissue.

Drugs may be prescribed to treat muscle problems (Table 19-2). Medical assistants need to be able to recognize the common signs and symptoms of and the diagnostic tests for the different types of muscle system disease.

- Study Box 19-2 to familiarize yourself with the common signs and symptoms.
- Study Box 19-3 to learn about common diagnostic tests.
- Study Table 19-3 to understand the two major diseases that affect the muscular system.

Patient-Centered Professionalism

- Why is it important for the medical assistant to understand the pathophysiology, signs and symptoms, diagnostic tests, and treatments for disorders of the muscular system?

Conclusion

The muscular system is crucial to maintaining our movement, posture, and body heat. However, it does not function alone. Muscles provide movement, but they work together to achieve coordinated movement only when the bones, joints, and nerves interact with the muscles. Muscles react to a stimulus by pulling toward it, away from it, rotating, and so on. Muscles are best studied by grouping them according to their specific function or location, by understanding how they are named, and by considering their type. As with the other body systems, a good understanding of the muscular system can help medical assistants perform more competently and communicate more clearly, resulting in more effective care for patients.

Box 19-2  

Common Signs and Symptoms of Muscle Disease

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibromyositis</td>
<td>Muscle and tendon inflammation</td>
</tr>
<tr>
<td>Contusion</td>
<td>Bruise resulting from internal bleeding and inflammation</td>
</tr>
<tr>
<td>Cramps</td>
<td>Painful muscle spasms (involuntary muscle twitches) or contractions</td>
</tr>
<tr>
<td>Myalgia</td>
<td>Muscle pain</td>
</tr>
<tr>
<td>Myositis</td>
<td>Muscle inflammation</td>
</tr>
<tr>
<td>Strain</td>
<td>Overstretching or tearing of a muscle</td>
</tr>
<tr>
<td>General complaints</td>
<td>Pain or tenderness, fatigue, malaise, muscle weakness, and fever</td>
</tr>
</tbody>
</table>

Box 19-3  

Diagnostic Tests and Procedures for the Muscles

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electromyography (EMG)</td>
<td>EMG records strength of muscle contraction resulting from electrical stimulation to muscle</td>
</tr>
<tr>
<td>Magnetic resonance imaging (MRI)</td>
<td>Magnetic properties of MRI used to record detailed information about internal structures</td>
</tr>
<tr>
<td>Muscle biopsy</td>
<td>Removal of muscle tissue for microscopic examination</td>
</tr>
</tbody>
</table>
### Table 19-3

**Diseases and Disorders of the Muscular System**

<table>
<thead>
<tr>
<th>Disease and Description</th>
<th>Etiology</th>
<th>Signs and Symptoms</th>
<th>Diagnosis</th>
<th>Therapy</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myasthenia gravis</strong></td>
<td>Autoimmune disease affecting normal transmission of nerve impulses</td>
<td>Muscle weakness, usually starting with facial muscles and eye</td>
<td>Clinical symptoms, especially ptosis of eyelids; blood tests, chest x-rays, EMG; injection of anticholinesterase (improves muscle strength temporarily)</td>
<td>Symptomatic and supportive; thyroectomy if tumor is involved; drug therapy: corticosteroids, pyridostigmine (Mestinon)</td>
<td>Encourage patient to rest and follow drug therapy as prescribed by physician</td>
</tr>
<tr>
<td><strong>Fibromyalgia</strong></td>
<td>Unknown</td>
<td>Patient complains of dull, aching muscle pain throughout the body, especially in neck and shoulder area; other complaints include stiffness, fatigue, depression, and disturbed sleep</td>
<td>Patient history; on examination, physician will apply moderate amount of pressure in specific areas (tender points)</td>
<td>Patient education; low-impact exercise (e.g., walking, swimming), NSAIDs, sometimes antidepressants</td>
<td>Provide emotional support</td>
</tr>
<tr>
<td><strong>Muscular dystrophy</strong></td>
<td>Unknown</td>
<td>Loss of muscle strength without neuronal involvement leading to progressive deformity</td>
<td>Elevations of muscle enzymes in the blood (CPK or CPK MM), but definitively by muscle biopsy</td>
<td>Supportive measures such as physical therapy and orthopedic procedures to minimize the deformity</td>
<td>Genetic counseling</td>
</tr>
</tbody>
</table>

*CPK, Creatine phosphokinase; EMG, electromyography; NSAIDs, nonsteroidal antiinflammatories.*

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**Chapter Summary**

Reinforce your understanding of the material in this chapter by reviewing the curriculum objectives and key content points below.

1. Define, appropriately use, and spell all the Key Terms for this chapter.
   - Review the Key Terms if necessary.
2. State the three functions of muscle and explain the importance of each.
   - Muscles enable movement, both voluntary and involuntary, and they provide support for bones and organs.
   - Muscles create body heat to maintain internal temperature.
   - Muscles help other body systems function (e.g., digestive muscles, respiratory muscles).
3. Explain the basic structure of muscle.
   - Muscle tissue consists of bundles of long muscle fibers.
   - Connective tissue holds the fibers in the bundles.
   - A fibrous sheath covers, supports, and separates muscles.
4. Describe the structure and function of tendons.
   - Tendons are strong, white cordlike structures made up of collagenous fibers.
   - Tendons connect muscle to bone.
5. Explain how a muscle contracts.
   - Nerve impulses stimulate muscles to make them contract.
   - Muscles can only pull; they cannot push.
   - Effective muscle movements are smooth and can be sustained.
6. Identify and define the two types of muscle.
   - Muscles can be voluntary or involuntary.
   - Voluntary muscles are consciously moved.
   - Involuntary muscles move on their own to support their various body systems (e.g., heart, breathing).
7. Briefly describe the three types of muscle tissue.
   - Involuntary muscles are either smooth (nonstriated) or cardiac and make up organs or cardiac muscle, which appears striated and works as one unit in the heart.
   - Voluntary muscles are made up of skeletal muscle tissue and allow for lifting, moving, and bending. Voluntary muscles move the skeleton and the face.

8. List four characteristics of muscle tissue.
   - Muscle tissue is contractible, extensible, elastic, and “irritable” to varying degrees.

9. List seven ways muscles can be named.
   - Muscles can be named for their origin and insertion, location, size, shape, fiber direction, attachment points, and type of action.

10. Locate and identify the main skeletal muscles of the body.
    - Review Figure 19-6 and Table 19-1.

11. List seven common signs and symptoms of muscular system disorders.
    - Review Box 19-2.

12. List two common diagnostic tests for muscular disease and describe the use of each.
    - Electromyography (EMG) is a procedure that records the electrical activity of the muscles.
    - Magnetic resonance imaging (MRI) uses magnetic properties to record detailed information about internal structures and soft tissue.
    - Review Box 19-3.

13. State the two most common muscular disorders seen in the physician’s office.
    - Myalgia and some form of muscle strain or sprain brought on by stress, trauma, or overexertion are most often seen.

14. List two muscular diseases and briefly describe the etiology, signs and symptoms, diagnosis, therapy, and interventions for each.
    - Review Table 19-3.

15. Analyze a realistic medical office situation and apply your understanding of the muscular system to determine the best course of action.
    - A medical assistant’s understanding of the muscular system can be helpful when the assistant is working with patients who have injured muscles.

16. Describe the impact on patient care when medical assistants have a solid understanding of the structure and function of the muscular system.
    - Knowing how the muscles interact with each other and work in pairs helps medical assistants understand how they help to move the body and how injuries can occur.
    - A good understanding of the muscular system also reinforces for medical assistants the importance of following the prescribed treatment plan.

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**Practical Applications**

If you have accomplished the objectives in this chapter, you will be able to make better choices as a medical assistant. Take another look at this situation and decide what you would do.

Tommy, age 18, has been playing sports since childhood. He has used weights to increase and strengthen the muscles of his body. Tommy has often wondered just how the muscles of his body work to make him move and what happens when one muscle contracts. He knows that some muscles are involuntary and some are voluntary.

Two days ago Tommy was skiing when he fell and twisted his left ankle. The emergency room physician told him that he had strained and sprained his ankle. In explanation, the physician also said that the extensors in the ankle had the greatest injury and that the contusion was going to become worse if Tommy did not keep ice on the ankle overnight. Because of the severity of the injury, Tommy was to see an orthopedist the next morning. The orthopedist has ordered antiinflammatories and muscle relaxants.

Tommy now has some new questions for the medical assistant about muscles, what the antiinflammatories will do, and what this might have done to his muscles had he been older.

Would you be able to answer Tommy’s questions?

1. How do muscles work to make the body move?
2. How do you define “synergistic muscles”?
3. How do you define “antagonistic muscles”?
4. What do voluntary muscles do in the body?
5. Define involuntary muscles.
6. What is the difference between a sprain and a strain?
7. What are the signs of a sprain?
8. Why would antiinflammatories and muscle relaxants be ordered?
9. If Tommy were older, what would the physician expect the aging process to have done to Tommy’s skeletal muscles?
10. What are isotonic and isometric movements?
WEB SEARCH

1. Research treatments available for the neuromuscular disease amyotrophic lateral sclerosis (ALS). Progressive muscular atrophy occurs when nerve impulses are not generated.

   • Keywords: Use the following keywords in your search: Charcot syndrome, Lou Gehrig disease, ALS.

WORD PARTS: Muscular System

<table>
<thead>
<tr>
<th>Combining Forms</th>
<th>Abbreviations: Muscular System</th>
</tr>
</thead>
<tbody>
<tr>
<td>fasci/o</td>
<td>fascia</td>
</tr>
<tr>
<td>kines, kinesi/o</td>
<td>movement</td>
</tr>
<tr>
<td>muscul/o</td>
<td>muscle</td>
</tr>
<tr>
<td>my/o</td>
<td>muscle</td>
</tr>
<tr>
<td>ten/o, tendin/o</td>
<td>tendon</td>
</tr>
<tr>
<td>ton/o</td>
<td>tone</td>
</tr>
</tbody>
</table>

Suffixes

-asthenia        | weakness                     |
-trophy          | nutrition                    |

ABBREVIATIONS: Muscular System

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALS</td>
<td>amyotrophic lateral sclerosis</td>
</tr>
<tr>
<td>DTR</td>
<td>deep tendon reflex</td>
</tr>
<tr>
<td>EMG</td>
<td>electromyography</td>
</tr>
<tr>
<td>lig</td>
<td>ligament</td>
</tr>
<tr>
<td>NSAID</td>
<td>nonsteroidal antiinflammatory drug</td>
</tr>
<tr>
<td>OT</td>
<td>occupational therapy</td>
</tr>
<tr>
<td>PT</td>
<td>physical therapy</td>
</tr>
</tbody>
</table>