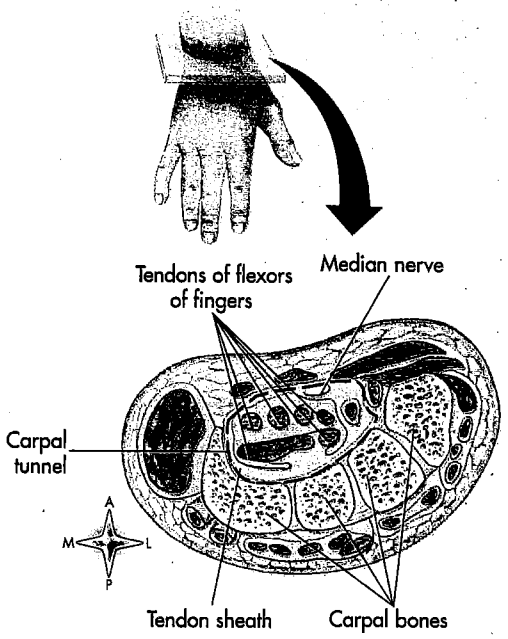
CLINICAL APPLICATION

Carpal Tunnel Syndrome

Some physicians specialize in the field of occupational health, the study of health matters related to work or the workplace. Many problems seen by occupational health experts are caused by repetitive motions of the wrists or other joints. Word processors (typists) and meat cutters, for example, are at risk of developing conditions caused by repetitive motion injuries.

One common problem often caused by such repetitive motion is **tenosynovitis** (ten-o-sin-o-VYE-tis)—inflammation of the tendon sheath. Tenosynovitis can be painful, and the swelling characteristic of this condition can limit movement in affected parts of the body. For example, swelling of the tendon sheath around tendons in an area of the wrist known as the *carpal tunnel* can limit movement of the wrist, hand, and fingers. The figure shows the relative positions of the tendon sheath and medial nerve within the carpal tunnel. If this swelling, or any other lesion in the carpal tunnel, presses on the *median nerve*, a condition called **carpal tunnel syndrome** may result. Because the median nerve connects to the palm and radial side (thumb side) of the hand, carpal tunnel syndrome is characterized by weakness, pain, and tingling in this part of the hand. The pain and tingling may also radiate to the forearm and shoulder. Prolonged and severe cases of carpal tunnel syndrome may be relieved by injection of antiinflammatory agents. A permanent cure is sometimes accomplished by surgical cutting or removal of the swollen tissue pressing on the median nerve.



SKELETAL MUSCLE GROUPS

In the paragraphs that follow, representative muscles from the most important skeletal muscle groups will be discussed. Refer to Figure 6-6 often so that you will be able to see a muscle as you read about its placement on the body and its function. Table 6-1 identifies and groups muscles according to function and provides information about muscle action and points of origin and insertion. Keep in mind that muscles move bones, and the bones that they move are their insertion bones.

Muscles of the Head and Neck

The **muscles of facial expression** (Figure 6-7) allow us to communicate many different emotions nonverbally. Contraction of the **frontal** muscle, for example, allows you to raise your eyebrows in surprise and furrow the skin of your forehead into a frown. The **orbicularis** (or-bik-yoo-LAR-is) **oris** (OR-iss), called the *kissing muscle*, puckers the lips. The **zygomaticus** (zye-go-MAT-ik-us) elevates the corners of the mouth and lips and has been called the *smiling muscle*.

The **muscles of mastication** are responsible for closing the mouth and producing chewing move-

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FIGURE 6-6

General overview of the body musculature. A, Anterior view.

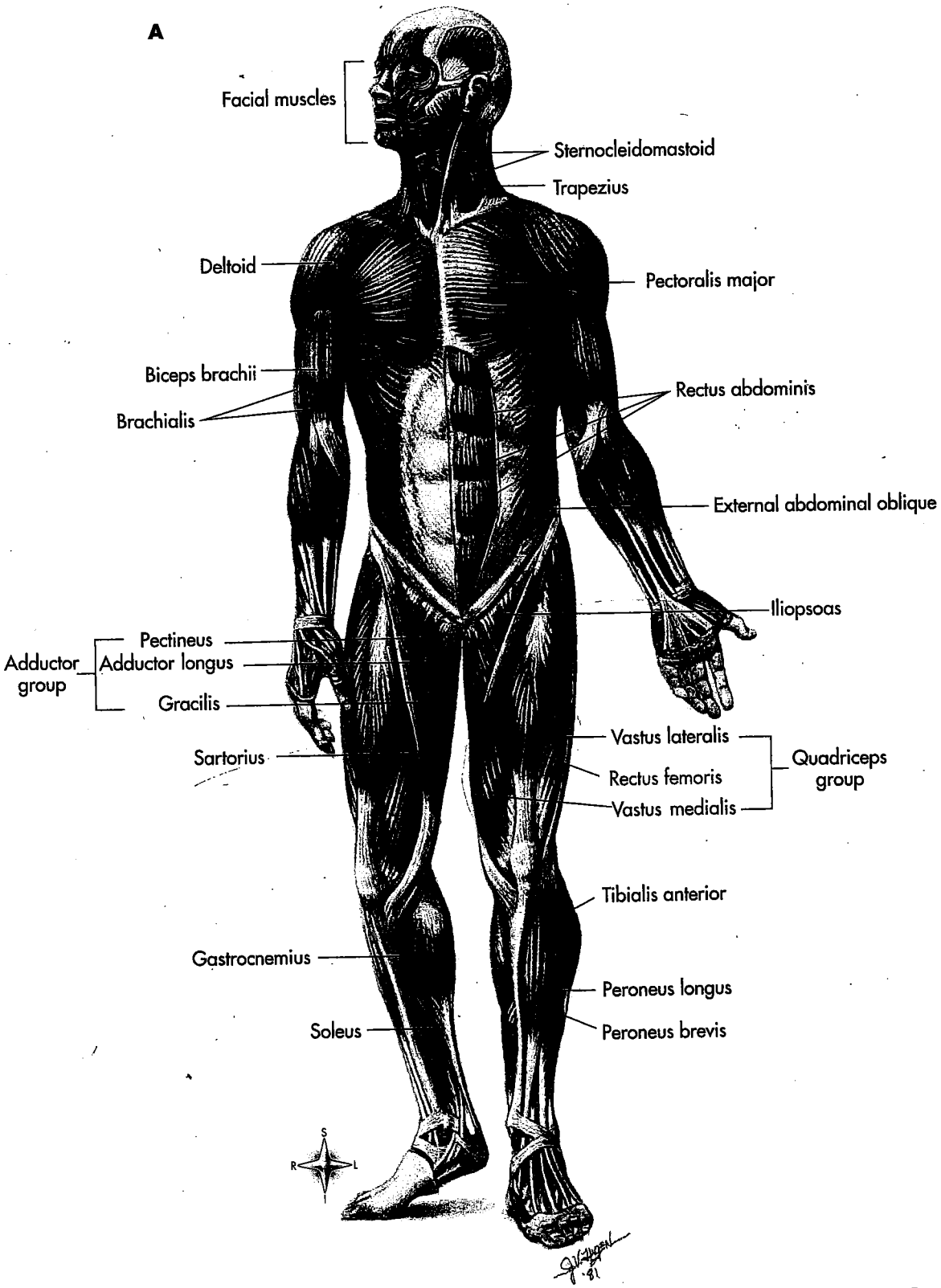

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FIGURE 6-6—CONT'D

B, Posterior view.

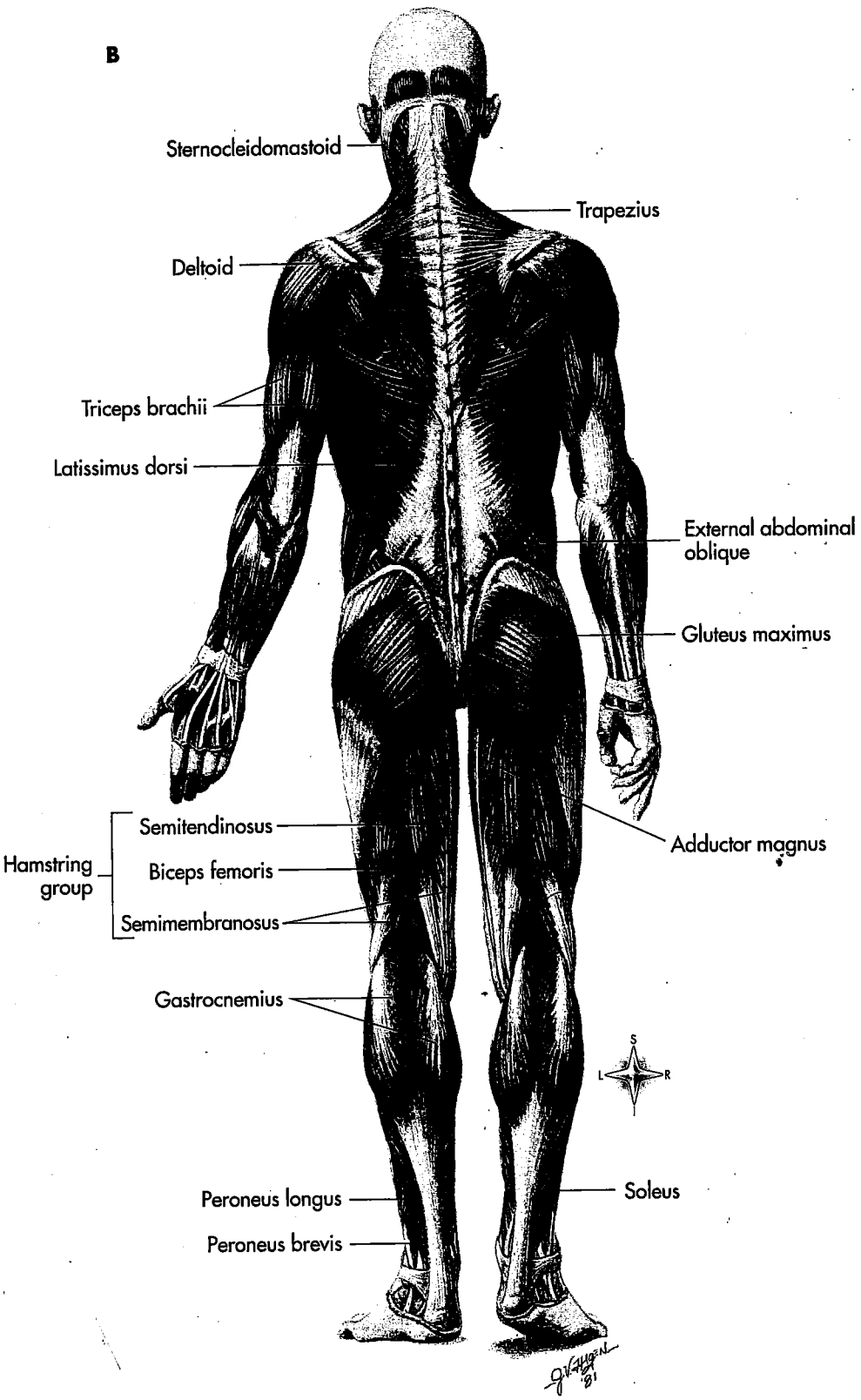


TABLE 6-1

Principal Muscles of the Body

MUSCLE	FUNCTION	INSERTION	ORIGIN
MUSCLES OF THE HEAD AND NECK			
Frontal	Raises eyebrow	Skin of eyebrow	Occipital bone
Orbicularis oculi	Closes eye	Maxilla and frontal bone	Maxilla and frontal bone (encircles eye)
Orbicularis oris	Draws lips together	Encircles lips	Encircles lips
Zygomaticus	Elevates corners of mouth and lips	Angle of mouth and upper lip	Zygomatic
Masseter	Closes jaw	Mandible	Zygomatic arch
Temporal	Closes jaw	Mandible	Temporal region of the skull
Sternocleidomastoid	Rotates and flexes head and neck	Mastoid process	Sternum and clavicle
Trapezius	Extends head and neck	Scapula	Skull and upper vertebrae
MUSCLES THAT MOVE THE UPPER EXTREMITIES			
Pectoralis major	Flexes and helps adduct upper arms	Humerus	Sternum, clavicle, and upper rib cartilages
Latissimus dorsi	Extends and helps adduct upper arm	Humerus	Vertebrae and ilium
Deltoid	Abducts upper arm	Humerus	Clavicle and scapula
Biceps brachii	Flexes elbow	Radius	Scapula
Triceps brachii	Extends elbow	Ulna	Scapula and humerus
MUSCLES OF THE TRUNK			
External oblique	Compresses abdomen	Midline of abdomen	Lower thoracic cage
Internal oblique	Compresses abdomen	Midline of abdomen	Pelvis
Transversus abdominis	Compresses abdomen	Midline of abdomen	Ribs, vertebrae, and pelvis
Rectus abdominis	Flexes trunk	Lower rib cage	Pubis
MUSCLES THAT MOVE THE LOWER EXTREMITIES			
Iliopsoas	Flexes thigh or trunk	Femur	Ilium and vertebrae
Sartorius	Flexes thigh and rotates lower leg	Tibia	Ilium
Gluteus maximus	Extends thigh	Femur	Ilium, sacrum, coccyx
Adductor Group			
Adductor longus	Adducts thigh	Femur	Pubis
Gracilis	Adducts thigh	Tibia	Pubis
Pectineus	Adducts thigh	Femur	Pubis

Continued

TABLE 6-1—CONT'D

Principal Muscles of the Body—cont'd

MUSCLE	FUNCTION	INSERTION	ORIGIN
MUSCLES THAT MOVE THE LOWER EXTREMITIES—cont'd			
Hamstring Group			
Semimembranosus	Flexes knee	Tibia	Ischium
Semitendinosus	Flexes knee	Tibia	Ischium
Biceps femoris	Flexes knee	Fibula	Ischium and femur
Quadriceps Group			
Rectus femoris	Extends knee	Tibia	Ilium
Vastus lateralis, intermedius, and medialis	Extend knee	Tibia	Femur
Tibialis anterior	Dorsiflexes ankle	Metatarsals (foot)	Tibia
Gastrocnemius	Plantar flexes ankle	Calcaneus (heel)	Femur
Soleus	Plantar flexes ankle	Calcaneus (heel)	Tibia and fibula
Peroneus Group			
Peroneus longus and brevis	Plantar flex ankle	Tarsal and metatarsals (ankle and foot)	Tibia and fibula

RESEARCH, ISSUES, & TRENDS

Enhancing Muscle Strength

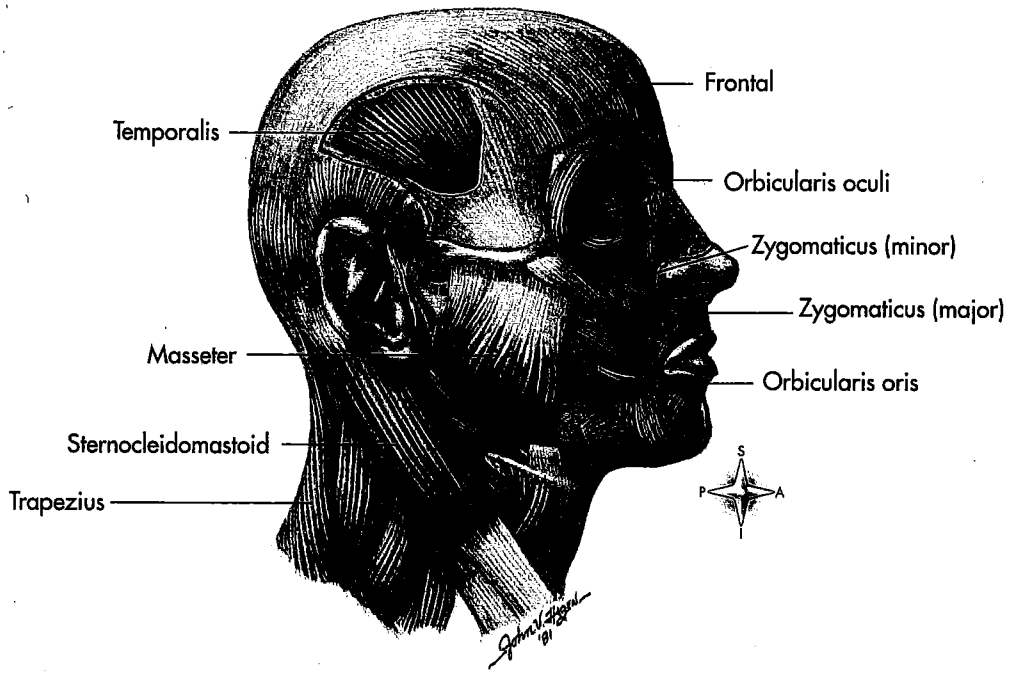
The most obvious and effective way of increasing skeletal muscle strength is by strength training; that is, regularly pulling against heavy resistance. The maximal amount of muscular strength one can achieve is determined mainly by genetics. However, there are a number of chemical enhancements athletes have tried over the centuries to improve strength. An early fad among athletes in the twentieth century was the overuse of vitamin supplements. While moderate vitamin supplementation will ensure adequate intake of vitamins necessary for good muscle function, overuse may lead to *hypervitaminosis* and possibly serious consequences.

Another type of chemical often abused by athletes is *anabolic steroids*. Anabolic steroids are usually synthetic derivatives of the male hormone testosterone. Like testosterone, they do in fact stimulate an increase in muscle size and strength, making them attractive to coaches and athletes wanting to win their events. However, prolonged use of these hormones can cause serious, even life-threatening, hormonal imbalances. For this reason, anabolic steroids are banned from most organized sports.

Sports physiologists are now investigating a whole variety of chemicals that are reported to enhance strength or endurance. Always carefully review the latest research findings on these substances with the help of your reference librarian before using them yourself, or you may suffer serious health consequences.

FIGURE 6-7

Muscles of the head and neck. Muscles that produce most facial expressions surround the eyes, nose, and mouth. Large muscles of mastication stretch from the upper skull to the lower jaw. These powerful muscles produce chewing movements. The neck muscles connect the skull to the trunk of the body, rotating the head or bending the neck.



ments. As a group, they are among the strongest muscles in the body. The two largest muscles of the group, identified in Figure 6-7, are the **masseter** (mas-SEE-ter), which elevates the mandible, and the **temporal** (TEM-po-ral), which assists the masseter in closing the jaw.

The **sternocleidomastoid** (stern-o-kli-doe-MAS-toyd) and **trapezius** (tra-PEE-zee-us) muscles are easily identified in Figures 6-6 and 6-7. The two sternocleidomastoid muscles are located on the anterior surface of the neck. They originate on the sternum and then pass up and cross the neck to insert on the mastoid process of the skull. Working together, they flex the head on the chest. If only one contracts, the head is both flexed and tilted to the opposite side. The triangular-shaped trapezius muscles form the line from each shoulder to the neck on its posterior surface. They have a wide line of origin extending from the base of the skull down the spinal column to the last thoracic vertebra. When contracted, the trapezius muscles help elevate the shoulders and extend the head backwards.

Muscles that Move the Upper Extremities

The upper extremity is attached to the thorax by the fan-shaped **pectoralis** (pek-tor-RAL-is) **major** muscle, which covers the upper chest, and by the **latissimus** (la-TIS-i-mus) **dorsi** muscle, which takes its origin from structures over the lower back (Figures 6-6 and 6-8). Both muscles insert on the humerus. The pectoralis major is a flexor, and the latissimus dorsi is an extensor of the upper arm.

The deltoid muscle forms the thick, rounded prominence over the shoulder and upper arm (see

FIGURE 6-8

Muscles of the trunk. A, Anterior view showing superficial muscles. **B,** Anterior view showing deeper muscles.

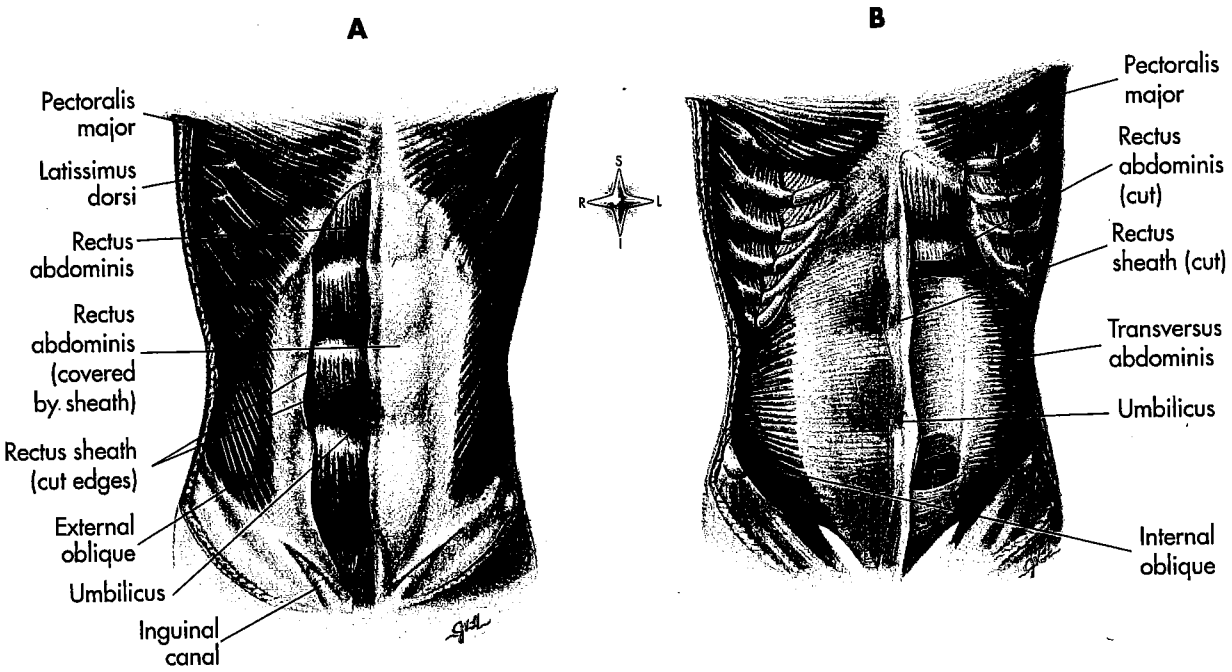


Figure 6-6). The muscle takes its origin from the scapula and clavicle and inserts on the humerus. It is a powerful abductor of the upper arm.

As the name implies, the biceps brachii (BRAY-kee-eye) is a two-headed muscle that serves as a primary flexor of the forearm (see Figure 6-6). It originates from the bones of the shoulder girdle and inserts on the radius in the forearm.

The **triceps brachii** is on the posterior or back surface of the upper arm. It has three heads of origin from the shoulder girdle and inserts into the olecranon process of the ulna. The triceps is an extensor of the elbow and thus performs a straightening function. Because this muscle is responsible for delivering blows during fights, it is often called the *boxer's muscle.*

Muscles of the Trunk

The muscles of the anterior or front side of the abdomen are arranged in three layers, with the fibers in each layer running in different directions much like the layers of wood in a sheet of plywood (see Figure 6-8). The result is a very strong "girdle" of muscle that covers and supports the abdominal cavity and its internal organs.

The three layers of muscle in the anterolateral (side) abdominal walls are arranged as follows: the outermost layer or **external oblique;** a middle layer or **internal oblique;** and the innermost layer or **transversus abdominis.** In addition to these sheetlike muscles, the band- or strap-shaped **rectus abdominis** muscle runs down the midline of the abdomen from the thorax to the pubis. The rectus abdominis and external oblique muscles can be seen in Figure 6-8. In addition to protecting the abdominal viscera, the rectus abdominis flexes the spinal column.

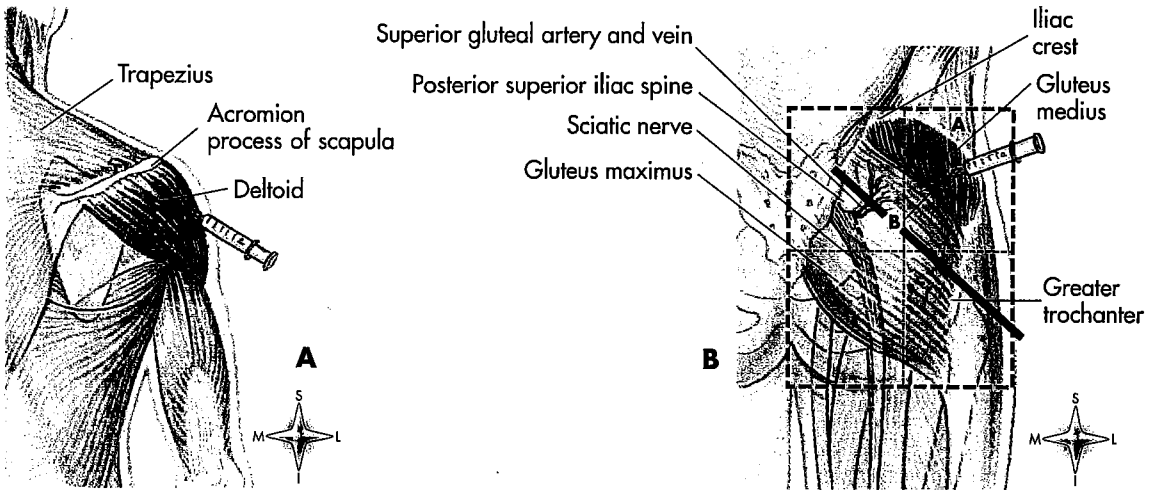
The *respiratory muscles* will be discussed in Chapter 13. **Intercostal muscles,** located between the ribs, and the sheetlike **diaphragm** separating the thoracic and abdominal cavities change the size and shape of the chest during breathing. As a result, air is moved into or out of the lungs.

CLINICAL APPLICATION

Intramuscular Injections

Many drugs are administered by intramuscular injection. If the amount to be injected is 2 ml or less, the deltoid muscle is often selected as the site of injection. Note in Figure A that the needle is inserted into the muscle about two-fingers' breadth below the acromion process of the scapula and lateral to the tip of the acromion. If the amount of medication to be injected is 2 to 3 ml, the gluteal area shown in Figure B is often used. Injections are made into the gluteus medius muscle near the center of the upper outer quadrant, as shown in the illustration. Another technique of locating the proper injection site is to draw an imaginary diagonal line from a point of reference on the back of the bony pelvis (posterior superior iliac spine) to the greater trochanter of the femur. The injection is given about three-fingers' breadth above and one third of the way down the line. It is important that the sciatic nerve and the superior gluteal blood vessels be avoided during the injection. Proper technique requires a knowledge of the underlying anatomy.

In addition to intramuscular injections, which are generally administered by a health care provider in an institutional setting, many individuals must self-administer injections of needed medications, such as insulin, on a regular basis in their homes. Educating these patients or their caregivers on how to correctly administer medication by injection is an important issue in the delivery of home health care services. Topics that must be covered include instruction on proper injection techniques, selection of needle length and gauge, identification of important anatomic landmarks in making injection site selections, and the preparation and rotation of selected injection sites.



Muscles That Move the Lower Extremities

The **iliopsoas** (il-ee-o-SO-us) originates from deep within the pelvis and the lower vertebrae to insert on the lesser trochanter of the femur and capsule of the hip joint. It is generally classified as a flexor of the thigh and an important postural muscle that stabilizes and keeps the trunk from falling over backward when you stand. However, if the thigh is fixed so that it cannot move, the iliopsoas flexes the *trunk*. An example would be doing sit-ups.

The **gluteus** (GLOO-tee-us) **maximus** (MAX-i-mus) forms the outer contour and much of the substance of the buttock. It is an important extensor of the thigh (see Figure 6-6) and supports the torso in the erect position.

The **adductor muscles** originate on the bony pelvis and insert on the femur. They are located on the inner or medial side of the thighs. These muscles adduct or press the thighs together.

The three **hamstring muscles** are called the *semimembranosus, semitendinosus,* and *biceps femoris.* Acting together, they serve as powerful flexors of the lower leg (see Figure 6-6). They originate on the ischium and insert on the tibia or fibula.

The **quadriceps** (KWOD-re-seps) **femoris** muscle group covers the upper thigh. The four thigh muscles—the *rectus femoris* and three *vastus* muscles—extend the lower leg (see Figure 6-6 and Table 6-1). One component of the quadriceps group has its origin on the pelvis, and the remaining three originate on the femur; all four insert on the tibia. Only two of the vastus muscles are visible in Figure 6-6. The vastus intermedius is covered by the rectus femoris and is not visible.

The **tibialis** (tib-ee-AL-is) **anterior** muscle (see Figure 6-6) is located on the anterior or front surface of the leg. It dorsiflexes the foot. The **gastrocnemius** (gas-trok-NEE-mee-us) is the primary calf muscle. Note in Figure 6-6 that it has two fleshy components arising from both sides of the femur. It inserts through the Achilles tendon into the heel bone or calcaneus. The gastrocnemius is responsible for plantar flexion of the foot; because it is used to stand on tiptoe, it is sometimes called the toe dancer's muscle. A group of three muscles called the **peroneus** (pair-o-NEE-us) **group** (see Figure 6-6) is found along the sides of the lower leg. As a group, these muscles plantar flex the foot. A long tendon from one component of the group—the *peroneus longus* muscle tendon—forms a support arch for the foot (see Figure 5-17).

Movements Produced by Skeletal Muscle Contractions

The types of movement that may produce a muscle contraction at any joint depend largely on the shapes of the bones involved and the joint type (see Chapter 5). Muscles acting on some joints produce movement in several directions, whereas only limited movement is possible at other joints. The terms most often used to describe body movements are as follows:

1. Flexion
2. Extension
3. Abduction
4. Adduction
5. Rotation
6. Supination and pronation
7. Dorsiflexion and plantar flexion

Flexion is a movement that makes the angle between two bones at their joint smaller than it was at the beginning of the movement. Most flexions are movements commonly described as bending. If you bend your elbow or your knee, you flex it. **Extension** movements are the opposite of flexions. They make the angle between two bones at their joint larger than it was at the beginning of the movement. Therefore, extensions are straightening or stretching movements rather than bending movements. Figures 6-9 and 6-10 illustrate flexion and extension of the elbow and knee.

Abduction means moving a part away from the midline of the body, such as moving your arm out to the side. **Adduction** means moving a part toward the midline, such as bringing your arms down to your sides from an elevated position. Figure 6-11, *A,* shows abduction and adduction.

Rotation is movement around a longitudinal axis. You rotate your head and neck by moving your skull from side to side as in shaking your head "no" (Figure 6-11, *B*).

Supination and **pronation** refer to hand positions that result from rotation of the forearm. (The term *prone* refers to the body as a whole lying face down. *Supine* means lying face up.) Supination results in a hand position with the palm turned to the anterior position (as in the anatomical position), and pronation occurs when you turn the palm of your hand so that it faces posteriorly (Figure 6-11, *C*).

Dorsiflexion and **plantar flexion** refer to ankle movements. In dorsiflexion the dorsum or top of the foot is elevated with the toes pointing upward. In plantar flexion the bottom of the foot is directed