unit TWELVE

UNDERSTANDING THE MUSCULOSKELETAL SYSTEM

45 Musculoskeletal Function and Assessment

RODNEY B. KEBICZ AND
JANICE L. BRADFORD

KEY TERMS

arthroscopy (ar-THROSS-scop-ee)
arthrocentesis (AR-throw-sen-tee-sis)
articular (ar-TIK-yoo-lar)
bone (BOWN)
bursae (BURR-sah)
crepitation (crep-i-TAY-shun)
hemarthrosis (heem-ar-THROW-sis)
joint (JOYNT)
muscle (MUSS-uhl)
synovitis (sin-oh-VIGH-tis)
vertebrae (VER-te-bray)

QUESTIONS TO GUIDE YOUR READING

1. What is the normal structure and function of the musculoskeletal system?
2. What areas are included in a nursing assessment of the musculoskeletal system?
3. What areas are reviewed when performing a neurovascular assessment?
4. How would you describe diagnostic tests for musculoskeletal problems?
5. What nursing care would you provide for each musculoskeletal diagnostic test?

REVIEW OF NORMAL ANATOMY AND PHYSIOLOGY

The skeletal and muscular systems may be considered one system because they work together to enable the body to move. The skeleton is the framework that supports the body and to which the voluntary **muscles** are attached. The skeletal framework includes the **joints,** or articulations, between **bones.** Contraction of a muscle pulls a bone and changes the angle of a joint. It is important to remember that movement would not be possible without the proper functioning of the nervous, cardiovascular, and respiratory systems. Voluntary muscles require nerve impulses to contract, a continuous supply of blood provided by the circulatory system, and oxygen provided by the respiratory system.

SKELETAL SYSTEM TISSUES AND THEIR FUNCTIONS

The tissues that make up the skeletal system are bone tissue; cartilage, which covers most joint surfaces; and fibrous connective tissue, which forms the ligaments that connect one bone to another and also form part of the structure of joints. The tissues of the muscular system are skeletal (also called striated or voluntary) muscle; fibrous connective tissue, which forms the tendons that connect muscle to bone; and the fasciae, the strong membranes that enclose individual muscles. Smooth muscle (also called involuntary or nonstriated) has the same function as skeletal muscle (i.e., contraction) but is not considered part of the skeletal system tissues as it is not involved with articulation or skeletal movement.

Besides its role in movement, the skeleton has other functions. It protects organs and tissues from mechanical injury. For example, the brain is protected by the skull and the heart and lungs are protected by the rib cage. Flat and irregular bones contain and protect the red bone marrow, the hematopoietic (blood-forming) tissue. The bones are also a storage site for excess calcium, which may be removed from bones to maintain a normal blood calcium level. Calcium in the blood is necessary for blood clotting and for the proper functioning of nerves and muscles.

Although the primary function of the muscular system is to move or stabilize the skeleton, the voluntary muscles collectively contribute significantly to heat production, which maintains normal body temperature. Heat is one of the energy products of cellular respiration, the process that produces adenosine triphosphate (ATP), the direct energy source for muscle contraction. Another important function of the muscular system is that it aids in returning blood from the legs through muscular compression on the leg veins.

Bone Tissue and Growth of Bone

Bone tissue is composed of bone cells, called osteocytes, within a strong nonliving matrix made of calcium salts and the protein collagen. In compact bone, the osteocytes and matrix are in precise arrangements called osteons (or haversian systems). Compact bone is very dense and to the unaided eye appears solid. In spongy bone, the arrangement of cells and matrix is less precise, giving the bone a spongy appearance. Compact bone forms the diaphyses (shafts) of the long bones of the extremities and covers the spongy bone that forms the bulk of short, flat, and irregular bones.

A living bone is covered by a fibrous connective tissue membrane called the periosteum, which is the anchor for tendons and ligaments because the collagen fibers of all these structures merge to form connections of great strength. This membrane also contains the blood vessels that enter the bone itself (most of the bone has a very good blood supply) and bone-producing cells called osteoblasts that are activated to initiate repair when bone is damaged.

The growth of bone from fetal life until a person attains final adult height depends on many factors. Proper nutrition (particularly vitamins and minerals) provides the raw material to produce bone matrix: comprised of calcium, phosphorous, and protein. Vitamin D is essential for the efficient absorption of calcium and phosphorus from food in the small intestine. Vitamins A and C do not become part of bone but are needed for the production of bone matrix (a process called calcification or ossification). Hormones directly necessary for growth include growth hormone (GH) from the anterior pituitary gland, thyroxine from the thyroid gland, and insulin from the pancreas. Growth hormone increases mitosis and protein synthesis in growing bones; thyroxine stimulates osteoblasts, as well as increasing energy production from food. Insulin is essential for the efficient use of glucose to provide energy. If a child is lacking any of these hormones, growth is much slower and the child does not reach his or her genetic potential for height.

Bone is not a fixed tissue, even when growth in height has ceased. There is a constant removal and replacement of calcium and phosphate (usually the rates are equal) to maintain normal blood levels of these minerals. Parathyroid hormone secreted by the parathyroid glands increases the removal of calcium and phosphate from bones; the hormone calcitonin from the thyroid gland promotes the retention of calcium in bones, although its greatest effects may be during childhood.

Osteoblasts produce bone matrix during normal growth to replace matrix lost during normal turnover and to repair fractures. Other cells called osteoclasts reabsorb bone matrix when more calcium is needed in the blood and during normal growth and fracture repair when excess bone must be removed as bones change shape.

The sex hormones, estrogen from the ovaries or testosterone from the testes, are important for the retention of calcium in adult bones. For women after menopause, more calcium may be removed from bones than is replaced, leading to a thinning of bone tissue and the possibility of spontaneous fractures.

Structure of the Skeleton

The 206 bones of the human skeleton are in two divisions: the axial skeleton and the appendicular skeleton. The axial

skeleton consists of the skull, hyoid, vertebral column, and rib cage; all are flat or irregular bones and contain red bone marrow (hematopoietic tissue). The appendicular skeleton consists of the bones of the arms and legs and the shoulder and pelvic girdles, by which the extremities attach to the axial skeleton (Fig. 45.1).

The long bones of the limbs are those of the arm, forearm, hand, and fingers and those of the thigh, leg, foot, and toes. All long bones have the same general structure: a central diaphysis, or shaft, with two ends called epiphyses. The diaphyses of long bones contain yellow bone marrow, which is mostly adipose—that is, stored energy. The bones of the wrist and ankle are short bones (except for the calcaneus, which is an irregular bone). The scapula is considered a flat bone, and the pelvic girdle is made of irregular bones. These bones contain red bone marrow.

Skull

The skull consists of 8 cranial bones and 14 facial bones and also contains the 3 auditory bones found in each middle ear cavity. The cranial bones that enclose and protect the brain are frontal, two parietal, two temporal, occipital, sphenoid, and ethmoid (Fig. 45.2). All the joints between cranial bones and those between most of the facial bones are immovable joints called sutures (comprised of dense collagenous connective tissue). The mandible is the only movable facial bone. It articulates with the temporal bone of the skull forming a combined hinge and planar joint called the temporo-

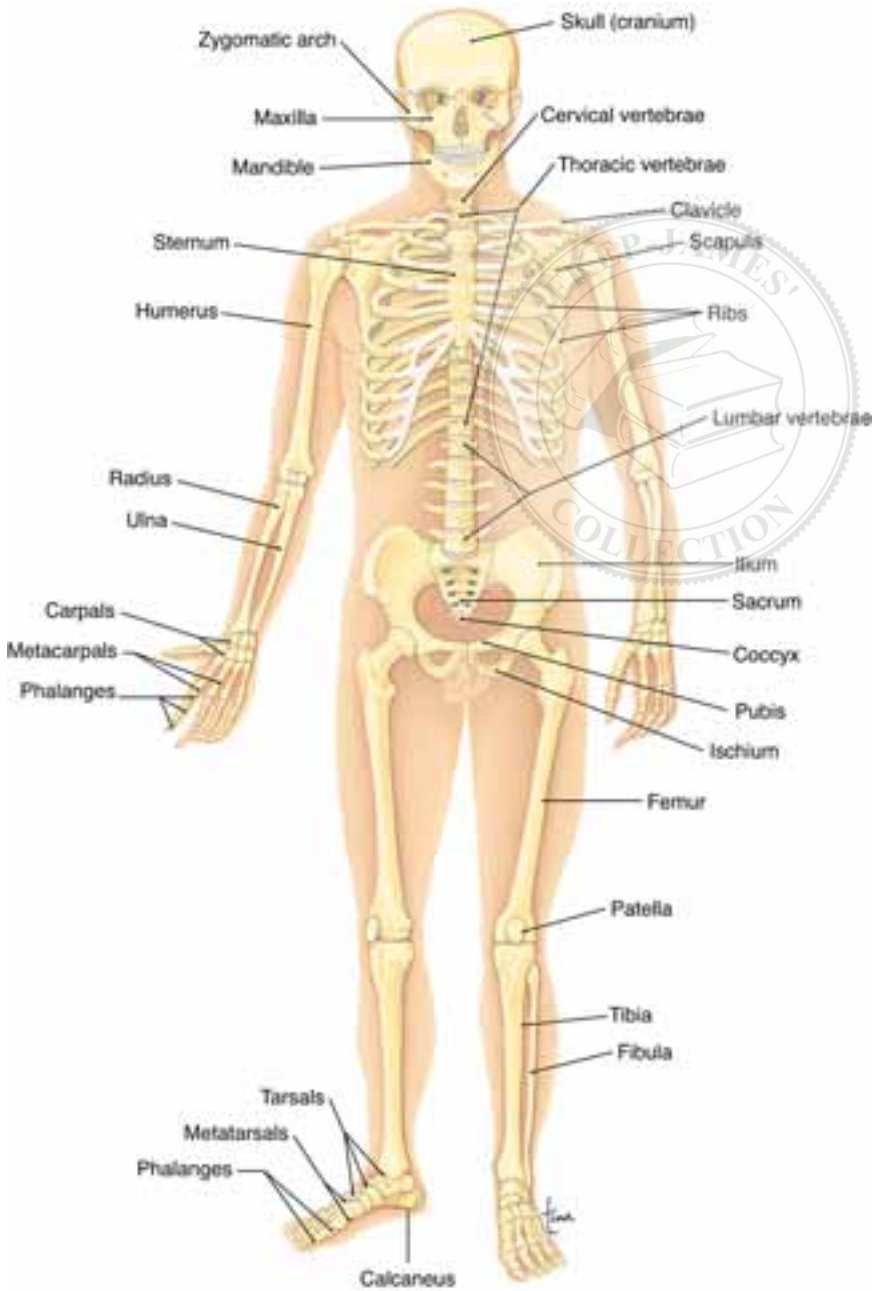

FIGURE 45.1 The full skeleton in anterior view. *(Modified from Scanlon, VC, and Sanders, T: Anatomy and Physiology, ed. 5. F.A. Davis, Philadelphia, 2007, with permission.)*

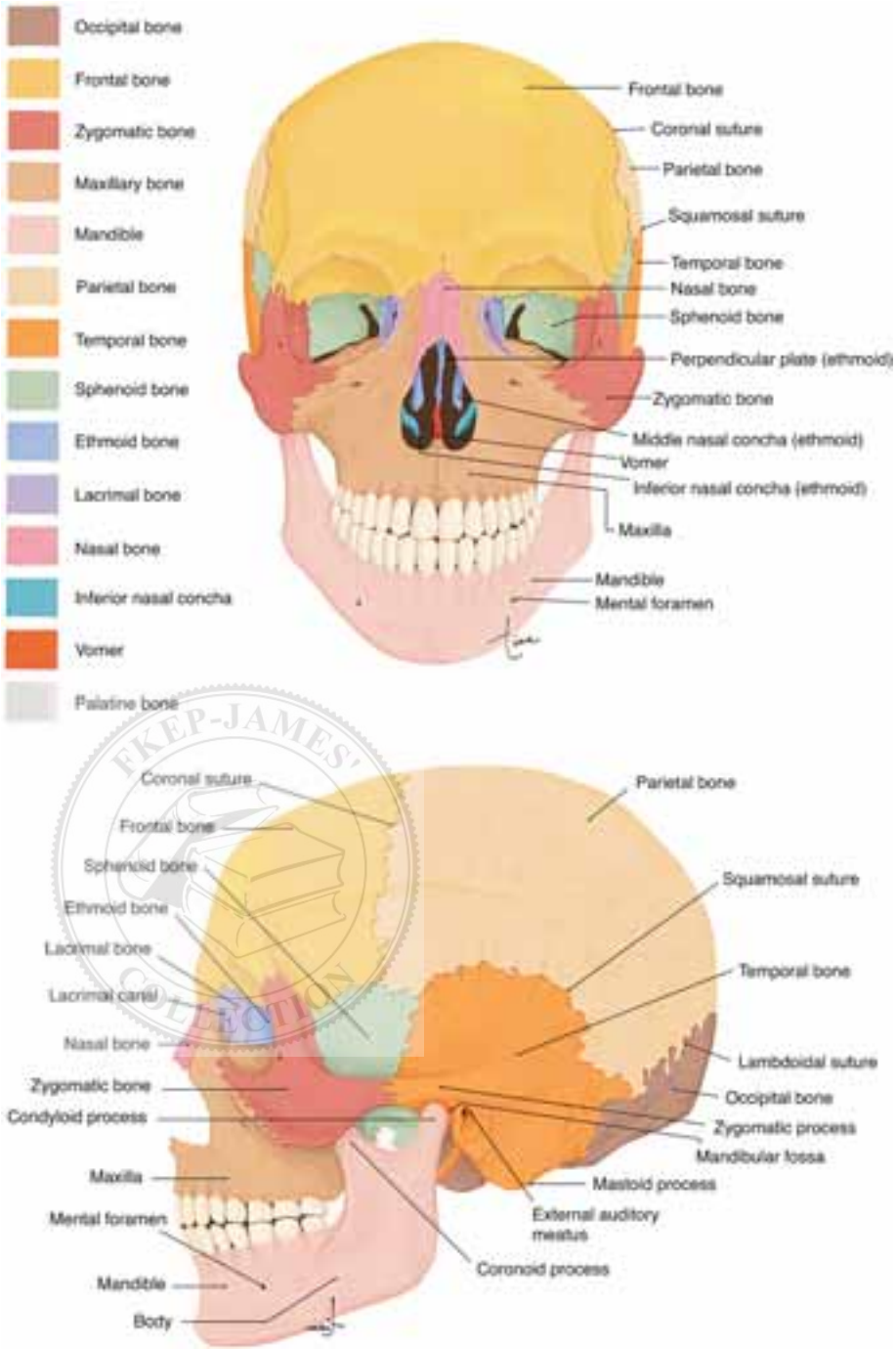

FIGURE 45.2 Anterior *(upper)* and lateral *(lower)* views of the skull. *(Modified from Scanlon, VC, and Sanders, T: Anatomy and Physiology, ed. 5. F.A. Davis, Philadelphia, 2007, with permission.)*

mandibular joint (Table 45.1). The maxillae are the upper jaw bones, which also form the front of the hard palate (part of the roof of the mouth). The rest of the facial bones are shown in Figure 45.2.

Vertebral Column

The vertebral column (or spinal column) is made of individual bones called **vertebrae** (see Fig. 45.1). From top to bottom there are 7 cervical, 12 thoracic, 5 lumbar, 5 sacral fused into 1 sacrum, and 4 or 5 coccygeal vertebrae fused into 1 coccyx.

The first cervical vertebra, the atlas, articulates with the occipital bone of the skull and forms a pivot joint with the axis, the second cervical vertebra. The thoracic vertebrae articulate with the posterior ends of the ribs. The lumbar vertebrae are the largest and strongest. The sacrum permits the articulation of the two hip bones, at the sacroiliac joints. The coccyx serves as an attachment point for some muscles of the perineum.

The vertebrae as a unit form a flexible backbone that supports the trunk and head and contains and protects the spinal cord. Openings, or intervertebral foramina, between

TABLE 45.1 JOINTS OF THE APPENDICULAR SKELETON

Type of Joint and Description	Examples
Symphysis—disk of fibrous cartilage between bones	Between vertebrae Between pubic bones
Ball and socket—movement in all planes	Scapula and humerus (shoulder) Pelvic bone and femur (hip)
Hinge—movement in one plane	Humerus and ulna (elbow) Femur and tibia (knee) Between phalanges (fingers and toes)
Combined hinge and planar	Temporal bone and mandible (lower jaw)
Pivot—rotation	Atlas and axis (neck) Radius and ulna (distal to elbow)
Gliding—side-to-side movement	Between carpals (wrist)
Saddle—movement in several planes	Carpometacarpal of thumb

Modified from Scanlon, VC, Sanders, T: Essentials of Anatomy and Physiology, ed. 5. F.A. Davis, Philadelphia, 2007, p. 120, with permission.

the vertebrae allow for the exit of spinal nerves and entry of blood vessels. The joints between vertebrae are symphysis joints in which a disk of fibrous cartilage serves as a cushion and permits slight movement.

Rib Cage

The rib cage consists of the 12 pairs of ribs and the sternum, or breast bone. All the ribs connect posteriorly with the thoracic vertebrae. The seven pairs of true ribs articulate directly with the sternum by means of costal cartilages; the three pairs of false ribs join indirectly with the sternum, and the inferior two pairs of floating ribs do not connect to the sternum at all.

The rib cage protects the heart and lungs, as well as upper abdominal organs such as the liver and spleen, from mechanical injury. During breathing, the flexible rib cage is pulled upward and outward by the external intercostal muscles to expand the chest cavity and bring about inhalation.

Appendicular Skeleton

The bones of the appendicular skeleton are shown in Figure 45.1. The important joints of the appendicular skeleton are summarized in Table 45.1.

Structure of Synovial Joints

All freely movable joints (this excludes amphiarthroses and synarthroses) are synovial joints in that they share similarities of structure (Fig. 45.3). On the joint surface of each bone is the **articular** cartilage, which provides a smooth surface. The joint capsule is similar to a sleeve. It is made of fibrous connective tissue and forms a strong sheath that encloses the joint. Lining the joint capsule is the synovial membrane, which secretes synovial fluid into the joint cavity. Synovial fluid is a mixture of hyaluronic acid, proteins, fat, and cells that provides a slippery consistency that prevents friction as the bones move.

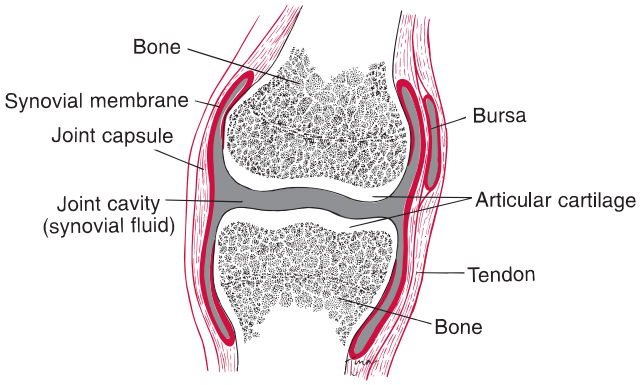

FIGURE 45.3 Longitudinal section through a typical synovial joint. *(Modified from Scanlon, VT, and Sanders, T: Workbook for Essentials of Anatomy and Physiology, ed. 5. F.A. Davis, Philadelphia, 2007, with permission.)*

Many synovial joints also have **bursae,** which are small sacs of synovial fluid between the joint and the tendons that cross over the joint. Bursae permit the tendons to slide easily as the joint moves.

MUSCLE STRUCTURE AND ARRANGEMENTS

One muscle is made of thousands of muscle cells (fibers), which are specialized for contraction. When a muscle contracts, it shortens and pulls on a bone. Each muscle fiber receives its own motor nerve ending, and the numbers of fibers that contract depend on the job the muscle has to do. Muscles are anchored to bones by tendons, which are made of fibrous connective tissue. A muscle usually has at least two tendons, each attached to a different bone. The more stationary muscle attachment is called its origin; the more movable attachment is the insertion. The muscle itself crosses the joint formed by the two bones to which it is attached, and when the muscle contracts, it pulls on the insertion and moves the bone in a specific direction. The muscle causing this particular action is termed the agonist.

The approximately 700 muscles in the body are arranged to bring about a variety of movements (Fig. 45.4). The general types of arrangements are the agonist with opposing antagonists and the cooperative synergists.

Antagonistic muscles have opposite functions; such arrangements are necessary because muscles can only pull, not push. If the biceps brachii, for example, flexes the forearm, an antagonist, the triceps brachii, is needed to extend the forearm. Other examples of antagonists are the quadriceps femoris and hamstring groups, the pectoralis major and the latissimus dorsi, and the tibialis anterior and gastrocnemius.

Synergistic muscles have similar functions or work together to perform a particular function. The brachioradialis is a synergist to the biceps brachii for flexion of the forearm; the sartorius is a synergist to the quadriceps group for

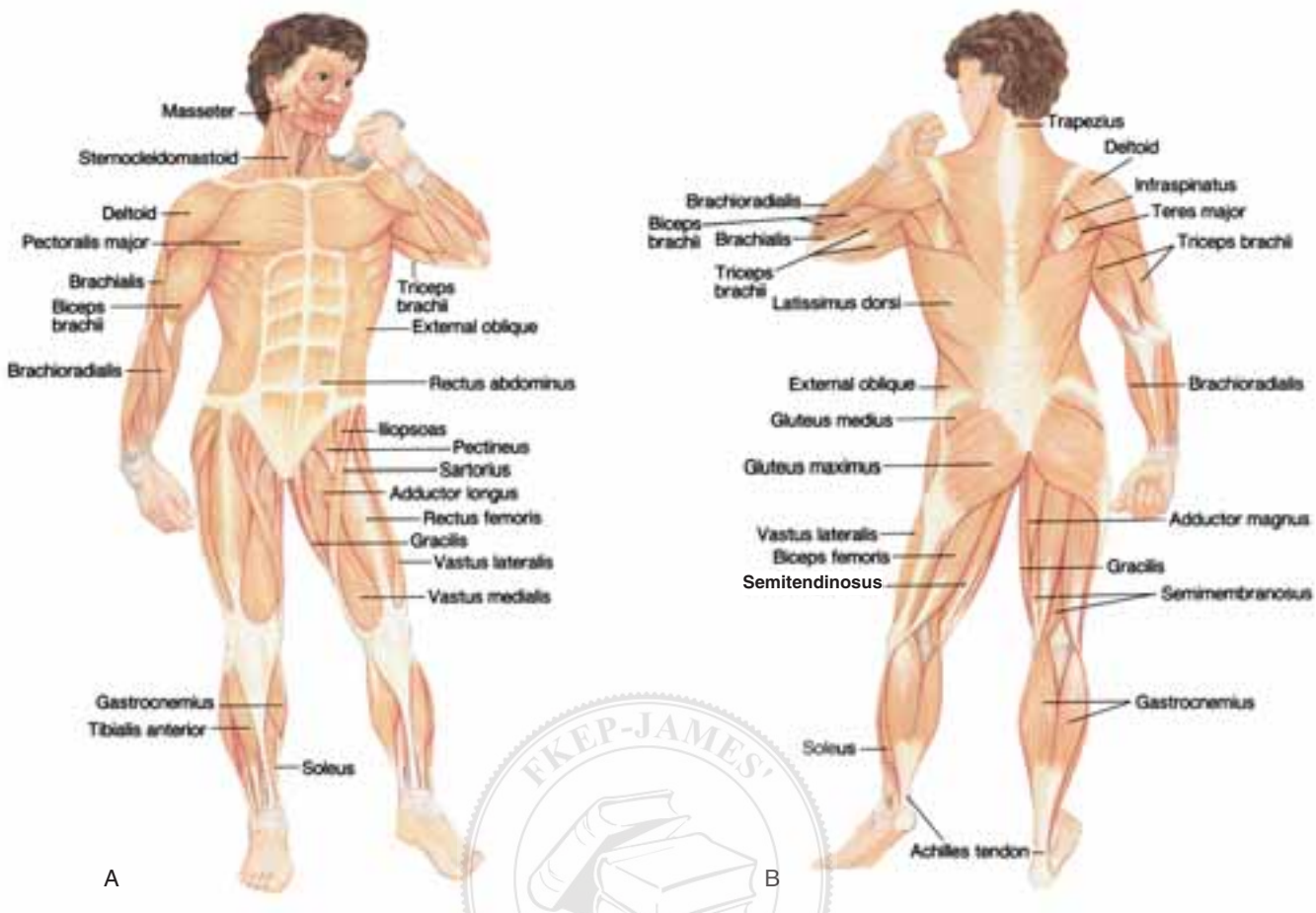

FIGURE 45.4 Major muscles. *(A)* Anterior view. *(B)* Posterior view. *(Modified from Scanlon, VC, and Sanders, T: Essentials of Anatomy and Physiology, ed. 5. F.A. Davis, Philadelphia, 2007, with permission.)*

flexion of the thigh. Synergists are necessary to provide slight differences in angles when joints are moved. Without synergism we would be unable to maintain our balance or have the fine motor control needed to do such movements as writing or talking.

ROLE OF THE NERVOUS SYSTEM

Skeletal muscles are voluntary muscles in that consciously controlled nerve impulses cause contraction. Such nerve impulses originate in the motor areas of the frontal lobes of the cerebral cortex. The coordination of voluntary movement is a function of the cerebellum. Neurons in the CNS (central nervous system) regulate muscle tone, the state of slight contraction usually present in muscles. Good muscle tone is important for posture and for good coordination.

Neuromuscular Junction

Each of the thousands of fibers in a muscle has its own motor nerve ending; the neuromuscular junction is the termination of the motor neuron at the muscle fiber (see Fig. 50.2). The axon terminal is the enlarged distal tip of the motor neuron. It contains vesicles of the neurotransmitter acetylcholine. The membrane of the muscle fiber, called the sarcolemma, contains receptor sites for acetylcholine. The synaptic cleft is the minute space between the axon terminal and the sarcolemma. The inactivating enzyme acetylcholinesterase is available in the synaptic cleft.

When a nerve impulse arrives at the axon terminal, it causes the release of acetylcholine, which diffuses across the synaptic cleft and bonds to the acetylcholine receptors on the sarcolemma. This makes the sarcolemma permeable to sodium ions, which rush into the cell and generate an electrical impulse (an action potential) along the entire sarcolemma. This electrical change triggers a series of reactions in the internal units of contraction called sarcomeres. Put simply, filaments of the protein actin slide over filaments of another protein called myosin, and the sarcomere shortens. All the thousands of sarcomeres in a muscle fiber shorten, and the entire cell contracts. If a muscle has little work to do, few of its many muscle fibers contract, but if the muscle has more work to do, more of its muscle fibers contract.

AGING AND THE MUSCULOSKELETAL SYSTEM

The amount of calcium in bones depends on several factors (Fig. 45.5). Good nutrition is certainly one factor, but age is another, especially for women. One function of estrogen or

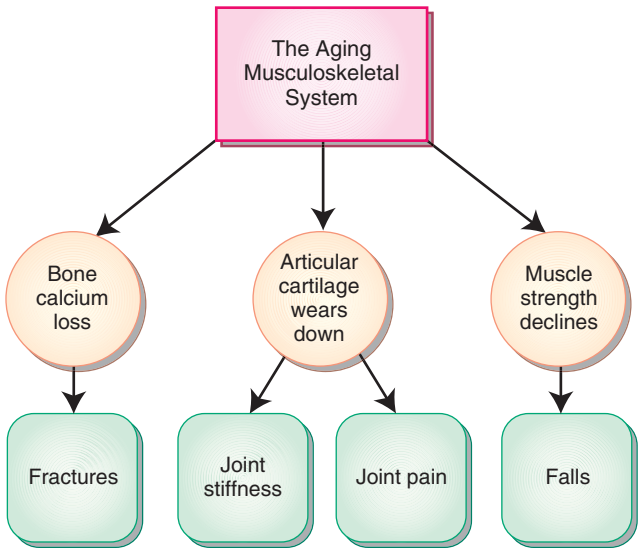

FIGURE 45.5 Aging and the musculoskeletal system. This concept map shows the effects the aging process has on the musculoskeletal system.

testosterone is the maintenance of a strong bone matrix. For women after menopause, bone matrix loses more calcium than is replaced. Calcium loss can lead to weakened bones that may result in bone fractures. Weight-bearing joints are also subject to damage after many years. Often the articular cartilage wears down and becomes rough, leading to pain and stiffness.

Muscle strength declines with age as the process of protein synthesis decreases. Such loss of strength need not be exaggerated because aging muscles benefit from regular exercise, which has been shown to increase strength and reduce falls and accidents (Box 45.1 Gerontological Issues).

Box 45.1

Gerontological Issues

Age-Related Changes in the Older Adult

Age-related changes can lead to impaired mobility, an increased risk for falls, and pain. Common age-related musculoskeletal changes include the following:

- Muscle mass and strength decline.
- Number of muscle cells decrease and are replaced by fibrous connective tissue.
- Elasticity of ligaments, tendons, and cartilage decrease, resulting in weaker bones.
- Intervertebral spaces decrease from loss of water, causing a loss of height.
- Posture and gait change. (Men develop a wider stance and take smaller steps; women have a narrow stance and walk with a waddling gait.)

NURSING ASSESSMENT OF THE MUSCULOSKELETAL SYSTEM

The initial assessment begins with a history that includes the effects the condition is having on the patient's life. It then proceeds to a physical and psychosocial assessment (Table 45.2). Frequent neurovascular assessments may be needed if there is a risk of circulation impairment, such as if the patient has a fracture or musculoskeletal surgery (Table 45.3).

Subjective Data

History

The patient's history should include the following:

- If there was an injury, how it happened and when it happened
- Occupation and activities, including sports and other physical activities
- Risk factors for musculoskeletal problems and family history of musculoskeletal problems (to detect hereditary problems)
- Current health status, including ongoing or chronic medical conditions (such as heart disease, diabetes, lung conditions)
- Diet history (including whether calcium and vitamin D intake are adequate to ensure proper bone and muscle maintenance and repair)
- Information specific to the patient's musculoskeletal problems

Patients with musculoskeletal problems frequently report pain or related stiffness and tenderness as a major concern. The pain may be acute or chronic and may limit the patient in everyday life. Assessment includes previous diagnoses, pain severity, medications, treatments, and procedures the patient uses to alleviate the pain. The WHAT'S UP? model can be used to assess the patient's pain (see Chapter 1.)

Objective Data

Physical Assessment

Three areas of musculoskeletal assessment are important: inspection, palpation, and range of motion (ROM). If the patient is able to walk, inspect the patient's posture and gait, noting poor posture or alterations in movement, such as limping. Note the use of mobility aids, such as a cane or walker. Document other gross deformities, such as unequal limbs, malalignment, or contractures. Spinal deformities are especially significant because they can compromise breathing and balance. Inspect the joints and muscles of the arms, hands, legs, and feet for deformity, redness, swelling, increased temperature, or **crepitation** (grating sound as joint or bone moves). Also note the patient's general nutritional status (e.g., normal, obese, emaciated).

After inspection, gently palpate for warmth, swelling, and tenderness in the areas of swelling, redness, and areas where the patient reported pain (being careful to minimize the pain this may cause). For example, reddened joints

TABLE 45.2 ASSESSMENT OF THE MUSCULOSKELETAL SYSTEM

Category	Questions to Ask During History Assessment	Rationale/Significance
	Subjective Assessment	
Demographic	• Age, gender, socioeconomic status	• Increased age, being female, and lower socioeconomic status increases risk of musculoskeletal injury/problems.
	• Occupation	• Enables you to begin planning for discharge teaching if the patient has to alter his or her employment.
Previous Health History	• Activities patient participates in	• Provides information regarding the level of activity the patient had before the concern.
	• Risk factors for musculoskeletal problems	• Smoking and a sedentary lifestyle are risk factors for musculoskeletal problems.
	• Family history	• Some musculoskeletal conditions have genetic and familial tendencies.
	• Diet history	• Dietary intake such as calcium and vitamin D influence some musculoskeletal disorders.
History of Injury or Present Concern	• Allergies	• Prevents exposure to medication or compounds used in diagnostic tests, treatments, and therapies.
	• History of the injury (if there was one)	• Provides information that helps in the diagnosis of the problem, as well as making you aware of possible complications of the injury.
	• Pain (Use Pain Assessment Scale [PAS])	• Provides information about severity of the condition and effectiveness of the treatment and therapy.
Psychosocial Assessment	• Determine if deformities, changes in body image, self-concept, socialization, or employment are present	• The patient may need assistance with strategies to cope with the stress of a possible chronic musculoskeletal condition.
	• Determine coping skills	• Some musculoskeletal conditions require lifestyle alterations that can cause increased stress and difficulties in coping.
	Objective Assessment	
Physical Assessment	• Inspect, palpate, and observe range of motion [ROM] of affected areas	• Altered gait, tone, size, shape, posture, contractures, deformities, ROM, pain, and effects on activities of daily living (ADLs) can be determined.
	• Assess color, warmth, circulation, and movement (CWCM) of affected areas	• Nerve function, sensation, movement, weakness, and the potential development of compartment syndrome can be determined.
	• Palpate all pulses below involved area	• Alterations may indicate altered vascular integrity (and therefore tissue integrity) of affected area or demonstrate developing compartment syndrome.

should be palpated for **synovitis** (swollen synovial tissue within the joint) or the presence of bony nodes. In some cases, joints and muscles may seem healthy but are tender when palpated.

Next, assess joint mobility. Stabilize the body area proximal to the joint being moved. Observe the patient's ROM for performing independent activities of daily living. Pay particular attention to the hands and observe movement in finger joints. For a quick and easy assessment of range of motion in the hands, ask the patient to touch each finger, one by one, to the thumb (known as opposition) and then to make a fist.

Also assess the size, shape, strength, and tone of muscles. Evaluate bilateral muscle strength by asking the patient to grip your hands. This enables you to feel the strength and equality. Pushing an extremity against your hand provides a general indication of muscle strength. More specific evaluation is performed by a physical therapist (PT) or an occupational therapist (OT). Using a scale of 0 to 5 (0 = paralysis and 5 = moving a muscle against resistance), the PT or OT measures the strength of each muscle group and rates it as a

synovitis: synovia—joint + itis—inflammation

TABLE 45.3 NEUROVASCULAR ASSESSMENT

Assess for	Note and Report
Color	Pallor, cyanosis, redness, or discoloration
Temperature	Unusual coolness or warmth
Pain	Pain that is worse on passive motion, pain that no longer responds to analgesics
Movement	Alterations in movement
Sensation	Alterations in feeling, tingling or paresthesias
Pulses	Diminished or absent distal pulses
Capillary refill	Nailbed that does not blanch in 3–5 seconds

fraction. For example, 5/5 means that the patient reached a 5 out of 5 possible on the muscle strength scale.

Psychosocial Assessment

Deformities resulting from arthritis or other musculoskeletal disorders can affect a patient's body image and self-concept (see Chapter 46.) Chronic pain may keep the patient from socializing or from working. Many work days are lost as a result of both acute and chronic musculoskeletal problems. Patients often avoid social events and tend to withdraw from people. Data collection should include questions related to the psychological effects of the musculoskeletal disorder.

Patients may experience a tremendous amount of psychological stress resulting from the pain, loss of income, and withdrawal from friends and family. The nurse assesses the patient's ability to cope, asking what coping strategies have been used in the past for other life stressors. Support systems for the patient need to be identified, especially spiritual and social systems. As needed, consult the appropriate member of the health-care team (social work, clergy, support groups) to ensure that the patient's psychosocial needs are being met.

CRITICAL THINKING

Mr. Smith

■ Mr. Smith, age 80, is brought to the emergency department with a fractured left hip. He is positioned for comfort while you collect data.

1. What information should you obtain in Mr. Smith's history?
2. What should be assessed in Mr. Smith's physical examination?

Suggested answers at end of chapter.

DIAGNOSTIC TESTS

Diagnosis of musculoskeletal problems is assisted by laboratory tests and diagnostic imaging (including x-ray examinations and nonradiological tests). Specific tests for patients with connective tissue diseases are described in Chapter 46.

Laboratory Tests

Serum Calcium and Phosphorus

Bone disorders commonly cause changes in calcium and phosphorus (or phosphate) levels. When a person is healthy, calcium and phosphorus have an inverse relationship. This means that when serum calcium increases, serum phosphorus decreases, and vice versa. Some disorders, however, cause an increase in both values or a decrease in both values. Calcium and phosphorus levels are regulated by calcitonin from the thyroid gland and parathyroid hormone from the parathyroid glands. When these glands are not functioning properly, alterations in calcium and phosphorus levels can occur (Table 45.4)

Serum calcium tends to decrease in patients with osteoporosis or in people who consume inadequate amounts of calcium in their diets. Serum calcium levels increase in patients with bone cancer, particularly those with metastatic disease.

Alkaline Phosphatase

Alkaline phosphatase (ALP) is an enzyme that increases when bone or liver tissue is damaged. In metabolic bone diseases and bone cancer, ALP increases to reflect osteoblast (bone-forming cell) activity.

Myoglobin

Myoglobin is a protein found in striated (skeletal or cardiac) muscle. It is what causes the red color of muscle. When skeletal or cardiac muscle is damaged myoglobin levels rise in the blood.

TABLE 45.4 DIAGNOSTIC LABORATORY TESTS FOR MUSCULOSKELETAL SYSTEM

Test	Normal Value	Significance of Abnormal Findings
Serum Calcium	8.5–10. 5 mg/dL	Hypercalcemia—may be related to metastatic bone disease or extended immobilization. Hypocalcemia—may be due to poor dietary intake. Can ultimately lead to rickets in a child or osteomalacia (bone softening) or osteoporosis in the elderly.
Serum Phosphorus	2.6–4.5 mg/dL	Usually evaluated with serum calcium. A number of disorders can be associated with high or low serum phosphorus.
Alkaline Phosphatase (ALP)	45–115 U/L (male) 30–100 U/L (female)	ALP increases may indicate bone abnormality (examples: Paget's disease, metastatic bone cancer). ALP is increased when new bone is formed.
Creatine Kinase (CK)	60–400 U/L (male) 40–150 U/L (female)	IM injections can cause a rise in CK.
Isoenzyme CK3 (MM)	95%–100%	High levels indicate need for further testing for muscle disease. Can be used as a screening test for malignant hyperthermia. Will be increased in rhabdomyolysis.
Myoglobin	50–120 µg/mL	Increased myoglobin can indicate MI or skeletal muscle destruction.

Serum Muscle Enzymes

When muscle tissue is damaged, a number of serum enzymes are released into the bloodstream, including skeletal muscle creatine kinase (CK-MM [CK3]), aldolase (ALD), aspartate aminotransferase (AST), and lactate dehydrogenase (LDH). These enzymes increase in certain muscle diseases such as muscular dystrophy, polymyositis, and dermatomyositis.

LEARNING TIP

Rhabdomyolysis is a very serious and potentially fatal condition associated with muscle destruction due to such things as injury (especially crushing), high fever, convulsions, or prolonged muscle compression (such as from lying in a coma) can have CK levels greater than five times normal. If the patient suffered muscle destruction, look at the patient's CK, myoglobin, and serum potassium levels to assess for rhabdomyolysis. The three laboratory values will be elevated.

Radiographic Tests

SAFETY TIP

For any radiographic test requiring injection or instillation of a medication or contrast solution, it is important for the nurse to assess for allergies or untoward responses resulting from previous examinations or exposures. Many of the contrast mediums used have alternate substances available in case of allergies. If the patient is unable to do so, then it is the nurse's responsibility to inform the technologist of the allergies or previous adverse responses experienced by the patient.

Standard X-Rays

An x-ray examination can determine bone density, texture, changes in alignment and bone relationship, erosion, swelling, and intactness. In addition, x-ray examinations can be useful in identifying certain soft tissue damage (e.g., ligaments and tendons) because of alterations in bone position and spacing.

Although there is no special nursing care associated with x-ray examinations, you should inform patients that they will have to lie still during the examination and that the x-ray table will be cold and hard (Table 45.5).

Computed Tomography

Tomograms are radiographs that focus on a particular slice of bone or soft tissue, such as ligaments and tendons. Computed tomography (CT) is especially helpful for diagnosing problems of the joints or vertebral column (Fig. 45.6). It may be used with or without a contrast medium (similar to a dye), which is given orally or intravenously.

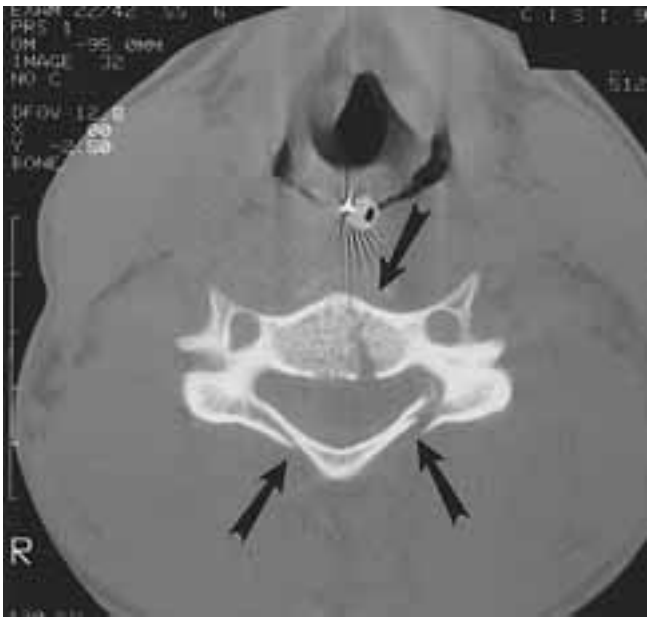

FIGURE 45.6 Computed tomography scan of fifth cervical vertebra showing a burst fracture of the vertebral body *(top arrow)* and both laminae *(bottom arrows)*. *(From McKinnis, LN: Fundamentals of Musculoskeletal Imaging, ed. 2. F.A. Davis, Philadelphia, 2005, p 164, with permission.)*

Inform patients that they must lie completely still during the test and that they will be surrounded by the scanner during the test. Headphones are worn for communication with the technician and to listen to soothing music of the patient's choice. Reports of claustrophobia and annoying clicking sounds made by the scanner while it is rotating are common. (See Table 45.5.)

Arthrography

An x-ray examination of any synovial joint can be performed for patients with suspected joint trauma. The most common joints tested are the knee and shoulder (see Table 45.5).

Myelogram

During a myelogram, a contrast medium is injected into the subarachnoid space so that the spine and spinal cord can be visualized. Inform patients that they may be positioned head down for a short period to allow the contrast medium to flow up to the level of the neck. This test is not performed as frequently as it used to be. It is usually reserved for those patients unable to have a CT or MRI or for complicated spinal surgery revisions (see Table 45.5).

Other Diagnostic Tests

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI), with or without contrast media, is a commonly performed test to diagnose mus-

TABLE 45.5 DIAGNOSTIC PROCEDURES FOR MUSCULOSKELETAL SYSTEM

Procedure	Definition/Normal Finding (if applicable)	Significance of Abnormal Findings	Nursing Management (if applicable)
		Noninvasive	
Standard X-Rays	Visualization of skeletal abnormality or deformity. Can also be used to visualize dense or inflamed tissues and joints.	Aids in treatment plan and provides additional information for care. Example: broken ribs will necessitate increased attention to respiratory system.	Inform patient of what to expect during ordered procedures.
Computed Tomography	Radiographic "slices" of bone or soft tissue. Provides a better image.		Check for allergies to contrast medium (or if allergic to contrast media or iodine). NPO for 4 hours before test.
Magnetic Resonance Imaging (MRI)	Electromagnets provide a three-dimensional visualization of the area. Produces the best image available.		
Ultrasonography	Visualization of bone or soft tissue using sound waves.		Inform the patient that the jellylike conducting substance will feel cold when applied.
Nerve Conduction Studies	Electromyography (EMG)—the electrical testing of nerves and muscles.	Alterations usually indicate a problem with the nerves or the muscles.	Inform the patient that there may be some discomfort during the nerve and muscle stimulation as well as when the needles are inserted (if needed).
		Invasive	
Arthrography	Injection of air or a contrast medium into a synovial joint which is then x-rayed.	Aids in the diagnosis of joint abnormalities.	Inform patient that the test is uncomfortable during injection. Joint swelling is common after the procedure. Apply ice and elevate limb. Avoid physical activity for 12–24 hours.
Myelogram	Visualization of the spine and spinal cord after injection of a contrast medium.		Assess for headache and nausea post test. Maximum head raise is 45 degrees for at least 3 hours post procedure (or as ordered by physician).
Nuclear Medicine Scans	Injection of a radioisotope to help visualize bone and other soft tissue abnormalities.	Finding a "hot spot" usually indicates metastases or bone infection.	Inform the patient that the test is not dangerous. Inform patient that the test may take up to 90 minutes.
Gallium/Thallium Scans	Injection of radioactive element which migrates to bone, brain, breast, and inflammatory tissue.		Check if the facility you work in recommends that children and pregnant women stay a few feet away from the patient for the first 48 hours.
Arthroscopy	Direct visualization of the joint and its capsule using an instrument inserted into the joint space.		Assess CWCM frequently. Monitor for complications. Apply ice and keep limb elevated to minimize swelling (if ordered by physician).
Arthrocentesis	Withdrawal of synovial fluid from a joint space. Used for analysis of the synovial fluid or for reduction of excess fluid pressure.		Monitor for infection, inflammation or hemarthrosis.
Bone or Muscle Biopsy	Needle aspiration (closed) or surgical extraction (open) of bone or muscle tissue.		Monitor site of biopsy for bleeding. Provide normal wound care for open biopsy. Perform neurovascular assessments prn.

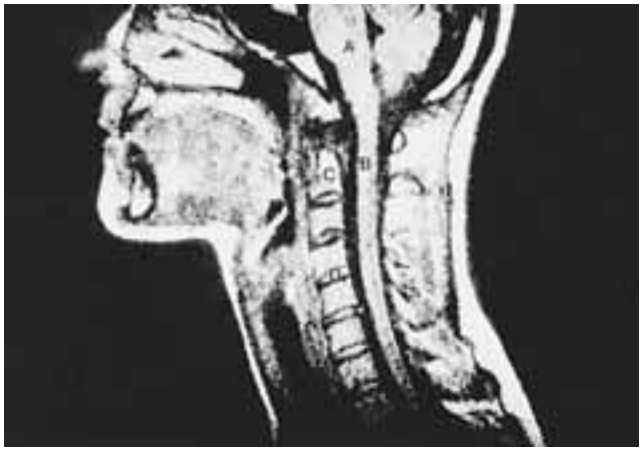

FIGURE 45.7 Magnetic resonance image of a normal cervical spine. *(A)* Cerebellum. *(B)* Spinal cord. *(C)* Marrow of C2 vertebral body. *(D)* C4-5 intervertebral disk. *(From McKinnis, LN: Fundamentals of Orthopedic Radiology. F.A. Davis, Philadelphia, 1997, p 26, with permission.)*

culoskeletal problems, especially those involving soft tissue (see Table 45.5) (Fig. 45.7). MRI is more accurate than CT for diagnosing many problems of the vertebral column. If the patient has had previous spinal surgery, a contrast medium is used.

The image is produced by interaction of magnetic fields and radio waves. For very large patients or those who are claustrophobic, the open MRI offers a comfortable alternative to the traditional machine (Box 45.2 Patient Perspective).

The use of an electromagnet in the machine necessitates the removal of anything metal or with metal components from the patient's body. Pacemakers, surgical clips, and any other internally implanted metal device or apparatus are contraindications for MRI.

SAFETY TIP

Check with the facility where the MRI will take place for all contraindications for metal implants within a person's body to prevent injury to the patient.

Nuclear Medicine Scans

Several tests are performed using radioactive material to help visualize bone and other tissues. A bone scan allows visualization of the entire skeleton. The patient is injected with a radioisotope 2 to 3 hours before the scan. The radioisotope is attracted to bone and therefore travels to bone tissue.

For an accurate test, the patient must be able to lie still for up to 90 minutes during scanning. Patients who are elderly, restless, agitated, or in pain may therefore find this test uncomfortable. Sedatives or analgesics may have to be administered before or during the procedure. The physician looks for "hot spots," which indicate areas where the radioactive substance is concentrated. These hot spots indicate abnormal bone metabolism, a sign of bone disease (see Table 45.5).

Box 45.2

Patient Perspective

Emily: Undergoing an MRI

I was told that the MRI scanner was small and could cause feelings of claustrophobia. When asked if I was claustrophobic, I said no and so was not offered an antianxiety medication before the procedure. I really am not claustrophobic, but I decided to keep my eyes closed during the test to be sure to prevent these feelings. As the table I was lying on moved into the scanner, my heart began beating fast. I shut my eyes and imagined myself walking on the beach, which is a favorite place for me. The cool air that was blowing in the machine I imagined to be the wind blowing. That air really is essential in keeping you cool and the claustrophobic feeling away. I had on headphones through which the music I had brought with me was playing. I focused on the music and sang along to myself as I "walked on the beach." I felt calmer as I did this. Through the headphones the technician kept me informed of how much longer the test would be and when the loud pounding noise would start. This really helped and I did not mind the noise. I knew that I had to be very still for the test, so I gave myself pep talks. "Okay, only 10 more minutes. Just lie still and this will be over soon."

Then, halfway through the MRI, I accidentally opened my eyes for an instant. "Uh, oh." I quickly shut them again with my heart racing and a feeling of panic rising. The wall of the MRI machine was only inches from my face. I quickly focused on the music again, told myself I could get through this, and focused on calming myself down by "going back to the beach." Before I knew it, the test was over and I was told that because I held so still it was a great test that went more quickly than usual. I sure was glad to hear that! My personal coping techniques really helped me through the MRI. Without them I would have panicked and been unable to complete the test. The information the nurse gave me helped me know what to expect during the procedure so I could prepare myself to cope with the test. Providing information to your patients on what to expect during the test, as well as coping methods to use, can help them successfully complete an MRI.

LEARNING TIP

Hot spots are created because increased circulation occurs in abnormal bone areas, resulting in increased amounts of the radioactive substance being transported to the abnormal area.

Gallium/Thallium Scans

A gallium or thallium scan is similar to a bone scan but is more specific and sensitive as a diagnostic test. Gallium not only migrates to bone but also to brain and breast tissues and is therefore used to diagnose problems in these tissues as well.

Traditionally used for heart problems, thallium is now used for evaluation of bone cancers. Thallium is best for detecting osteosarcoma. Like the bone scan, these scans are not harmful to the patient.

Arthroscopy

An arthroscope allows the surgeon to directly visualize a joint (see Table 45.5). The knee and shoulder are the joints most often evaluated. Because **arthroscopy** is an invasive procedure performed under local or light general anesthesia, the patient is treated as a surgical candidate.

Arthroscopy is done in same-day surgery settings. The surgeon makes several small incisions and distends the joint with injected saline. The scope is inserted and the joint is visualized from different angles. The joint is moved through range of motion, so tears, defects, or other soft tissue damage can be assessed and or repaired through the scope using special instrumentation. Depending on the extent of the procedure, a bulky or small dressing wrapped with an elastic bandage may be applied.

The nurse in the postanesthesia care unit (PACU) assesses the neurovascular status of the surgical limb frequently (see Table 45.3). If the patient had a diagnostic arthroscopy and no surgical repair, the PACU nurse encourages the patient to exercise the leg, including straight-leg raises. A mild analgesic usually relieves pain, and the patient returns to regular activities in 24 to 48 hours. If a surgical repair was performed, the patient may have activity restriction and need a stronger analgesic, such as oxycodone with acetaminophen (Tylox, Percocet).

Although complications are not common, monitor and teach the patient to watch for and report to the physician the following:

- Thrombophlebitis (blood clot and vein inflammation)
- Infection (fever or warmth, pain, redness, swelling at surgical site)
- Increased joint pain

arthroscopy: arthro—joint + scopy—to examine

If a repair was done during the surgery, the patient is seen by the physician in 1 week to check for complications and progress. The patient may need crutches for the first week to limit weight bearing, depending on the surgical procedure performed. Physical or occupational therapy may be ordered (see Home Health Hints).

CRITICAL THINKING

Mrs. Jones

■ Mrs. Jones was walking down the street when, without warning, she suddenly fell to the ground with extreme pain in her left leg. She was taken to the hospital, where it was determined that the greater trochanter of her left femur was fractured.

1. What information should you obtain from Mrs. Jones?
2. What possible condition may be the cause of her fracture?
3. What tests may be performed to identify the condition creating her problem?

Suggested answers at end of chapter.

Bone or Muscle Biopsy

Bone or muscle tissue can be surgically extracted for microscopic examination to confirm cancer, infection (bone biopsy), inflammation, or damage (muscle biopsy). Muscle can also be biopsied to diagnose malignant hyperthermia, a genetic disorder (see Chapter 11). Two techniques are used to retrieve muscle tissue: a needle (closed) biopsy or an incisional (open) biopsy.

A closed biopsy can be performed in the patient's room or special procedures area. After local or general anesthesia, the physician inserts a long needle into the tissue for extraction of a sample.

The open biopsy is performed in the operating suite under general anesthesia. A small incision is made and a section of bone or muscle is removed. A sterile pressure dressing is applied because bone is highly vascular.

The nurse inspects the biopsy site for bleeding, swelling, and hematoma formation. Increased pain that is unresponsive to analgesic medication may indicate bleeding in the soft tissue. The area is not moved for 8 to 12 hours to prevent bleeding. Vital signs and neurovascular assessments are monitored (see Table 45.3).

Ultrasonography

Sound waves are used to detect osteomyelitis (bone infection), soft tissue disorders, traumatic joint injuries, and surgical hardware placement. The technologist applies a jellylike conducting substance over the area to be tested. A transducer is moved over the area while the ultrasound machine records the images (see Table 45.5).

Arthrocentesis

Arthrocentesis is a diagnostic or therapeutic procedure where synovial fluid is aspirated from a joint for analysis or to relieve pressure (pain) from effusion. Analysis of the synovial fluid aids in the diagnosis of noninflammatory conditions, septic arthritis, crystal detection, and **hemarthrosis** (blood in the joint cavity). Using aseptic technique, the physician provides local anesthetic and then uses a needle to aspirate the contents of the joint space. If required, the physician can instill medications such as an anti-inflammatory corticosteroid or antibiotic. The site is covered with a sterile dressing (see Table 45.5).

Nerve Conduction Studies

Electromyography (EMG) measures a muscle's electrical impulses. This aids in the diagnosis of muscle diseases or nerve damage. There are no special nursing actions related to this procedure other than informing the patient what will occur. Occasionally, slight discomfort occurs at the site where the study occurred. Warm compresses or mild analgesics can be offered for pain relief (see Table 45.5).

CRITICAL THINKING

Mr. Allan

■ Mr. Allan, age 45, comes to emergency with extreme pain in his lower back. The pain radiates down his right buttock and down the back of his leg to his knee. He tells you that he hurt his back picking up a box in the warehouse where he works.

1. What other information should you obtain from Mr. Allan?
2. What is a probable cause of Mr. Allan's pain?
3. What tests, procedures, and treatments may be done for Mr. Allan's condition?
4. How might this injury impact Mr. Allan's life?
5. Mr. Allan is to receive morphine 10 mg by intramuscular injection. You have available morphine 15 mg/mL. How many milliliters will you give?

Suggested answers at end of chapter.

Home Health Hints

- Patients are considered homebound if (1) they are bedbound or require the maximum assistance to ambulate while using a walker or to transfer; (2) they can ambulate with only moderate assistance while using a cane to negotiate uneven surfaces; or (3) they can leave home only for periods of relatively short duration or for need of medical treatment.
- When testing strength, extend two or three fingers and ask the patient to squeeze the fingers.
- Observe patients moving around a room or bed. If they are clumsy or have involuntary movement, make efforts during that visit and subsequent visits to protect them from potential injury. Research has shown that pain or fear of falling may prevent a patient from moving and functioning to maximum potential.
- Use sand or cat box filler on icy steps to increase traction, preventing slips and falls.

REVIEW QUESTIONS

1. Which of the following is the function of synovial fluid in joints?
   a. Exchange nutrients
   b. Prevent friction
   c. Absorb water
   d. Wear away rough surfaces

Multiple response item. Select all that apply.

2. A patient has been diagnosed with a musculoskeletal disease that causes decreased bone density. Which assessment questions are most appropriate by the nurse?
   a. "Do you have any broken bones?"
   b. "Has your doctor informed you not to exercise so you will not break a bone?"
   c. "What forms of physical activity are you able to participate in?"
   d. "Do any of your spouse's relatives have problems with their bones?"
   e. "Do you exercise regularly?"
   f. "What is typically included in your daily diet?"

3. Which of the following assessments is included in neurovascular checks of the lower extremities?"
   a. Radial pulses
   b. Checking for clubbing
   c. Biceps reflex
   d. Femoral pulses

4. A patient is scheduled for an MRI of the pelvis. Which of the following would the nurse do if during data collection the nurse found out that the patient had had a previous surgery for heart problems?
   a. Ask if there is any metal in the patient's body.
   b. Order a chest x-ray examination to identify any metal objects in the patient's body.
   c. Cancel the MRI.
   d. Inform the physician.
5. A patient has undergone an arthroscopy. Two hours after the procedure the patient's pedal pulses are diminished from the previous assessment. What should the nurse do?
   a. Take vital signs.
   b. Notify the physician.
   c. Perform neurovascular assessment in 30 minutes.
   d. Change the dressing and rewrap the elastic wrap.

SUGGESTED ANSWERS TO

CRITICAL THINKING

Mr. Smith

1. You should determine if Mr. Smith has any allergies, how and when the injury occurred, if he has had any previous surgeries, what medications he takes, his medical history, and any past problems with anesthesia (in Mr. Smith or his family).
2. You should assess his left leg compared with his right leg, including limb length, deformity, pain, loss of range of motion, edema, and ecchymosis, and perform neurovascular checks, including movement, sensation (numbness/tingling), presence of pulses, skin temperature, color, and capillary refill.

Mrs. Jones

1. You should assess Mrs. Jones's age, her diet (does she have a low-calcium or vitamin D–deficient diet?), what she was doing at the time of the break, whether anything like this has happened before, whether anything similar has happened to any of her relatives, her pain level, when she ate last, her medications, her medical history, whether she smokes, and whether she has any allergies.
2. There is a possibility that Mrs. Jones has osteoporosis and that she has experienced a pathological fracture from decreased bone density. This is a common occurrence in postmenopausal women.
3. X-ray examinations, bone scans, bone density tests, and laboratory tests such as serum calcium, phosphorus, acid phosphatase, thyroid, and vitamin D levels are tests that might be performed.

Mr. Allan

1. You should determine what occurred, when it occurred, how it happened, if the pain was immediate, where exactly the pain is, whether anything makes it better or worse, if any kind of treatment was started, what kind of job Mr. Allen has, whether he has had any back problems in the past, what medications he is on, and whether he has any allergies.
2. Mr. Allan may have ruptured a disk in his vertebral column, which is a common occurrence with improper lifting or trying to lift something too heavy.
3. Test might include x-ray examination, myelogram, MRI, bone scan, and CT scan. Conservative treatment will be attempted first but ultimately a diskectomy may be necessary.
4. Many back injuries result in lifelong chronic pain. Depending on the severity of the injury and the effectiveness of therapy, Mr. Allan may have to limit his physical and social activities. He may also have to find another type of employment.
5. Unit analysis method:

$$\frac{10\ \cancel{\text{mg}}}{15\ \cancel{\text{mg}}} \left| \frac{1\ \text{mL}}{} \right. = \frac{10}{15} = 0.67\ \text{mL}$$

46 Nursing Care of Patients with Musculoskeletal and Connective Tissue Disorders

RODNEY B. KEBICZ

KEY TERMS

arthritis (ar-THRYE-tis)
arthroplasty (AR-throw-PLAS-te)
avascular necrosis (a-VAS-kue-lar ne-KROW-sis)
fasciotomy (fash-e-OTT-oh-me)
hemipelvectomy (hem-e-pell-VEC-toe-me)
hyperuricemia (HIGH-per-yoor-a-SEE-me-ah)
osteogenesis imperfecta (AHS-TEE-oh-gen-i-sis im-per-FEC-ta)
osteomyelitis (AHS-tee-oh-my-LIGHT-tis)
osteosarcoma (AHS-tee-oh-sar-KOH-mah)
polymyositis (PAH-lee-my-oh-SIGH-tis)
replantation (re-plan-TAY-shun)
scleroderma (SKLER-ah-DER-ma)
synovitis (sin-oh-VIE–tis)
vasculitis (VAS-kue-LIGH-tis)

QUESTIONS TO GUIDE YOUR READING

1. What are the signs and symptoms and complications of fractures?
2. Which nursing interventions are appropriate when caring for a patient in a cast or traction?
3. What are causes, prevention, and nursing care for osteomyelitis?
4. What are the risk factors for the development of osteoporosis?
5. What signs and symptoms may be seen in patients with Paget's disease?
6. What is the pathophysiology, treatment, and nursing care for gout?
7. Which nursing interventions are appropriate when caring for patients with systemic lupus erythematosus, scleroderma, and polymyositis?
8. How would you differentiate between the care for osteoarthritis and rheumatoid arthritis?
9. What would you include when preparing a plan of care for the patient with a fractured hip or undergoing a total joint replacement?
10. What patient education would be included for a patient with a lower extremity amputation and prosthesis?

BONE AND SOFT TISSUE DISORDERS

The musculoskeletal system is the second largest system in the body. A variety of injuries and diseases can affect bone, soft tissue, or both. Common problems are discussed in this section.

Strains

A strain is a soft tissue injury that occurs when a muscle or tendon is excessively stretched. Causes of strains include falls, excessive exercise, and lifting heavy items without using proper body mechanics. Back and ankle injuries are common. Strains can be mild, moderate, or severe. A mild strain causes minimal inflammation; swelling and tenderness are present. A moderate strain involves partial tearing of the muscle or tendon fibers. Pain and inability to move the affected body part result. The most severe strain occurs when a muscle or tendon is ruptured, with separation of muscle from muscle, tendon from muscle, or tendon from bone. Severe pain and disability result from this injury.

RICE is an acronym for rest, ice, compression, and elevation. These four components are the basis of therapy for strain injuries. Immediately after a strain, ice should be applied to decrease pain, swelling, and inflammation. Applying an elastic bandage (compression) and elevating the affected area (if appropriate) provide support and minimize swelling. Once inflammation subsides, heat application (15 to 30 minutes four times a day) brings increased blood flow to the injured area for healing. Activity is limited (depending on the severity of the injury, casting may even be required for immobilization) until the soft tissue heals, and anti-inflammatory drugs are prescribed. Muscle relaxants may also be used. Exercise may begin as early as 2 to 5 days after the injury (depending on the severity of the injury), but it may take 1 to 3 weeks of immobility before exercise can begin. For more severe strains, surgery to repair the tear or rupture may be needed. These procedures are done on an ambulatory, same-day-surgery basis.

Sprains

A sprain is excessive stretching of one or more ligaments that usually results from twisting movements during a sports activity, exercise, or fall. Like strains, sprains also vary in severity. A mild sprain involves tearing of just a few ligament fibers and causes tenderness. In a moderate sprain, more fibers are torn but the stability of the joint is not affected. A moderate sprain is uncomfortable, especially with activity. A severe sprain causes instability of the joint and usually requires surgical intervention for tissue repair or grafting. Pain and inflammation prevent mobility.

For mild sprains, RICE is used for several days until swelling and pain diminish. Anti-inflammatory drugs are also used to decrease inflammation and control pain. Moderate sprains may need immobilization with a brace or cast until healing occurs.

Dislocations

Dislocations are a common injury in which the ends of the bones are forced from their normal position. They are usually caused by trauma as in falls or contact sports or a disease such as rheumatoid arthritis. Any joint large or small may become dislocated. Severe pain along with lost range of motion of the joint and joint deformity occurs. Immediate medical treatment is required to preserve function. Splint the extremity as it is found, apply ice, and seek help. Do not move the extremity as blood vessels, mucles, and nerves could be damaged.

NURSING CARE TIP

It is important for those with disease processes that could result in dislocation or fractures to use lift sheets when moving the patient rather than pulling on their arms. Always follow institutional policy for moving patients or you could be found liable for a patient's injury.

Bursitis

Bursae (fluid-filled sacs) cushion tendons during movement to prevent friction between the bone and tendon. Several joints have bursae (shoulder, elbow, hip, knee, ankle, heel). Inflammation of a bursa occurs from repetitive movement, sleeping on the side and compressing the bursa, arthritis, or gout. Prevention is key as it may become harder to cure over time. Muscle stretching and strengthening, move often, avoid repetitive movements for long periods, use cushion seats, and do not lean on your elbows to protect the bursae and prevent compression.

Symptoms of bursitis include achy pain, stiffness, or burning pain over the joint area which worsens with activity. Usually pain decreases in about a week. The condition can become chronic if it lasts more than 6 months. Treatment includes resting the joint, application of ice 20 minutes several times per day until joint warmth is gone, then switching to heat, elevating the joint, ultrasound, massage, foam mattress toppers, nonsteroidal anti-inflammatory drugs (NSAIDs), or physical therapy.

Rotator Cuff Injury

Short tendons that are connected to muscles around the shoulder form the rotator cuff. The cuff covers the top, front, and back of the shoulder. Muscle contraction causes these tendons to tighten and move or rotate the shoulder. Various injuries can occur. The top tendon of the cuff (supraspinatus tendon) and bursa may become impinged in the narrow space under the acromion bone. This causes inflammation when the arm is repeatedly moved forward and pain results. This is known as chronic impingement syndrome. Over time the tendon may finally tear from the bone.

Symptoms of rotator cuff injury include shoulder aching, increased pain with lifting the arm, pain that is

greater at night, weakness, and sometimes limited range of motion. A magnetic resonance image (MRI) can help diagnosis rotator cuff injury. For minor injury, resting the shoulder, NSAIDs, ice, and physical therapy are recommended. For a more severe injury, arthroscopic and or small incision surgery may be needed to relieve the impingement or repair the tear. A sling or special brace is worn after surgery. Physical therapy for rehabilitation after surgery is used.

Carpal Tunnel Syndrome

Pathophysiology

Carpal tunnel syndrome results in the compression of the median nerve within the carpal tunnel when swelling in the tunnel occurs. This swelling can result from edema, trauma, rheumatoid arthritis, or repetitive hand movements (repetitive motion injury) as used in some occupations such as typing or cash register operation.

Signs and Symptoms

Carpal tunnel syndrome usually results in slow-onset finger, hand, and arm pain and numbness. Painful tingling and paresthesias may also be present. Eventually, fine motor deficits and then muscle weakness may develop.

Diagnosis

Diagnosis is based on signs and symptoms, along with the patient's history. A positive Phalen's test (numbness with wrist flexion) is indicative of carpal tunnel syndrome. Electromyography (EMG) can also be used to detect nerve abnormalities.

Therapeutic Interventions

Medical treatment focuses on relieving the inflammation and resting the wrist. A splint is often ordered for the patient to wear. Medications to reduce pain and inflammation are ordered, such as aspirin and NSAIDs. Cortisone may be injected into the carpal tunnel to decrease pain and inflammation.

For some patients, surgery may be necessary. The surgeon may use an open incision or may perform an endoscopy. The median nerve is released from compression during the surgery, thus correcting the problem of the nerve and the surrounding area becoming inflamed. Physiotherapy helps in the recovery of function.

Nursing Management

Educate the patient on methods to prevent carpal tunnel syndrome, such as frequent short breaks during the work day, interspersing ongoing tasks with repetitive movements throughout the day, and using ergonomically appropriate devices to minimize the pressure placed in the area of the wrist.

Provide pain relief as ordered, and if surgery is performed, provide routine preoperative and postoperative care. Postoperatively elevate the patient's hand and use a splint as ordered for up to 2 weeks. Lifting is restricted for several weeks. The patient is taught to report signs and symptoms of neurovascular compromise, such as numbness and tingling, coolness, lack of pulse, pale skin or nailbeds, or limited movement. The patient may need family assistance with activities of daily living (ADLs).

Fractures

A fracture is a break in a bone and can occur at any age and in any bone. Some fractures are minor and are treated on an ambulatory basis; others are more complex and require surgical intervention with hospitalization and rehabilitation.

Pathophysiology

Bone is a dynamic, changing tissue. When it is broken, the body immediately begins to repair the injury (Fig. 46.1). For an adult, within 48 to 72 hours after the injury a hematoma (blood clot) forms at the fracture site because bone has a rich blood supply. Various cells that begin the healing process are attracted to the damaged bone. In about a week or so, a nonbony union called a callus develops and can be seen on x-ray examination. As healing continues, osteoclasts (bone-destroying cells) resorb any necrotic bone and osteoblasts (bone-building cells) make new bone as a replacement. This process is sometimes referred to as bone remodeling. Young, healthy adult bone completely heals in about 6 weeks; however, it can take up to a year before the whole process of remodeling is complete. An older person takes longer to heal, and children tend to heal more quickly.

Causes and Types

The major reason for a fracture is trauma from either a fall or accident (usually motor vehicle) or some type of crushing injury. Bone disease, such as osteoporosis and metastatic bone cancer, malnutrition, and regular drinking of soda pop (phosphoric acid added to pop may interfere with calcium absorption), can lead to fractures as can various drugs (e.g., certain drugs used to treat human immunodeficiency [HIV] and certain drugs used to treat endometriosis) that as a side effect cause a decrease in bone density. Fractures resulting from any of these diseases are referred to as pathological fractures. One of the most common types of fracture is the hip fracture, which occurs most frequently in middle-aged and older adult women who have osteoporosis (irreversible bone loss).

Fractures can be classified in several ways: by the extent of the fracture, the extent of the associated soft tissue damage, or the configuration of the bone after it breaks. A fracture that is complete, breaking the bone into two separate pieces, is called a displaced fracture. An incomplete fracture does not divide the bone into two pieces; it may also be referred to as a nondisplaced fracture. Complete fractures have the potential to be life threatening because sharp bone fragments can sever blood vessels and nerves.

A fracture may also be classified as open or closed. In an open (or compound) fracture, the bone breaks the skin. A closed fracture does not disrupt the skin. Open fractures are more likely to become infected than closed fractures.

Another way to describe a fracture is by the way that the bone breaks, such as in a spiral or oblique fashion (Fig. 46.2). These fractures may be open or closed, complete or incomplete. Table 46.1 describes the types of fractures.

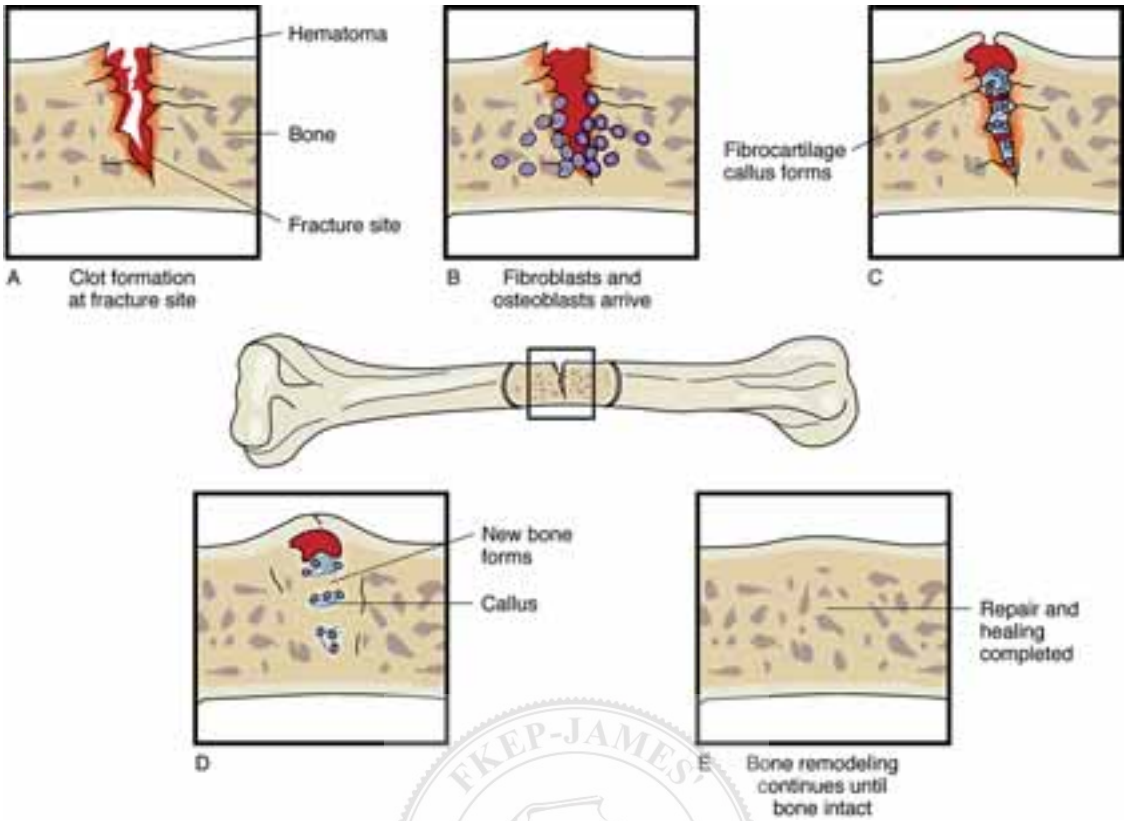

FIGURE 46.1 Fracture healing phases.

Signs and Symptoms

This section focuses on fractures of upper and lower extremities. If the patient sustains a hairline (microscopic) fracture, the signs and symptoms are not readily observable. The patient may complain of tenderness over the site of the injury or more severe pain when moving the affected part of the body. The patient with a hip fracture usually complains of pain either in the groin area (the hip is a deep joint) or at the back of the knee (referred pain). If the fracture is displaced, the limb is often shortened because of contraction of the muscles pulling on the bone sections.

In addition to pain, patients with more complex fractures experience limb rotation or deformity and shortening of the limb (if a limb bone is broken). Range of motion is decreased. If the affected part is moved, a continuous grating sound (crepitation) caused by bone fragments rubbing on each other may be heard. The extremity should not be moved (to try and reposition the bone alignment) if crepitation is present.

Inspect the skin for intactness. A patient with a closed fracture may have ecchymosis (bruising) over the fractured bone from bleeding into the soft underlying tissue. Ecchy-

TABLE 46.1 TYPES OF FRACTURES

Fracture Type	Description
Avulsion	Piece of bone is torn away from the main bone while still attached to a ligament or tendon.
Comminuted	Bone splintered or shattered into numerous fragments. Often occurs in crushing injuries.
Impacted	Bone is forcibly pushed together, resulting in bone being pushed into bone.
Greenstick	Bone is bent and fractures on the outer arc of the bend. Often seen in children.
Interarticular	Fracture involves bones within a joint.
Displaced	Bone pieces are out of normal alignment. One or both pieces may be out of alignment.
Pathological (also called neoplastic)	Caused by bone's being weakened either by pressure from a tumor or an actual tumor within the bone.
Spiral	Fracture curves around the shaft of the bone.
Longitudinal	Fracture occurs along the length of the bone.
Oblique	Fracture occurs diagonally or at an oblique angle across the bone.
Stress	Results in the bone being fractured across one cortex. This is an incomplete fracture.
Transverse	Bone fractured horizontally.
Depressed	Bone pushed inward. Often seen with skull and facial fractures.

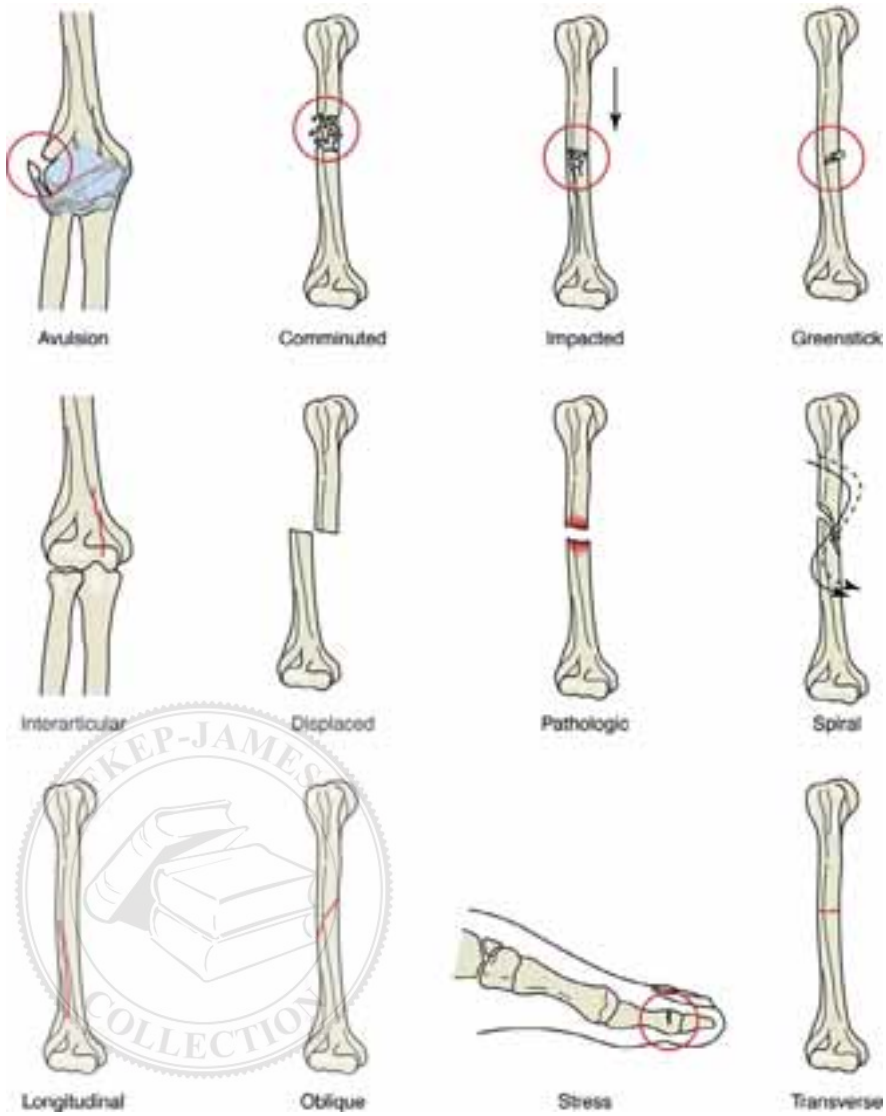

FIGURE 46.2 Types of fractures.

mosis may not develop for several days after the injury. Swelling may also be present and can impair blood flow, causing marked neurovascular compromise. In an open fracture, one or more bone ends pierce the skin, causing a wound, thus increasing the possibility of infection.

Diagnostic Tests

An x-ray examination usually visualizes bone fractures, showing bone malalignment or disruption. Computed tomography may be needed to help detect fractures of complex areas, such as the hip and pelvis. Magnetic resonance imaging is useful in determining the extent of associated soft tissue damage.

For patients experiencing moderate to severe bleeding, a hemoglobin and hematocrit level is obtained. If extensive soft tissue damage is present, the erythrocyte sedimentation rate (ESR) is usually elevated, indicating the expected inflammatory response. The physician may order a serum calcium level to determine baseline values because bone repair requires a sufficient amount of calcium and other minerals.

Emergency Treatment

A patient with a suspected fracture often has injuries elsewhere in the body. Assess the patient for respiratory distress, bleeding, and head or spine injury. If any of these problems occurs, emergency treatment is provided before concern is given to extremity or other fractures.

The treatment of fractures depends on the type and extent of the injury. Emergency treatment is essential to prevent possible life-threatening complications. Box 46.1 Urgent Management of Fractures describes the emergency interventions for the patient with an extremity fracture.

LEARNING TIP

For emergency care of a suspected fracture, do not try to reposition the limb. Remember: Splint it as it lies. Also, ensure that the limb is secured above and below the break to minimize movement and bone grating.

Box 46.1

Urgent Management of Fractures

1. Immediately immobilize affected limb. If movement is required before splinting, support limb above and below fracture.
2. Unless there is bleeding apply splints and padding (above and below fracture site) directly over the clothing. If bleeding is present visualization may be necessary before pressure can be applied where bleeding is originating. Keep patient covered to preserve body heat.
3. If the fractured extremity is a leg bone, the unaffected extremity can be used as a splint by bandaging both legs together. An arm can be bandaged to the chest or put into a sling to minimize further tissue damage.
4. Assess color, warmth, circulation, and movement (CWCM) of the limb distal to the fracture.
5. Open fractures require the protruding bone be covered with a clean (sterile preferred) dressing.
6. Do not attempt to "straighten" or realign the fractured extremity. Move the affected limb as little as necessary.
7. Transport to an emergency department as soon as possible.

Fracture Management

The goals of fracture management are reduction, or realignment, of bone ends; immobilization of the fractured bone (with bandages, casts, traction, or a fixation device); prevention of deformity or further injury; preservation or restoration of function; promotion of early healing; and pain relief.

CLOSED REDUCTION. Closed reduction is the most common treatment for simple fractures. While manually pulling on the bone (limb), the physician manipulates the bone ends into realignment. Analgesia and/or conscious sedation is typically used before the procedure. An x-ray examination is done to confirm that the bone ends are aligned before the area is immobilized.

BANDAGES AND SPLINTS. For some areas of the body, such as the clavicle or wrist, an elastic or muslin bandage or a splint may be used to immobilize the bone during the healing phase. Splints can be used when the fracture has some associated soft tissue damage that needs care or if there is an expectation of swelling. It is important that the splint be well padded, thereby preventing skin breakdown or unnecessary pressure. Perform neurovascular assessments to ensure adequate blood flow to the area (see Chapter 45).

CASTS. Casts provide a strong support for fractured bones, thereby aiding in early mobility and decreased pain. They are also used to correct deformities and to support weak joints while restricting movement. The type of cast used depends on the reason the cast is applied. For more extensive fractures or for weight-bearing areas, a more rigid and durable cast is used for immobilization. Once the need for the cast is resolved (e.g., when bone healing is complete), the cast is removed.

Several types of materials are used for casts, including the traditional plaster of Paris (anhydrous calcium sulfate) and a variety of synthetic products such as fiberglass. Plaster is used for large casts and for weight-bearing areas. Because of a chemical reaction that occurs when the plaster is wet, the cast feels hot when applied for about 30 minutes and then feels cool, taking anywhere from 24 to 72 hours to completely dry. The cast is dry when it feels hard and firm, is odorless, and is shiny white. Keep the wet cast open to air and turn the patient about every 2 hours to expose all sides of the cast to the air to aid in drying and prevent mold growth. A wet cast should be handled with the palms of the hand ("palming the cast") to prevent indentations or a change in the shape of the cast (Fig. 46.3). This prevents the possibility of pressure points forming inside the cast. Unlike plaster of Paris, synthetic material casts such as fiberglass harden quickly and dry in less than 2 hours.

A casted limb is elevated for 24 to 48 hours, and ice can be applied over the injury to reduce swelling. Assess the cast for dryness, tightness, drainage, and odor. A serious complication of a cast being too tight is compartment syndrome (discussed later). If the cast becomes too tight, the physician orders it to be cut (bivalved) with a cast cutter to relieve pressure and prevent pressure necrosis of the underlying skin (Fig. 46.4). If a wound is present or an odor is detected, a window opening into the cast is created to treat the underlying skin problem, often an infected area. The cast window should always be taped in place when wound care is not being provided to prevent the skin from "popping up" through the window and developing pressure points and ischemia. See Box 46.2 Nursing Interventions for a Patient with a Cast.

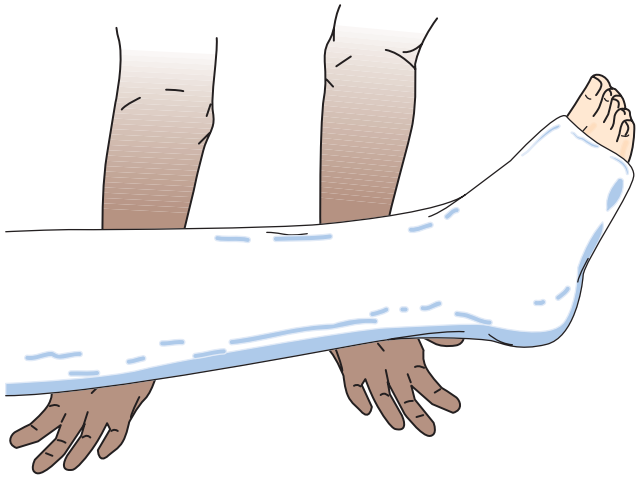

FIGURE 46.3 A wet plaster cast is moved with the palms of the hand to prevent making indentations in the plaster that could become pressure points.

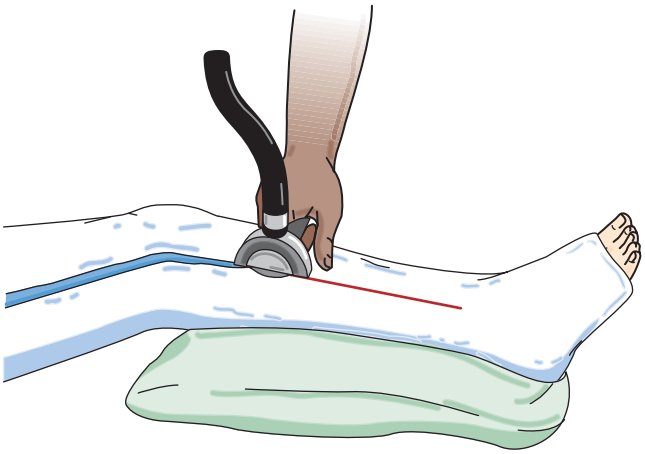

FIGURE 46.4 Bivalving a cast with a cast saw.

TRACTION. Casts can be worn in or out of a hospital setting, but traction for fracture treatment often requires that the patient be hospitalized. As a general definition, traction is the application of a pulling force to a part of the body to provide fracture reduction (positioning bone fragments in correct alignment), reduce movement, or pain relief. Although still used in certain situations, improvements in surgical techniques and orthopedic devices have greatly decreased the use of traction.

Traction is classified as either continuous or intermittent. Continuous traction is required for fracture management; intermittent traction, although not commonly used, may be applied for patients experiencing muscle spasm. Traction can also be performed manually for short periods of time (e.g., to maintain traction on a leg when removing Buck's traction for skin assessment or skin care). The most common types of traction are either skin or skeletal. Skin traction typically involves the use of a Velcro boot (Buck's traction), sling (Russell's traction or knee sling), belt (pelvic), or halter, which is secured around a part of the body (Fig. 46.5). This type of traction does not promote bone alignment or healing but is used instead for relief of painful muscle spasms that often accompany fractures. Buck's traction is indicated for patients with hip fractures and is frequently applied to prevent further trauma while the patient is waiting for surgery. Occasionally, the patient's physical condition or inflammation surrounding the fracture prohibits early surgical intervention, thus necessitating the application of skin (Buck's) traction. When traction is being applied to the skin, there is a restriction as to the amount of weight that can be applied. The weight applied is usually between 5 and 10 lb (2.2 to 4.5 kg). Skeletal traction, also called balanced suspension, involves the use of pins (Steinmann), screws, wires (Kirschner), or tongs (Gardner-Wells, Crutchfield), which are surgically inserted into the

Box 46.2

Nursing Interventions for a Patient with a Cast

1. Assess color, warmth, circulation, movement (CWCM) every 1 to 2 hours for 24 hours and then qid and prn.
   a. Assess cast for tightness (ask patient) and for rough or frayed edges of the cast (can interfere with skin integrity).
   b. Ensure patient can move (wiggle) all digits distal to the cast.
2. With newly applied casts (wet)
   a. Never grasp a wet cast to hold or move it (and do not place on any surface that can cause an indentation)—only use the palms of the hands (finger pressure on a wet cast can cause pressure points on the inside surface)
   b. Ensure patient is turned every 1 to 2 hours to prevent "flattening" of cast surface during drying.
   c. With hip spicas or any cast with an abductor bar, do not use bar to move limb or to help with turns.
   d. Inform patient that plaster casts give off heat when drying. Ensure cast air dries (may require 24 to 72 hours for complete drying). Do not cover cast or use drying aids such as blow dryers. Place cast on absorbent surfaces not plasticized pillows.
   e. Protect skin integrity by ensuring rough edges of cast are properly covered.
   f. Ensure patient knows to keep cast dry during bathing. (Cover with plastic and prevent water seeping into cast ends.)
   g. Synthetic casts (e.g., fiberglass) can be exposed to water (e.g., for hydrotherapy) as needed but require complete drying afterward.
3. Tissue integrity within the cast.
   a. When assessing CWCM assess visible skin for signs of impaired integrity.
   b. Cast edges can be smoothed and covered with stockinettes or gauze and tape (ensure there are no tape allergies) to prevent rubbing of cast.
   c. Monitor for signs and symptoms of infections such as foul odor, heat, redness, and pain.
   d. Skin products should not be used on affected limb.
   e. Visible blood on the surface of the cast has to be monitored. (Outline area with a pen to observe for increasing size of area.) Shadowing of blood not quite reaching the surface of the cast is fairly common but also has to be circled and monitored.
   f. Never place any object inside the cast. Teach patient potential for skin damage if this is done.

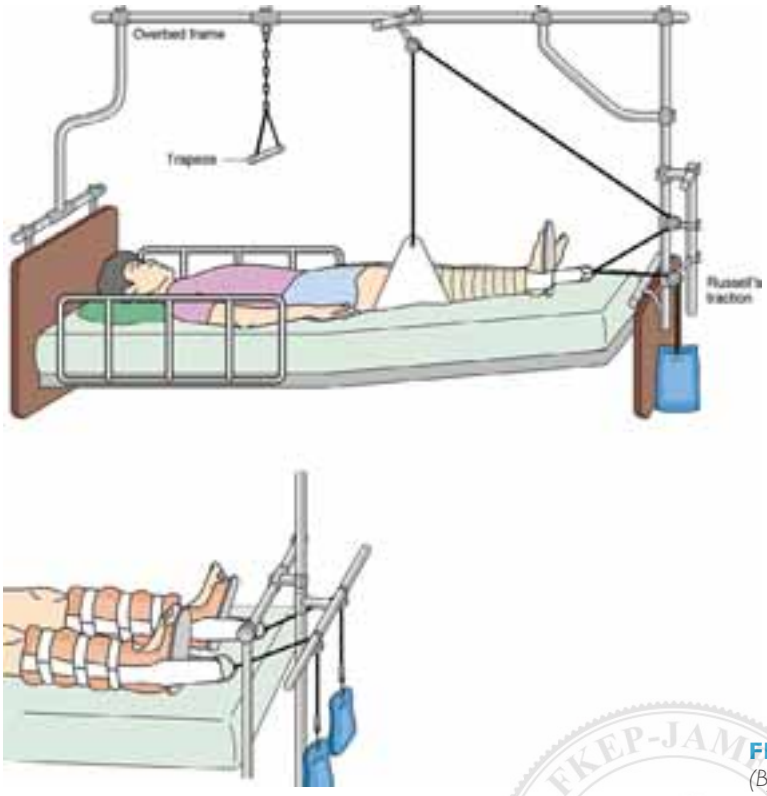

FIGURE 46.5 Types of skin traction. *(A)* Russell's traction. *(B)* Buck's (boot) traction.

bone for the purpose of alignment while the fracture heals (Fig. 46.6). From 20 to 40 lb (9 to 18 kg) of weight is usually applied for skeletal traction, as ordered.

Balanced suspension maintains the traction while allowing the patient some mobility in bed. A Thomas (or T) splint with Pearson's attachment can be used to provide balanced suspension for the lower extremity. The patient's leg rests on a suspended sheepskin-covered splint (see Fig 46.6). Balanced traction methods require countertraction to ensure the patient does not move toward the pull and therefore minimize the effectiveness of the traction. Usually the patients' weight as well as elevating the foot of the bed provides the countertraction necessary.

Caring for the patient in traction includes frequently monitoring neurovascular status for impaired blood flow, checking the equipment to ensure proper functioning, and monitoring skin condition for pressure points or irritation from equipment. Traction must be maintained at all times for fractures. All knots, ropes, weights, and pulleys are inspected

LEARNING TIP

When applying manual traction, usually done by the physician, it is important to maintain a firm, smooth, continuous "pull" on the extremity and not a jerking or yanking motion. The limb is kept in anatomical position and correct alignment is maintained while providing manual traction.

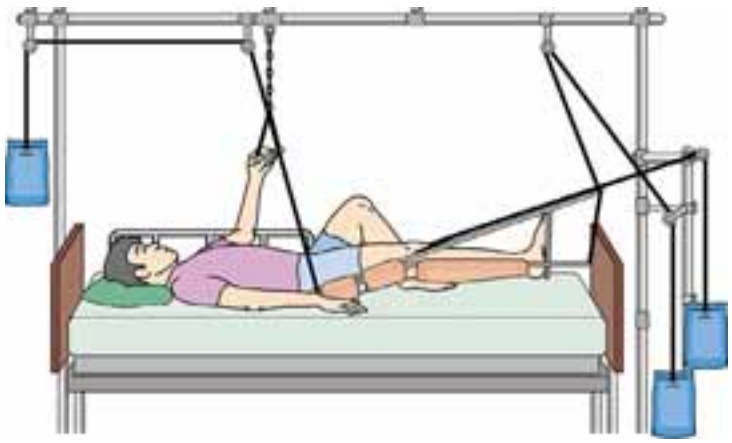

FIGURE 46.6 Balanced suspension and skeletal traction for femur fracture.

every 8 to 12 hours for any loosening and intactness. Weights are to hang unobstructed and should never touch the floor or be removed or lifted. The patient's feet should not rest against the end of the bed. It is important that the traction not be inhibited by any form of friction or impedance. Assistance should be obtained to reposition the patient in bed to prevent lifting injuries, especially with heavy weights in use.

For patients in skeletal traction, pin sites are observed for redness, drainage, odor, swelling, and excessive warmth. Clear, odorless drainage is expected. Some agencies or physicians advocate special solutions or ointments for the skin around the pins (pin care). Others recommend no cleaning to maintain skin integrity. Follow agency policy or physician's order for pin care. Depending on the type of pin used, the pin ends may be covered to protect the patient (and health-care workers) from being injured.

Patients who have traction may be immobilized for an extended period and often experience problems associated with immobility. For example, pressure ulcers on heels are common among older adult patients in traction. Unfortunately, loss of bone density is also a complication of immobility, which may create an additional impairment for normal healing. Another common concern is the person's psychosocial health. Ensure that the patient does not become socially isolated because of the need for extended bedrest.

OPEN REDUCTION WITH INTERNAL FIXATION. An open reduction with internal fixation (ORIF) is a treatment reserved for patients who cannot be managed by casts or traction. One of the most common indications for this surgical procedure is fractured hips. Fractures of the hip involve the proximal femur and affect the older adult more than any other age group. ORIF of the hip allows early mobilization while the bone is healing.

As the name implies, the bone ends are realigned (reduced) by direct visualization through a surgical incision (open reduction [OR]). The bone ends are held in place by internal fixation (IF) devices such as metal plates and screws or by a prosthesis with a femoral component similar to that for total joint replacement (Fig. 46.7). For hip surgery, the IF device is not removed after the fracture heals. For ankle or long bone surgery, the hardware may be removed after healing because of loosening or pain (Box 46.3 Nursing Care Plan for the Patient After Open Reduction with Internal Fixation [ORIF] of the Hip).

EXTERNAL FIXATION. An alternative treatment for some fractures is external fixation. External fixation is used when there has been severe bone damage, such as in crushed or splintered fractures, or if there have been numerous fractures along the bone. After the fracture is reduced, the physician surgically inserts pins into the bone; the pins are held in place by an external metal frame to prevent bone movement (Fig. 46.8). External fixation is ideal for the patient who has an open fracture with soft tissue damage that needs to be treated at the same time. Like skeletal traction, the patient with this device is at risk for complications of skeletal pins,

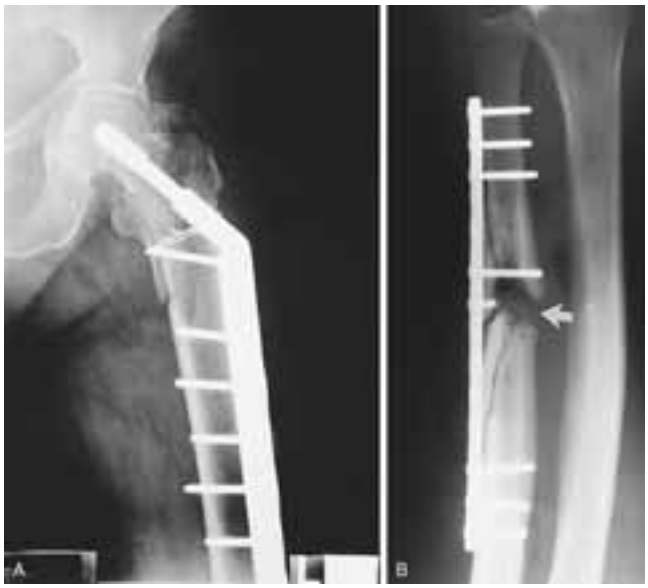

FIGURE 46.7 Internal fixation. *(A)* Intertrochanteric fracture of the hip with fracture fixation via a side plate and screw combination device. *(B)* Side plate and screw fixation of radial fracture. *(From McKinnis, LN: Fundamentals of Orthopedic Radiology. F.A. Davis, Philadelphia, 1997, with permission.)*

CRITICAL THINKING

Mrs. Brown

■ Mrs. Brown, a long-time resident of Happy Hills Care Center, was found lying in the dayroom on her left side, moaning and holding her left leg at 10 a.m. (1/4/07). She cried out with any movement and said she fell and broke her leg. The supervisor notified the paramedics and Dr. Jones. Her vital signs are blood pressure 150/84, pulse 100, respirations 20. Her left leg is noticeably shorter than her right leg. The licensed practical nurse (LPN) remained with Mrs. Brown and instructed her not to move until help arrived. The LPN got blankets and a pillow for her head. The paramedics arrived quickly and took Mrs. Brown to nearby Grace Hospital by ambulance, where she was diagnosed as having a nondisplaced femoral neck (hip) fracture. Dr. Jones ordered 5 lb of Buck's traction. Mrs. Brown is restless and picking at her bedcovers when you assess her at the beginning of your shift.

1. How should the LPN/LVN document the incident of Mrs. Brown's fall at the care center?
2. What is the purpose of Buck's traction for Mrs. Brown?
3. What are your nursing responsibilities while caring for Mrs. Brown?
4. What might explain Mrs. Brown's restlessness?

Suggested answers at end of chapter.

Box 46.3 NURSING CARE PLAN for the Patient After Open Reduction with Internal Fixation (ORIF) of the Hip

Pain related to surgical wound

Patient Outcome Patient states that pain relief is satisfactory.

Evaluation of Outcome Does patient state that pain is absent or at tolerable level (pain rated 0 to 2 on pain assessment scale)?

Intervention	Rationale	Evaluation
Give pain medication as needed; anticipate need for pain medication.	Pain medication relieves pain, especially if given before pain is severe.	Does patient state pain is relieved?
Give pain medication before activity (e.g., session with physical therapist).	Increased activity can cause pain.	Is patient restless or agitated during activity?
Use nondrug pain relief measures, such as distraction, guided imagery, other relaxation techniques.	Analgesic therapy is enhanced with complementary pain relief measures.	Does patient report pain relief is enhanced with music or relaxation?
Use fracture bedpan.	Fracture bedpans are more comfortable and easier to position for patients.	Is patient able to use fracture pan with comfort?

Impaired physical mobility related to hip precautions and surgical pain

Patient Outcome Patient will maintain desired level of activity.

Evaluation of Outcome Does patient maintain activity desired?

Intervention	Rationale	Evaluation
Reinforce transfer and ambulation techniques.	Activity is restricted due to hip precautions and weight-bearing limitations.	Does patient transfer and ambulate as instructed by physical therapist?
Place overhead frame and trapeze on bed; teach patient how to use it.	Patient mobility is increased and pain decreased with use of trapeze for movement.	Does patient use overhead frame and trapeze for movement in bed with less pain?
Monitor patient for and take measures to prevent complications of immobility: turn patient every 2 hours and check skin; keep heels off bed; teach patient to deep breathe and cough q2hr; teach use of incentive spirometer.	Immobility complications can occur if preventive measures are not used.	Does patient experience complications of immobility?
Apply thigh-high elastic stockings or sequential compression device to unaffected limb as ordered.	Helps prevent blood clots.	Is patient free from blood clots?
Give anticoagulants as ordered.		
Get patient out of bed as soon as ordered.		
Ambulate patient as early as possible.		
Remind patient to practice leg exercises.		

CRITICAL THINKING

Tommy Martin

■ Tommy, age 18, was in a motor vehicle accident that resulted in a fractured pelvis and femur. He is to be in skeletal traction for several weeks.

1. Identify three nursing diagnoses related to Tommy's physical or emotional well-being.
2. What are some nursing interventions for these diagnoses?

Suggested answers at end of chapter.

which includes pin reaction, compromised circulation, and infection. Pin sites are observed frequently for signs and symptoms of infection. Pin site care varies from facility to facility. The overriding principle is to ensure that strict aseptic technique is always maintained as the pin is a pathway for microorganisms to directly enter bone tissue and cause osteomyelitis. See Box 46.4 Nursing Care Plan for the Patient with External Fixation of the Lower Extremity.

NURSING CARE TIP

If you have to move an extremity that has an external fixation device, grasp the device and lift, raise, or move the limb as needed. By grasping the device, there is less movement of the healing bone and therefore less trauma to the site of healing and less pain with movement. Care must be taken not to loosen any fasteners holding the pins in place.

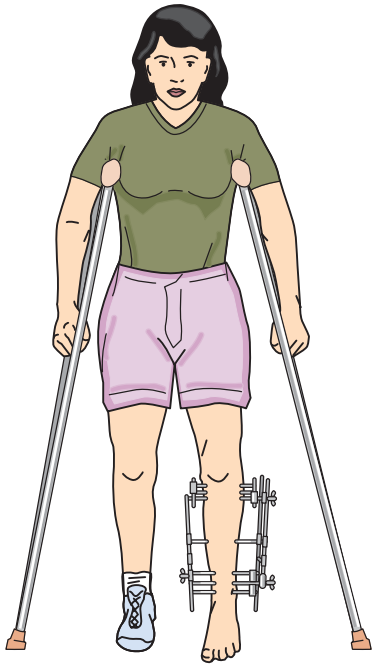

FIGURE 46.8 External fixation for complex fractures and wound care.

NONUNION MODALITIES. Although most bones heal properly with the correct treatment, some patients experience malunion (malalignment of healed bone) or nonunion (delayed or no healing). A number of variables influence how a bone heals, including age, nutritional status, and the presence of other diseases that alter the healing process, such as diabetes mellitus.

Several methods for treating nonunion are available, including electrical bone stimulation and bone grafting. For selected patients, bone stimulation may be effective in promoting healing; the exact mechanism of action is not known. Bone grafting involves adding packed bone to the fracture site in an attempt to facilitate healing. Bone-stimulating compounds such as Osteoset, Pro Osteon, or Allomatrix are being used to promote bone growth in patients. These compounds are used during surgical procedures as glue, cement, or filler.

Another fracture healing method is low-intensity pulsed ultrasound (also called Exogen therapy). Ultrasound treatment has provided excellent results for slow-healing fractures, as well as for new fractures. The patient applies the treatment for about 20 minutes each day.

Complications of Fractures

Monitor for possible complications and implement interventions to prevent them. The most common complications include impaired neurovascular status, hemorrhage, infection, and thromboembolitic complications. Although they do not occur often, acute compartment syndrome and fat embolism syndrome (more common with fractures of long bones) can be life-threatening complications of fractures.

NEUROVASCULAR. Neurovascular checks are done to detect abnormalities. Decreased or absent pulses, cool skin temperature, and dusky color indicate circulation alterations. Numbness and tingling, decreased sensation, and mobility indicate neurological alterations. These findings should be reported to the physician promptly.

HEMORRHAGE. Bone is highly vascular, and damage to or surgery on bone (particularly the large long bones of the extremities) can cause bleeding. Assess for bleeding and monitor vital signs carefully. Hypovolemic shock may result from severe hemorrhage (see Chapter 8).

INFECTION. Trauma predisposes the body to infection, especially when the skin, the body's first line of defense, is disrupted. Wound infections, pin site infections, drainage tube infections, and osteomyelitis (bone infection) are common. Hospital-acquired infections, such as pneumonia or urinary tract infection, can occur in patients who are immobilized for extensive periods while their fractures heal.

THROMBOEMBOLITIC COMPLICATIONS. Deep vein thrombosis or pulmonary embolus (PE) (see Chapter 31)

Box 46.4 NURSING CARE PLAN for the Patient with External Fixation of the Lower Extremity

Risk for infection related to skin integrity impairment

Patient Outcomes Patient does not develop an infection.

Evaluation of Outcome Does patient remain free from infection?

Interventions	Rationale	Evaluation
Inspect dressings, wounds, pin sites for signs and symptoms of infection.	Signs and symptoms of infection could include warmth, redness, heat, swelling, drainage, pain.	Are any wounds infected?
Monitor color of and measure wound drainage.	Wound drainage color and amount can indicate severity of infection.	Does wound have large amount of purulent drainage?
Change dressings or provide wound and pin care per facility policy using aseptic technique.	Use of aseptic technique minimizes chance of infection. Pin wound sites should be free of crusting, which promotes infections because of decreased skin integrity.	Are pin sites clean with no crusting?
Monitor vital signs frequently.	Alterations in vital signs can indicate infection.	Are vital signs within baseline findings?

Impaired physical mobility related to the external fixation (EF) device

Patient Outcomes Patient will maintain desired level of mobility/activity.

Evaluation of Outcome Has patient maintained desired level of mobility and activity?

Interventions	Rationale	Evaluation
Reinforce transfer and ambulation techniques.	Depending on severity of fracture and size of EF device, there may be special needs to transfer and ambulate.	Does patient transfer and ambulate as instructed?
Place overhead frame and trapeze on bed; teach patient how to use them.	Patient mobility is increased and pain decreased with use of trapeze for movement.	Does patient use overhead frame and trapeze for movement with less pain?
Teach patient how to move limb using EF device.	Providing patient with instruction on moving the extremity promotes independence and minimizes pain.	Does patient move the extremity using EF device?
Assess patient for and take measures to prevent complications of immobility. Promote early ambulation to minimize complications.	Immobility complications can occur if preventative measures are not used.	Does patient have any complications of immobility?
Include other disciplines such as the physiotherapist in promoting and teaching about ambulation.	EF devices allow for earlier ambulation. Physiotherapy can provide initial or reinforce the education needed to promote ambulation (e.g., with crutch walking).	Has patient used information learned from other disciplines to aid ambulation?

Disturbed body image related to external fixation device

Patient Outcomes Patient will not experience disturbed body image while EF device is in place.

Evaluation of Outcome Does patient experience disturbed body image resulting from EF device?

Interventions	Rationale	Evaluation
If possible, explain to patient preoperatively what EF device will look like.	Preparing patient for what to expect postoperatively increases likelihood of acceptance and minimizes the unknown.	Was patient able to verbalize why device is to be used and what device will look like?
Reinforce the idea that EF device will decrease discomfort and allow for earlier ambulation.	Promoting early ambulation and increased comfort enhance acceptance.	Did patient understand benefit of EF device allowing for early ambulation and increased comfort?
Provide psychological support and an environment of acceptance.	Accepting your patient and allowing for discussion of concerns promotes a sense of well-being and acceptance of EF device.	Did patient feel comfortable in expressing concerns related to body image?

can develop in patients who are immobile because of trauma or surgery. Thromboembolitic complications are the most common problems of lower extremity surgery or trauma and the most fatal complication of musculoskeletal surgery, particularly in the older adult. Leg exercises, early ambulation, and anticoagulant therapy, usually using low molecular weight heparin, such as dalteparin (Fragmin) or enoxaparin (Lovenox), help prevent these problems.

ACUTE COMPARTMENT SYNDROME. Compartments are sheaths of fibrous tissue that support and partition nerves, muscles, and blood vessels, primarily in the extremities (Fig. 46.9). There are several compartments within each extremity. Acute compartment syndrome (ACS) is a serious problem in which the pressure within one or more extremity compartments increases, causing massive circulation impairment to the area. An external device such as a cast or bulky dressing can increase pressure when there is tissue swelling or compression in the area. The early symptom of ACS is the patient's report of severe, increasing pain that is not relieved with narcotics and occurs more on active movement than passive movement. Decreased sensation follows before ischemia becomes severe. In severe ACS, the patient has the six *P*s:

- Pain (severe, unrelenting, and increased with passive stretching)
- Paresthesia (painful tingling or burning)
- Paralysis (late symptom)

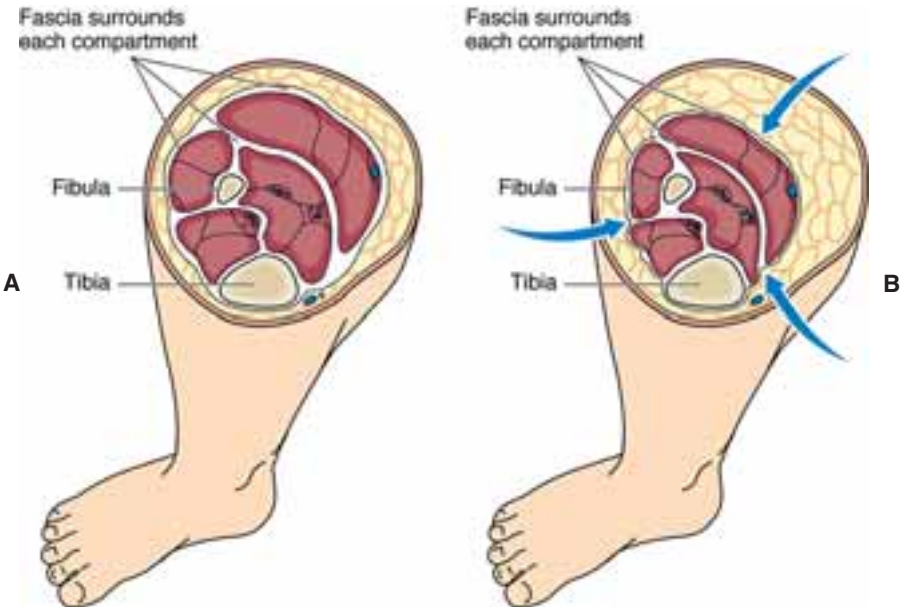

FIGURE 46.9 *(A)* Lower leg compartments. Each compartment contains muscles, an artery, a vein, and a nerve. *(B)* Compartment syndrome. Increased pressure in a compartment compresses structures within the compartment.

- Pallor (but there may be warmth or redness over the area)
- Pulselessness (late and ominous sign)
- Poikilothermia (temperature matches environment; i.e., the extremity is cool to touch)

Relief of pressure is the goal. It may be accomplished by removing the source of pressure, such as bivalving a cast, or by performing a **fasciotomy,** which is an incision into the fascia that encloses the compartment. This incision allows the compartment tissue room to expand and relieves the pressure. If more than one compartment has increased pressure, multiple fasciotomies are required. These surgical wounds remain open until the pressure decreases. Then they are closed and may require skin grafting. If this condition continues without pressure relief, tissue necrosis, infection, extremity contracture, or renal failure may result. Renal failure is a potentially fatal complication of ACS.

CRITICAL THINKING

Mr. Andrews

■ Mr. Andrews has suffered a nondisplaced fracture of his right femur. He has a cast on from his groin to the middle of his foot. An hour ago he received 10 mg of morphine intravenously (IV), and he is complaining of continuing and increasing pain.

1. What nursing assessment should now be performed?
2. What might be happening with Mr. Andrews?
3. What interventions may be necessary?

Suggested answers at end of chapter.

FAT EMBOLISM SYNDROME. Fat embolism syndrome (FES) is another serious complication in which small fat globules are released from yellow bone marrow into the bloodstream. The globules then travel to the lung fields, causing respiratory distress. This process most often occurs when long bones (especially the femoral shaft) are fractured or when the patient has multiple fractures. The older adult patient with a fractured hip is also at a high risk for FES. This condition can occur up to 72 hours after the initial injury or procedure.

The earliest manifestation of FES is altered mental status resulting from a low arterial oxygen level. The patient then experiences tachycardia, tachypnea, fever, high blood pressure, and severe respiratory distress (shortness of breath). Most patients also have a measleslike rash, called petechiae, over the upper body. Even when aggressively treated, patients with FES often die from the pulmonary edema that typically develops. Note early FES signs and symptoms and report them to the physician immediately. If a fat embolism is suspected, the following actions should be taken:

- Promote oxygenation by administering oxygen at 2 L per minute via nasal cannula.
- Place patient in high-Fowler's position or raise head of bed as tolerated by patient.
- Maintain bedrest and keep movement of extremity to a minimum.
- Prepare patient for a chest x-ray examination or lung scan.
- Prepare patient for arterial blood gas (ABG) determination.
- Administer intravenous fluids as ordered.
- Administer corticosteroids as ordered.
- Provide emotional support and calm environment.

Nursing Process for the Patient with a Fracture

Caring for the patient with a fracture requires coordinated care with other health team members.

ASSESSMENT/DATA COLLECTION. The most important aspect of monitoring the patient with a fracture is frequent checking of neurovascular status (circulation, sensation, mobility) distal to the fracture site (Chapter 45). As mentioned earlier, acute compartment syndrome is a potentially limb- or life-threatening complication that results when blood flow is impaired.

Pain is managed by both medications and complementary therapies. Bone pain can be excruciating and must be treated aggressively. For the patient who cannot report pain, such as a cognitively impaired or comatose patient, ensure that pain relief is maintained by regularly scheduled analgesic administration.

NURSING DIAGNOSIS, PLANNING, AND IMPLEMENTATION. Determination of the appropriate nursing diagnosis depends on the type of fracture. See Box 46.3 Nursing Care Plan for the Patient After Open Reduction with Internal Fixation [ORIF] of the Hip.

Acute pain related to fractured bone

EXPECTED OUTCOME: Patient will report relief from pain using pain assessment scale.

- Provide analgesics and anti-inflammatories as ordered *to relieve pain and swelling*.
- Ensure proper positioning and alignment *to minimize discomfort and promote pain relief.*
- Assess for compartment syndrome if patient has a cast in place *to prevent neurovascular complications.*
- Apply ice as ordered *to decrease swelling and pain.*
- Teach alternative measure of pain relief *to maximize means to relieve pain.*

Impaired physical mobility related to bone fracture

EXPECTED OUTCOME: Patient will demonstrate increased mobility.

- Encourage independence *to promote mobility.*
- Utilize other disciplines such as occupational and physiotherapy *to encourage and promote patient mobility.*

fasciotomy: fascia—fibrous tissue + otomy—opening into

- Provide equipment and resources such as crutches and wheelchairs *to improve mobility.*

Risk for peripheral neurovascular dysfunction related to increased tissue volume or restrictive envelope

EXPECTED OUTCOME: Patient will maintain peripheral pulses, warm skin, sensation, and ability to move extremity.

- Assess and monitor frequently for compartment syndrome.
- Assess for swelling of affected limb (especially if patient has a cast or tight dressing).
- Keep limb elevated above heart *to minimize edema.*
- Administer anti-inflammatory agents as ordered.
- Monitor for increasing pain even after analgesic administration.

NURSING CARE TIP

A confused or comatose patient may not be able to report pain, the most reliable indicator of pain. Nonverbal indicators (e.g., grimacing, restlessness, elevated blood pressure and heart rate) are not reliable for pain assessment and should not be used to determine pain absence. You need to prevent the patient's pain by anticipating it and treating it in advance. You can do this by recognizing causes of pain and understanding that the effects of mild but repetitive pain (as in turning several times a day) can adversely affect the patient (such as by leading to exhaustion). Causes of pain include conditions or diseases (such as fractures, surgery, trauma, or cancer), procedures (such as turning or wound care), and biomedical devices (such as orthopedic fixation devices, wound drains, urinary catheters, nasogastric tubes, and chest tubes).

With few patients being medicated before painful procedures, some of which may be done several times a day (turning), confused or comatose patients are at greater risk for lack of pain relief. Provide analgesics as ordered before painful procedures and on a regular basis when pain is assumed to be present to keep your patients comfortable. For anticipated pain, the acronym APP (assume pain present) can be used.

Use pain assessment tools designed for those who are cognitively impaired to ensure that their pain is adequately relieved. The **P**ain **A**ssessment **IN** **A**dvanced **D**ementia (PAINAD) is a tool that was developed for this purpose. Search the web to view it or visit http://www.amda.com/caring/may2004/painad.htm. Share pain research findings with administrators in your institution to establish policies that support proactive pain management for all patients.

EVALUATION. The outcome is met if the patient reports or demonstrates pain is within tolerable levels on a pain assessment scale, demonstrates increased physical mobility, and maintains peripheral pulses, warm skin, sensation, and ability to move extremity.

PATIENT EDUCATION. If the patient has a cast, review the appropriate instructions for cast care (see Box 46.2 Nursing Interventions for a Patient with a Cast). Health teaching is also important for care of the extremity after cast removal (Box 46.5 Extremity Care Following Cast Removal). If the patient has a wound, teach the patient and caregiver how to assess and dress the wound (and provide pin care if needed), and when to report changes such as signs and symptoms of infection.

Teach the importance of adequate protein, calories, vitamins, and minerals for healing to occur. Unless otherwise contraindicated, milkshakes and instant breakfast preparations are good sources of additional protein and calories, as well as a source of calcium.

Osteomyelitis

Osteomyelitis is an infection of bone that can be either acute or chronic. A bone infection lasting less than 4 weeks is considered acute; one that lasts more than 4 weeks is chronic.

Pathophysiology

Regardless of the type of osteomyelitis, the infection results from invasion of bacteria into bone and surrounding soft tissues. Inflammation occurs, followed by ischemia (decreased blood flow) (Fig. 46.10). Bone tissue then becomes necrotic (dies), which retards healing and causes more infection, often as a bone abscess.

Pathogens enter bone in several ways. Direct inoculation means that an injury to the body allows the offending microbes direct access to bone tissue. An open fracture is an example of that process. Contiguous spread occurs when surrounding soft tissue becomes infected. An example is the patient with cellulitis whose infection then spreads to underlying bone. In hematogenous spread, an infection beginning in another part of the body migrates to bone. For instance, a

Box 46.5

Extremity Care Following Cast Removal

- Ensure skin properly cleansed. Soak rather than rub skin to remove dry scales.
- The extremity likely will be weak with decreased ROM—move it gently and provide analgesics prn.
- When extremity is not in use, provide support with pillows or orthotic device until strength and movement return.
- Ensure active and passive ROMs are performed as per PT and patient tolerance will allow.
- Lower extremity swelling can be prevented with elastic support stockings.

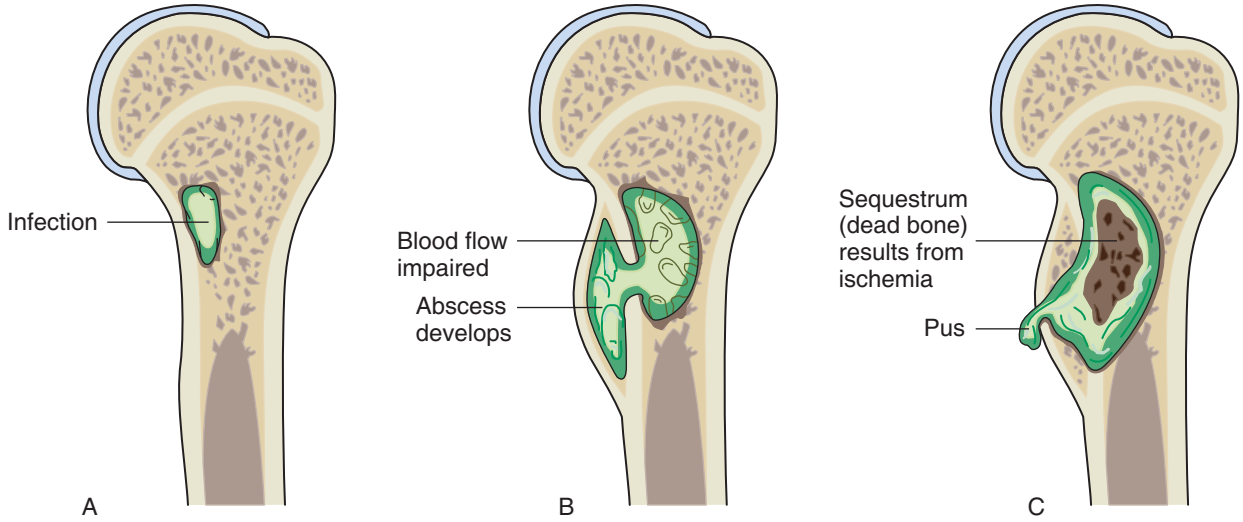

FIGURE 46.10 Sequence of osteomyelitis development. *(A)* Infection begins. *(B)* Blood flow is blocked in the area of infection. An abscess with pus forms. *(C)* Bone dies within the infection site, and pus formation continues.

patient with a total hip replacement may acquire osteomyelitis from a urinary tract infection.

Causes and Types

Penetrating trauma leads to acute osteomyelitis by direct inoculation. The most common pathogens causing osteomyelitis are *Pseudomonas aeruginosa, Staphylococcus aureus,* and *Proteus.* The leading cause of contiguous spread is a slow-healing foot ulcer in the patient who has diabetes mellitus or peripheral vascular disease. Multiple organisms may be present in the wound and subsequently the bone. Hematogenous spread results from bacteremia (infection of the blood), underlying disease, or nonpenetrating trauma. Long-term intravenous catheters are primary sources of infection.

Signs and Symptoms

The patient with acute osteomyelitis has fever, as well as local signs of inflammation, such as tenderness, redness, heat, pain, and swelling. Pain (particularly over the area of infection), may be the only apparent complaint. Ulceration, drainage, and localized pain are typical signs and symptoms of chronic osteomyelitis.

Diagnostic Tests

The patient with osteomyelitis typically has an elevated leukocyte (white blood cell) count, an elevated erythrocyte sedimentation rate, and positive bone biopsy for infection. Some patients also have a positive blood culture. MRIs, x-ray examinations, and CT scans can show areas of infection.

Therapeutic Interventions

Long-term antibiotic therapy is the treatment of choice for patients with bone infection. Infection in bone tissue is difficult to resolve and may require weeks to months of medication. Antibiotic therapy alone may not resolve the infection. Patients with chronic osteomyelitis may require surgery to remove necrotic bone tissue or replace it with healthy bone tissue. Amputations are reserved for patients who have massive infections that have not responded to one or more of the conventional treatments.

Nursing Management

Patients often administer their intravenous antibiotics at home rather than have a costly stay in a hospital. Teach the patient and caregiver about the side effects, toxicity, interactions, and precautions for antibiotic therapy. A home care nurse may be needed to assist the patient.

If a soft tissue wound is present, ensure that sterile technique is used for dressing changes. The home health nurse may teach the patient and family how to perform dressing changes, the importance of hand washing prior to dressing changes, and how to avoid the spread of pathogens.

Osteoporosis

Osteoporosis is a common metabolic disorder in which the bone loses its density, resulting in fragile bones and possibly fractures. The wrist, hip, and vertebral column are most commonly involved. Over 10 million people have osteoporosis, and 18 million more have low bone mass according to the National Osteoporosis Foundation. Both women and men develop osteoporosis, although it is often thought that only women are affected. Women are at greatest risk because their bones are smaller than men's bones. To protect against osteoporosis, good health habits through age 30 are important. They include adequate calcium and vitamin D intake (ages 11 to 25: 1200 to 1500 mg/day), weight-bearing exercise, avoiding alcohol, and not smoking.

Pathophysiology

Bone is living tissue that is resorbing (breaking down) old tissue (osteoclast cells) and constantly building new tissue (osteoblast cells). Bone density (mass) peaks between 30 and 35 years of age. After these peak years, the rate of bone breakdown exceeds the rate of bone building as we age.

Trabecular (cancellous) bone is lost first, followed by a loss of cortical (compact) bone. The result is irreversible bone loss that makes the inside of bones porous and weaker. As a result, over 1,000,000 fractures occur annually, and 700,000 of these are vertebral fractures. Hip fractures are the second most common, accounting for more than 300,000 per year. The mortality rate for hip fractures is about 50% during the first year after the fracture. For postmenopausal women, decreased estrogen appears to slow down the absorption of calcium, resulting in an increased bone loss.

Cause and Types

Osteoporosis is either primary or secondary. Primary osteoporosis is the most common and is not associated with another disease or health problem. Risk factors for primary osteoporosis include the following:

- Caucasian or Asian heritage, postmenopausal, female (less estrogen available to protect bone)
- Sedentary lifestyle
- Decreased calcium intake
- Lack of vitamin D (to absorb calcium)
- Excessive alcohol consumption
- Cigarette smoking
- Excessive caffeine intake
- Small boned, petite body build

Secondary osteoporosis results from an associated medical condition, such as hyperparathyroidism; having renal dialysis; drug therapy, such as steroids and certain antiseizure drugs, sleeping medications, hormones for endometriosis, or cancer drugs; and prolonged immobility, such as that seen with patients who have a spinal cord injury.

Signs and Symptoms

Most women do not realize they have osteoporosis until they fracture a bone. During the late middle years, the classic "dowager's hump," or kyphosis of the spine, is usually present. The patient's height decreases and back pain may be present. The patient may be embarrassed by the change in body image and may have curtailed social activities. Some patients have difficulty finding clothes that fit comfortably.

Diagnostic Tests

X-ray examination of the bone is not helpful in diagnosing bone loss in its early stages. Computed tomography and quantitative CT scans detect early spinal changes and measure bone density. Ultrasound can also be used to screen bone mass. Dual-energy x-ray absorptiometry (DXA) is used as a screening tool to measure bone mineral content. This test is noninvasive and is currently the most widely used technique to measure bone density.

Serum calcium and vitamin D levels may be decreased, and serum phosphorus may be increased. With severe bone loss, alkaline phosphatase levels may be elevated, confirming bone damage.

Therapeutic Interventions

The cornerstone of treatment for osteoporosis is medication and avoidance of modifiable risk factors to prevent bone loss.

MEDICATION. Medication may be used for prevention or treatment purposes. The current drugs of choice are calcium supplements, vitamin D, and bisphosphonates, such as alendronate (Fosamax) and risedronate (Actonel).

Calcium is also important to prevent bone loss. If serum calcium falls below normal levels, the parathyroid glands stimulate the bone to release calcium into the bloodstream. The result is demineralized bone. Therefore, calcium supplements are an important aspect of treatment. Teach the patient to drink plenty of fluids to prevent calcium-based urinary stones. Vitamin D supplementation, to aid calcium absorption, may also be necessary for patients who have inadequate sunlight exposure (institutionalized people) or who cannot metabolize vitamin D.

Alendronate and risedronate are used to prevent or slow the progress of osteoporosis. They suppress osteoclast activity to prevent the breakdown of bone. Although side effects are not common, serious cases of esophagitis and esophageal ulcers have been reported. Therefore, teach the patient to take the drug early in the morning and follow it with a full glass of water. The patient should not lie down for at least 1 hour after taking the drug.

A newer drug class for osteoporosis is the selective estrogen receptor modulator (SERM). Raloxifene (Evista) increases bone mass 2% to 3% each year. SERM drugs are designed to mimic estrogen in some parts of the body while blocking its effects elsewhere. Recently approved for use is the newest drug class for osteoporosis, recombinant human parathyroid hormone. Teriparatide (Forteo) is used for men and women at a great risk for fracture. Teriparatide increases bone mass by increasing the action and number of osteoblasts. It is considered a bone formation agent.

Other drugs that may be used include testosterone (the male hormone that helps build bone), calcitonin (nasal spray, injection), and sodium fluoride. All these medications have major disadvantages and are consequently not commonly given. Any drug used to prevent or control osteoporosis must be administered under the supervision of a physician, including supplements.

DIET. Increasing calcium and fluids are the main dietary considerations for women. Calcium intake should be 1000 mg/day for those age 25 to 65 and 1500 mg for those over age 65. Teach patients what foods are high in calcium, such as dairy products and dark green, leafy vegetables. If the patient consumes excessive caffeine or alcohol, teach about the need to avoid these substances. For more information, visit the National Osteoporosis Foundation at www.nof.org.

Exercise

Weight-bearing exercise, especially walking, stimulates bone building. The patient should wear well-supporting, nonskid shoes at all times and avoid uneven surfaces that could contribute to falls. Resistance exercise such as weight training or the use of some of the equipment available at fitness centers is also beneficial.

FALL PREVENTION. Osteoporotic bone may cause a pathological fracture in which the hip breaks before the fall.

For other patients, a fall can cause a hip or other fracture. Therefore, fall prevention programs in hospitals and nursing homes are important.

In collaboration with the physical or occupational therapist, case manager, or discharge planner, assess the patient's home environment. The patient and family are taught how to create a hazard-free environment, such as avoiding scatter rugs and slippery floors. Walking paths in the home must be kept free of clutter to prevent falls. If needed, a walker or cane provides additional support.

Paget's Disease

Paget's disease, also called osteitis deformans, is a metabolic bone disease in which increased bone loss results in large, disorganized bone deposits throughout the body. It is primarily a disease of the older adult.

Pathophysiology

Three phases of the disorder have been described: active, mixed, and inactive. A prolific increase in osteoclasts (cells that break down bone) causes massive bone deformity and destruction. Osteoblasts (bone-building cells) then react to form new bone. However, the result is disorganized in structure. Finally, when osteoblastic activity exceeds the osteoclastic activity, the inactive phase occurs. The newly formed bone becomes sclerotic with increased vascularity.

Paget's disease can affect one or multiple bones. The most common areas involved are the femur, skull, vertebrae, and pelvis.

Causes and Types

The exact cause of this disease is not known, but it tends to run in families. Paget's disease may be the result of a latent viral infection contracted in young adulthood. It is more common in Europe than in the United States.

Signs and Symptoms

Most patients with Paget's disease have no obvious symptoms, particularly when the disorder is confined to one bone. Pain is a major symptom in many. For patients with more severe disease, signs and symptoms are varied and potentially fatal.

Diagnostic Tests

Diagnosis may be made solely on x-ray findings. Radiographs of pagetic bone show punched-out areas indicating increased bone resorption. The overall mass of bone may be enlarged, depending on the phase of the disorder. Deformities, fractures, and arthritic changes are not uncommon. Bone scans can also be used to help in the diagnosis.

The primary laboratory findings are an increased alkaline phosphatase (ALP) and an increase in urinary hydroxyproline. Pyrilinks and Osteomark are urine tests that can be used in place of the urinary hydroxyproline test. ALP reflects bone damage. Urinary hydroxyproline indicates an increase in bone turnover. The higher the level, the more severe the disease. Calcium levels in both blood and urine are elevated as damaged bone releases calcium into the bloodstream.

Therapeutic Interventions and Nursing Management

Nonsurgical management is employed to relieve pain and promote a reasonable quality of life for the patient. For mild disease, nonsteroidal anti-inflammatory drugs (NSAIDs) are given.

MEDICATION. The purpose of drug therapy for the patient with Paget's disease is to relieve pain and decrease bone loss. Calcitonin (Calcimar) is a thyroid hormone that is often effective in initiating a remission of the disease. It appears to decrease bone loss while also decreasing pain. If effective, the ALP level decreases. The usual duration of therapy is 6 months, followed by 6 months of etidronate disodium (Didronel) or another bisphosphonate drug. Its action is similar to that of calcitonin, and it must be taken on an empty stomach. Alendronate is a bone resorption inhibitor and calcium regulator. Intravenous dosing for 5 days may initiate a disease remission.

Plicamycin (Mithramycin, Mithracin) is a potent anticancer drug and antibiotic that is reserved for patients with severe hypercalcemia or severe disease with neurological involvement. This drug suppresses both osteoclastic and osteoblastic activity within days, but it has serious adverse effects. As with all drugs, observe for toxic effects such as liver and kidney failure. The platelet count is monitored because the drug can decrease platelet production. When liver enzymes become too high, the drug is temporarily discontinued until they return to baseline.

Nursing management for Paget's disease focuses on pain relief and support for symptoms. Teaching about the disease, medications, and other therapies is done.

Bone Cancer

Bone tumors may be benign or malignant. Malignant tumors may be either primary (originating in the bone) or metastatic, originating from another location and migrating to bone. Primary bone tumors tend to develop in people under 30 years of age and account for only a small percentage of bone cancers. Metastatic lesions are much more common and most often affect the older adult. The pathophysiology depends on the type of bone cancer. The cause of bone cancer is not known.

Primary Malignant Tumors

Osteosarcoma, or osteogenic sarcoma, is the most common primary malignant bone tumor as well as being the most fatal bone tumor. It is a fairly large tumor that typically metastasizes to the lung within 2 years of diagnosis and treatment. Osteosarcoma most frequently affects the arms and legs (particularly around the knees), but can be found in other bones. This type of cancer usually affects young people between the ages of 10 and 25, and boys are twice as likely to develop the disease. Long bones of the legs and arms are most often the sites of origin. More than 50% of osteosarcomas occur in the distal femur in young men.

osteosarcoma: osteo—bone + sarc—flesh + oma—tumor

The disease itself is relatively rare, with an occurrence rate of approximately two per million people. Pain and swelling in an arm or leg that worsens with exercise or at night are some of the manifestations of osteosarcoma. A lump in the area or an unexplained limp may also be cause for further investigation. X-rays, bone biopsy, CT scan, bone scan, and MRI are some of the diagnostic tests that can be performed to help in the diagnosis of the malignancy. Older patients with Paget's disease may also develop these lesions. Chemotherapy and surgical excision of the affected bone with bone grafting or amputation of the affected limb are the treatments most commonly used for osteosarcomas.

Ewing's sarcoma is the most malignant bone tumor. In addition to local pain and swelling, systemic signs and symptoms, including low-grade fever, leukocytosis, and anemia, are common. The pelvis and lower extremity are most often affected in children and young men.

Patients with a *chondrosarcoma* (cancer of cartilaginous cells) have a better prognosis than those with the previously described types of bone cancer. This type of cancer occurs in middle-aged and older people.

METASTATIC BONE DISEASE. Primary malignant tumors that occur in the prostate, breast, lung, and thyroid gland are called bone-seeking cancers because they migrate to bone more than any other primary cancer. Once cancer has metastasized, multiple bone sites are typically seen. Pathological fractures and severe pain are major concerns in managing metastatic disease. See Chapter 10 regarding caring for patients with cancer.

Signs and Symptoms

Primary tumors cause local swelling and pain at the site. A tender, palpable mass is often present. Metastatic disease is not as visible, but the patient complains of diffuse severe pain, eventually leading to marked disability.

Diagnostic Tests

Diagnosis of bone cancer is made by x-ray examination, computed tomography, bone scan, bone biopsy, or MRI. Chapter 45 discusses these tests in detail.

The patient with metastatic disease has an elevated ALP level and possibly an elevated erythrocyte sedimentation rate, indicating secondary tissue inflammation.

Therapeutic Interventions

Management of bone cancer depends on the type and extent of the tumor. The treatment of primary bone tumors is usually surgery, often combined with chemotherapy or radiation. The surgeon attempts to salvage the limb and performs a resection of the tumor. For patients with Ewing's sarcoma or early osteosarcoma, external radiation may be the treatment of choice to reduce tumor size and pain.

Care of the postoperative patient is similar to that for any patient undergoing musculoskeletal surgery. Monitoring neurovascular status of the operative limb to be operated on is a vital nursing intervention (see Chapter 45). Other general postoperative care is discussed in Chapter 11.

For metastatic bone disease, surgery is not appropriate. External radiation is given primarily for palliation. The radiation is directed toward the most painful sites in an attempt to shrink them and provide more comfort for the patient.

Nursing Management

Nursing care for the patient with bone cancer is not unlike that for patients with any other type of cancer. Help the patient adjust to the diagnosis and refer the patient to resources such as the American Cancer Society and its various support groups. Chapter 10 describes the nursing care associated with chemotherapy and radiation therapy. For more information, visit the American Cancer Society at www.cancer.org.

CONNECTIVE TISSUE DISORDERS

Connective tissue disorders comprise a group of more than 100 diseases in which the major signs and symptoms result from joint involvement. Some connective tissue diseases affect only one part of the body; others affect many body organs and systems. Several disorders are discussed here, including gout, systemic lupus erythematosus, progressive systemic sclerosis, **osteogenesis imperfecta**, **polymyositis,** osteoarthritis, and rheumatoid **arthritis.**

Gout

Gout is an easily treated systemic connective tissue disorder. Men, especially those middle aged and older, are affected more than women. Patients with gout are seldom hospitalized for their disease.

Pathophysiology

Uric acid is a waste product resulting from the breakdown of proteins (purines) in the body. Urate crystals, formed because of excessive uric acid (**hyperuricemia**) build up and are deposited in joints and other connective tissues, causing severe inflammation. When an "attack" of gout occurs, the patient has severe pain and inflammation in one or more small joints, usually the great toe. The inflammation may resolve in several days with or without treatment. Months or years may pass between attacks, and the patient may have no signs or symptoms of joint inflammation between episodes. Urate deposits may appear under the skin (tophi) (Fig. 46.11) or in the kidneys or urinary system, causing stone (calculi) formation (see Chapter 37).

Causes and Types

The causes and types of gout are well known. Primary gout is the most common and is caused by an inherited problem with purine metabolism. Uric acid production is greater than the kidneys' ability to excrete it. Therefore, the amount of

polymyositis: poly—many + myo—muscle + itis—inflammation
arthritis: arthr(on)—joint + itis—inflammation
hyperuricemia: hyper—excessive + uric—uric acid + emia—in blood

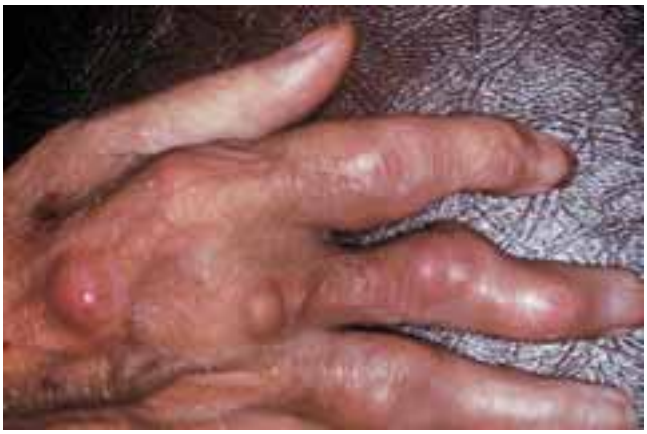

FIGURE 46.11 Gout: subcutaneous nontender lesions near joints. *(From Goldsmith, LA, Lazarus, GS, Tharp MD, et al: Adult and Pediatric Dermatology. F.A. Davis, Philadelphia, 1997, p 405, with permission.)*

uric acid in the blood increases. About 25% of patients have a family history of primary gout. Acute attacks of gout may be triggered by stress, alcohol, illness, trauma, dieting, or certain medications.

Patients with secondary gout also experience hyperuricemia, but the increase is the result of another health problem, such as renal insufficiency, or medications, such as diuretic therapy and certain chemotherapeutic agents.

Signs and Symptoms

ACUTE GOUT. Patients with acute gout have one or more severely inflamed joints due to the uric acid crystals, usually small joints, often in the joint of the great toe. The joint is swollen, red, hot, and usually too painful to be touched.

CHRONIC GOUT. Patients with chronic gout may not have obvious signs and symptoms. Tophi are not commonly seen today because management of patients with gout has improved. If they are present, they tend to appear most often in the outer ear. Renal stones develop in about 20% of patients with gout. Various diagnostic tests may be needed to determine stone formation.

Diagnostic Tests

Diagnosis of gout is based on an elevated serum uric acid level. Joint fluid aspiration analysis can identify uric acid crystals in the synovial fluid, further confirming the diagnosis of gout.

Therapeutic Interventions

MEDICATION. The treatment of secondary gout is management or removal of the underlying cause. Drug therapy is the first-line treatment for primary gout. When the patient has an acute gout episode, the physician usually prescribes either colchicine or an NSAID to reduce the inflammatory response to urate crystals. The patient usually takes these medications until joint inflammation subsides.

Uricosuric agents (medications used to decrease uric acid) are the drug of choice when trying to decrease serum levels. Allopurinol (Zyloprim) is the preferred drug for chronic gout. Allopurinol decreases uric acid production, necessitating several weeks of therapy before the medication becomes effective. The patient must take it every day to keep the uric acid level within the normal range. Probenecid (Benemid) may also be used temporarily to increase renal excretion of uric acid. The patient's serum uric acid level is monitored periodically.

DIET. For patients with gout, certain foods should be avoided or consumed in moderation (Box 46.6 Health Promotion for Patients with Gout). The patient should avoid all forms of aspirin and diuretics because they can trigger an attack. Increasing daily fluid intake is also important to help prevent kidney stones. The patient should also avoid alcohol (especially beer) as this too can provoke an attack.

Systemic Lupus Erythematosus

The word *lupus* comes from the Latin word for wolf, and was originally associated with leg ulcers. However, it became associated with facial ulcers, and the butterfly facial rash that patients with lupus may develop is one of the most defining characteristics of lupus. The rash is red, and thus the word *erythematosus,* meaning reddened, was added to describe the disease.

Most patients with lupus have the systemic type, but a small percentage have the type that affects only the skin, a condition called discoid lupus erythematosus. Discoid lupus is not life threatening; systemic lupus erythematosus (SLE) can be life threatening because it is a progressive, systemic inflammatory disease that can cause major body organ and system failure. Although this definition seems similar to the definition of rheumatoid arthritis (RA), one distinct difference exists. Patients with SLE typically have more body organ involvement earlier in their disease than patients with RA.

Pathophysiology

SLE is an autoimmune disease characterized by spontaneous remissions and exacerbations. The body's immune system normally produces antibodies to fight invaders such as bacteria, viruses, and other materials foreign to the body. In SLE, the body does not recognize itself and begins to produce antibodies directed at the foreign "self." These anti-

Box 46.6

Health Promotion for Patients with Gout

- Avoid high-purine (protein) foods, such as organ meats, shellfish, and oily fish (e.g., sardines).
- Avoid alcohol.
- Drink plenty of fluids, especially water.
- Avoid all forms of aspirin and drugs containing aspirin.
- Avoid diuretics.
- Avoid excessive physical or emotional stress.

bodies attack the self antigens and form immune complexes. Production of abnormal antibodies (antinuclear antibodies [ANAs]), immune complex formation, and complement system activation results in autoimmune effects on the patient's healthy connective tissue. Many of the manifestations result from recurring injuries to the patient's vascular system. The immune complexes that result lodge in the blood and organs, leading to inflammation, damage, and possibly death.

The cause of SLE is unknown, but the disorder tends to occur in families. Identified chromosomal markers indicate a genetic link. There is evidence that environmental factors also play a critical role in the development of SLE. Infections, high stress levels, various hormones and drugs (especially antibiotics such as sulfa and penicillin), and ultraviolet (UV) light have all been linked to triggering SLE. Exacerbation of symptoms often occurs prior to the start of menstruation and during pregnancy, demonstrating the link hormones have in triggering SLE.

African Americans, Hispanics, Native Americans, and Asians are two to three times more likely to develop SLE than others. Lupus most often affects women between ages 15 and 40 and at a rate 10 to 15 times more often than for men. Women represent 90% of all cases of SLE.

With improved therapy, the mortality rate for patients with the disease has improved greatly over the past 30 years. The leading causes of death are kidney failure, heart failure, and central nervous system involvement.

Signs and Symptoms

Unfortunately, there is no classic description of patients with SLE. Some patients have a very mild form of the disease in which only the skin and joints are affected. Others have devastating effects when the disease affects multiple body systems at the same time.

The classic feature of lupus is the characteristic raised, reddened butterfly rash found over the bridge of the nose that extends to both cheeks, although only half of patients develop it (Fig. 46.12). The rash is usually dry and may itch. It commonly is photosensitive, tends to worsen during an exacerbation, and can be triggered by exposure to ultraviolet light or by physical stressors, such as pregnancy or infection. Instead of the butterfly rash, some patients have discoid (coinlike) skin lesions on other parts of the body. During flare-ups, a fever develops which can rise to more than 100° F (38° C). Fatigue, arthralgia or arthritis, myalgia, malaise, weight loss, mucosal ulcers, and alopecia are other possible signs and symptoms of SLE. Table 46.2 lists other possible signs and symptoms of SLE.

Diagnostic Tests

Skin lesions can be biopsied and examined microscopically for signs of inflammation. Patients with suspected SLE are evaluated using the same immunologically based laboratory tests that are used to assess patients with rheumatoid arthritis. These tests include ESR (to detect systemic inflammation) and ANA titers (to detect the presence of abnormal antibodies). There are also two subtypes of ANA: anti-DNA and anti-sm antibodies, which are only found in patients with SLE and can be useful when the physician is attempting to confirm a diagnosis of SLE. A new blood test has been developed that aids in the diagnosis of SLE. Systemic lupus erythematosus patients make antibodies against serine/arginine–rich (SR) proteins (which are important in cell division). Seventy percent of SLE patients react positively to the SR proteins. This new diagnostic tool should help in identifying those SLE patients who do not produce some of the other antibodies looked for in the diagnosis of SLE. Although no laboratory test confirms a diagnosis of lupus, the results of the immunological tests may support the diagnosis.

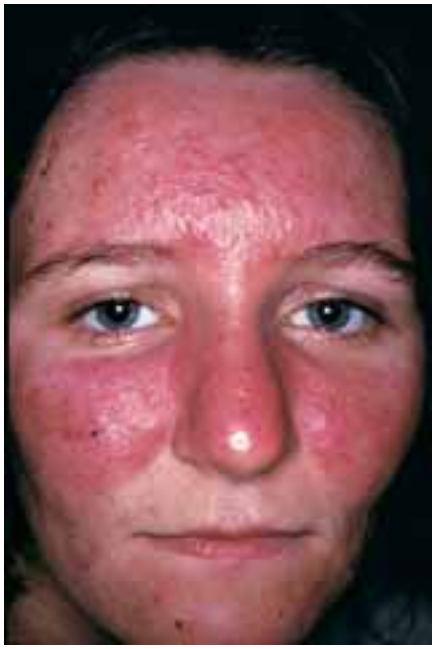

FIGURE 46.12 Lupus erythematosus: red papules and plaques in butterfly pattern on face. *(From Goldsmith, LA, Lazarus, GS, Tharp, MD, et al: Adult and Pediatric Dermatology. F.A. Davis, Philadelphia, 1997, p 230, with permission.)*

Therapeutic Interventions

Treatment of SLE focuses on decreasing inflammation and preventing life-threatening organ damage. At present, the therapy of choice includes medications to treat the symptoms or the body systems affected. Research is ongoing regarding the possible cause of SLE. Researchers have found the general location of a gene that is believed to predispose a person to lupus. Identifying the genetic cause of lupus will enable researchers to develop new methods of therapy, including gene therapy. Prevention of exacerbations (flares) is important, and therefore taking preventative measures is suggested. Minimizing exposure to the sun and wearing sunscreens helps those patients who are photosensitive. Regular exercise and keeping immunizations up to date are also helpful.

MEDICATION. Medications are prescribed according to the patient's needs. NSAIDs, acetaminophen, corticosteroids, antimalarials (chloroquine [Aralen], hydroxychloroquine

TABLE 46.2 CHARACTERISTICS OF SYSTEMIC LUPUS ERYTHEMATOSUS (SLE)

Manifestations

Central Nervous System
- Headache, epilepsy, psychoses
- Peripheral or sensory neuropathies
- Personality changes, mild alterations in cognition

Cardiovascular
- Inflammation of pericardium (pericarditis)
- Alteration in circulation, particularly to digits (Raynaud's phenomenon)

Pulmonary
- Pleural effusions

Renal
- Inflammation of Kidney Glomerulonephritis

Gastrointestinal
- Peritonitis

Musculoskeletal
- Arthralgias (due to inflammation), especially of the hands, wrists, and knees
- Myalgias

Skin
- Butterfly rash across bridge of nose
- Rash is reddened and raised

Constitutional Signs and Symptoms
- Increased temperature
- Malaise, tiredness
- Weight loss

[Plaquenil]), immunomodulating drugs, and anticoagulants may all be part of the medication regimen. Topical cortisone preparations may help reduce skin inflammation and promote fading of skin lesions.

Patients who experience joint inflammation are usually placed on an NSAID. Patients with organ or major body system involvement are given more potent drugs that suppress the immune process, including oral steroids such as prednisone or immunomodulating agents such as azathioprine (Imuran) or cyclophosphamide (Cytoxan). These drugs have serious side effects, and patients receiving them are monitored very carefully. In addition to monitoring for a variety of side effects, patients must be taught to avoid people with infections because they are immunocompromised while taking any of these medications.

Nursing Process for the Patient with Systemic Lupus Erythematosus

ASSESSMENT/DATA COLLECTION. Determine the extent and severity of signs and symptoms, such as pain, fatigue, skin lesions, and fever. Individualize the plan of care as every patient with SLE is unique.

NURSING DIAGNOSIS, PLANNING, AND IMPLEMENTATION. See nursing process sections on osteoarthritis and rheumatoid arthritis for:

Acute pain related to joint swelling
Chronic sorrow related to loss of health, role changes, and having a chronic disease
Fatigue related to chronic disease process
Disturbed body image related to alterations in skin integrity
Self-care deficits

Ineffective coping related to chronic disease condition and alteration in body integrity

EXPECTED OUTCOME: Patient will make appropriate decisions related to personal life and condition.

- Assess patient's coping pattern and ability to have a baseline.
- Provide support and reassurance to patient to let patient know someone is there for them.
- Assist in problem solving without taking over to help when needed but improving self-confidence.
- Encourage inclusion of support systems and resources to utilize all avenues available to help.
- Include input from other disciplines such as social work and clergy to ensure all alternatives are considered.

Risk for impaired skin integrity related to disease condition and increased susceptibility to UV light

EXPECTED OUTCOME: Patient will maintain skin integrity.

- Teach importance of protecting self from UV light (decrease sun exposure, wear sunscreen and appropriate clothing) *to minimize flare-ups*.
- Ensure good hygiene *to help minimize infections and promote skin integrity.*
- Apply topical creams and ointments as ordered *to help with inflammation and discomfort.*

EVALUATION. The outcome is met if patient makes appropriate decisions related to personal life and condition and skin integrity is maintained.

CRITICAL THINKING

Mr. Wolf

■ Mr. Wolf is experiencing a relapse of SLE and requires administration of prednisone. The doctor's order states: prednisone 55 mg PO in two equal doses. Prednisone is available as 1-mg, 2.5-mg, and 5-mg tablets. Which of the following combinations of drug would be most appropriate to administer for each dose?

1. Administer four 5-mg tablets in the morning and five 5-mg tablets in the evening.
2. Administer five 5-mg tablets in the morning and four 5-mg tablets in the evening.
3. Administer two and one half 1-mg tablets and five 5-mg tablets in the morning and evening.
4. Administer one 2.5-mg tablet and five 5-mg tablets in the morning and evening.

Suggested answers at end of chapter.

PATIENT EDUCATION. Teach the patient about skin care and ways to prevent disease exacerbations. Skin care includes use of a mild soap, patting the skin dry, using lotion, avoiding drying agents, protecting from sunlight with sun block of SPF 30, cover with clothing and hats, and avoid tanning beds. Exercise can prevent muscle weakness and fatigue. The patient should be encouraged to be immunized against specific infections. Methods of stress reduction should be identified and utilized.

The Arthritis Foundation and the Lupus Foundation are national organizations that can provide information, assistance, and community support groups for patients diagnosed with lupus. For more information, visit the Lupus Foundation of America at www.lupus.org.

Scleroderma

The term **scleroderma** is Greek in origin meaning "hard skin." It is similar to SLE in that it can affect multiple organs and other connective tissues. Scleroderma is not as common as SLE but has a higher mortality rate. There are two types of scleroderma: localized and systemic. As the name implies, systemic scleroderma can affect any part of the body. Among other names for systemic scleroderma are diffuse and progressive systemic scleroderma; however, since scleroderma is not necessarily progressive, this term is not encouraged. What is more frequently seen is the term *systemic sclerosis* (SSc).

Pathophysiology

Scleroderma is characterized by inflammation that ultimately develops into fibrosis (scarring) and then sclerosis (hardening) of tissues. The disease is an autoimmune response to the body's normal tissues. Like some of the other systemic connective tissue diseases, abnormal antibodies damage healthy tissue, resulting in inflammation, which then triggers overproduction of collagen, which is deposited in the skin. The collagen produced is insoluble and when deposited in the skin causes inflammation. Edema in the skin ultimately results in loss of elasticity and tissue function. The same process can occur internally, affecting blood vessels and organs.

SSc is relatively rare in that it affects approximately 300,000 Americans. It affects women three to four times more often than men. It can occur at any age but usually develops between ages 25 and 55. The disease tends to progress rapidly and does not respond well to treatment. Spontaneous remissions and exacerbations can occur. There is a relationship between scleroderma and Raynaud's syndrome; approximately 95% of patients with scleroderma have Raynaud's phenomenon.

Signs and Symptoms

Although arthritis and fatigue are commonly seen, the most obvious sign of SSc is manifested at first by pitting edema, starting in the upper extremities. The skin is taut, shiny, and without wrinkles. The swelling is replaced by tightening, hardening, and thickening of skin tissue. The skin then loses its elasticity, range of motion is decreased, and skin ulcers may appear. As the disease progresses, the patient loses range of motion and the affected area becomes contracted.

The same pathophysiological process affects certain body systems, especially the kidneys, lungs, heart, and gastrointestinal tract. If any of these systems are affected, the corresponding signs and symptoms are present. For example, gastrointestinal tract involvement usually manifests as esophagitis, dysphagia (difficulty swallowing), and decreased intestinal peristalsis caused by decreased smooth muscle elasticity.

The prognosis is thought to be worse when the patient has CREST syndrome, a group of signs and symptoms occurring at the same time:

Calcinosis (calcium deposits)
Raynaud's phenomenon (severe vasospasms of the small vessels in the hands and feet)
Esophageal dysmotility (decreased activity)
Sclerodactyly (scleroderma of the finger digits)
Telangiectasia (spiderlike skin lesions)

Diagnosis

The patient's clinical history and physical manifestations (particularly the sclerotic changes that occur in the skin) aid in the diagnosis of scleroderma. Biopsies of the skin, laboratory tests (ANA, and most recently anti–Scl-70 antibodies and anticentromere antibodies [ACA]), pulmonary function tests, and electrocardiographic (ECG) or x-ray examinations (including esophageal studies) are used to determine the severity of organ involvement or if other diagnostic testing is not helpful in diagnosing this condition.

Therapeutic Interventions

The goal of medical management is to slow the progression of the disease. Systemic steroids, such as prednisone, and immunosuppressant drugs are used in large doses and in combination during a flare-up of SSc.

Other care approaches are directed toward symptom management. Skin-protective measures can help minimize the chance of ulcerations or irritation. For example, teach the patient to use mild soaps and lotions to moisturize the skin.

If the patient has esophageal involvement, small, frequent, bland meals are better tolerated than large, spicy ones. Difficulty swallowing may necessitate cutting the food into smaller, more manageable portions or by providing food that is pureed (thicker liquids are easier to swallow than thin liquids). Medications to treat esophageal reflux, such as antacids and histamine blockers, may be prescribed.

Patients who have Raynaud's phenomenon or other types of **vasculitis** usually experience severe pain when small blood vessels constrict. Joints may also be painful. Pain management is a priority in the care of patients with SSc. A bed cradle or footboard keeps bed covers away from skin. Socks and gloves may keep the fingers and toes warm, thus diminishing pain. Minimizing exposure to cold and

scleroderma: sclero—hardening + derma—skin

vasculitis: vascul—blood vessel + itis—inflammation

avoiding stressful situations, stopping smoking, and taking certain medications, such as calcium channel blockers, antiadrenergic agents, and angiotensin-converting enzyme (ACE) inhibitors, can all help promote circulation or minimize the likelihood of an attack. Research has suggested that antioxidant therapy may provide another approach to treating SSc.

Rehabilitative therapy may be needed to help the patient be as independent as possible with activities of daily living and mobility. Collaborate with other members of the interdisciplinary team to individualize care.

Osteogenesis Imperfecta

Osteogenesis imperfecta (OI) is a rare inheritable disease that is also called fragilitas ossium or brittle bones disease. It is a congenital abnormality characterized by skeletal bone fragility. The fragility predisposes the person to pathological fractures and bone deformities. In addition, there is connective tissue involvement which can cause changes or abnormalities in the eyes, ears, joints, skin, and teeth.

Pathophysiology

In OI, osteoblasts and fibroblasts synthesize collagen abnormally, resulting in fragile bones, multiple fractures (especially of the long bones), bone deformities (resulting from improper healing and weak callus formation along with thinner, smaller, and shorter bones), fragile and discolored teeth, loose joints, and thin, easily damaged skin. There are four types of OI classified according to severity and characteristics, with type l being the most common and least severe form of the condition.

Signs and Symptoms

There is much variation in the signs and symptoms for a person with OI. Some of the symptoms common to all types of OI include:

- Fragile bones (easily broken or bent)
- Triangular-shaped face
- Potential hearing loss
- Scoliosis (spine curvature) which may create respiratory problems
- Loose joints
- Alterations in muscle tone or development
- Blue, purple, or gray tint to sclerae
- Brittle or discolored teeth
- Smooth, thin skin

OI types II, III, and IV symptoms also include:

- Decreased height (may only grow to 3 feet tall)
- Barrel-shaped rib cage

Diagnosis

The diagnosis of OI may be based on clinical features of the patient. Most frequently, the diagnosis is made because of the frequency of fractures the patient (usually an infant or child) experiences without an apparent cause. Most OI patients can have 40 to 100 fractures by the time they reach puberty depending on the type of OI they have. It is also not uncommon for type II OI babies to be born with fractures and to either be born dead or die shortly after birth. The only test currently available is a biopsy of the skin assessing the collagen fibers. The test can take weeks to get results and is not definitive.

Therapeutic Interventions and Nursing Care

There is no treatment for OI. Therapy consists of treating the fractures and trying to minimize the bone deformities that result from the disease. Splints, casts, and braces are utilized to aid in healing the fractures and maintaining structure and function. Medications such as pamidronate (Aredia), a bone resorption inhibitor, are being trialed to see if bone density can be increased with the hope of decreasing fractures and improving mobility while decreasing the associated pain. Gene therapy is also being suggested as a means to treat OI; however, this form of therapy will not be soon available. Nursing care requires careful handling of the patients with the understanding that no matter how careful you may be, fractures will still occur. It is important to teach the family and for the nurse to understand that it is not necessarily something that they did that causes the fractures, rather it is the pathological process causing the breaks. The Osteogensis Imperfecta Foundation (www.oif.org) is an excellent resource for patients, family, and the health-care team.

Polymyositis

Polymyositis is a disease with an unknown cause that results in diffuse inflammation of skeletal muscle, leading to weakness, atrophy, and degeneration. When a rash is present with muscle inflammation, the disease is called dermatomyositis. The disease is progressive; however, remissions and exacerbations are common. Women are affected more than men, especially in their middle-aged years.

The shoulder and pelvic girdle muscles (proximal muscles) are most commonly affected. The patient may have associated conditions such as arthritis, fatigue, and possibly Raynaud's phenomenon (spasms and constriction of small vessels in the hands and feet). Patients with dermatomyositis also have the classic heliotrope (lilac) rash and periorbital (around the eyes) swelling. Malignant tumors occur in patients with these diseases more often than in the rest of the population.

Patients are treated symptomatically, using an interdisciplinary approach, to maintain optimum function. The drug of choice is high doses of prednisone. Side effects, such as immunosuppression, can occur with prednisone.

Muscular Dystrophy

Muscular dystrophy (MD) is a group of nine disorders resulting in loss of muscle tissue and progressive muscle weakness. A number of the disorders are diagnosed in childhood (e.g., Duchenne's MD is most common in children); however, other forms of MD, such as myotonic MD, are most common in adults. In addition, individuals with MD

are now living longer into adulthood as a result of advances in treatment.

Pathophysiology and Etiology

Muscular dystrophy has a genetic origin. However, the exact cause is unknown. Skeletal (voluntary) muscle fibers degenerate and atrophy. This loss of muscle tissue results in muscle weakness and wasting. Muscle tissue is replaced by connective tissue. These changes in muscle tissue result in increasing disability and deformity. Life expectancy after diagnosis depends on the type of MD as well as the speed and severity of progression. Involvement of the heart and lungs also influences the life expectancy. In some forms of MD, young adulthood (mid to late 20s) is the average life expectancy.

Signs and Symptoms

Signs and symptoms usually become apparent in childhood. Difficulty walking and muscle weakness in the arms, legs, and trunk are indicators of MD. Individuals with MD may have difficulty raising their arms above their heads or climbing stairs. Other signs and symptoms include frequent falls, developmental delays involving muscle skills, drooping eyelids (ptosis), drooling, intellectual retardation (only in some types of MD), contractures, and skeletal deformities.

Diagnosis

An increase in serum creatinine phosphokinase (CPK) caused by muscle atrophy is present in MD. Electromyography (EMG) and muscle biopsy can be used for diagnosis. Lactic dehydrogenase (LDH) and the isoenzymes, myoglobin (urine or serum), creatinine (urine or serum), CPK isoenzymes, and aspartate aminotransferase (AST) levels may also be altered in patients with MD. There are also tests looking for gene mutations for some of the various types of MD.

Therapeutic Interventions

Goals include supportive care and prevention of complications. Treatment regimens focus on controlling symptoms and maximizing quality of life. Keeping the patient as active as possible is a priority in the planning of care. Exercise programs (e.g., range of motion, physical therapy) help prevent muscle tightness, contractures, and atrophy. Splints and braces provide support during ADL. Surgery may be done to correct deformities. The potential benefit of gene therapy is currently being investigated. Some of the current research indicates that gene therapy could prove effective with some types of MD.

Nursing Process for the Patient with Muscular Dystrophy

ASSESSMENT/DATA COLLECTION. Assess for muscle weakness, noting what areas of the body are affected and the severity of the weakness. Asking the patient and family what activities can be done with and without assistance helps determine the plan of care.

NURSING DIAGNOSIS, PLANNING, AND IMPLEMENTATION. Impaired physical mobility related to muscle weakness

EXPECTED OUTCOME: Patient's mobility will increase or be maintained for as long as possible.

- Provide assistive devices (e.g., braces, splints, wheelchair) *to assist with mobility.*
- Provide active and passive range-of-motion exercises and other physical therapy *to prevent contractures and improve muscle strength.*
- Encourage the patient to do as much as possible *to increase independence and help maintain muscle function.*
- Include disciplines such as physiotherapy and occupational therapy *to provide equipment and devices that will help with independence and mobility.*

Ineffective breathing pattern related to muscle weakness

EXPECTED OUTCOME: Patient will demonstrate normal respiratory function and normal oxygen saturation.

- Monitor respiratory function (rate and effort) every 4 hours.
- Monitor oxygen saturation and keep above 90%.
- Administer oxygen at 2 L/minute or as ordered if oxygen saturation drops below 90%.
- Position patient to increase respiratory efficiency.
- Teach and prepare patient about lung function studies to evaluate lungs
- Teach patient to minimize chances of infection (e.g., stay away from crowds) and to ensure early attention to respiratory alterations

EVALUATION. The outcome is met if the patient improves or maintains physical mobility and the patient's oxygen saturation is normal.

PATIENT EDUCATION. The patient and family need to understand the importance of physical therapy in maintaining function and preventing complications. National organizations and support groups provide information, resources, and emotional support. Family members need to encourage the patient to have activity and rest periods. As with any neuromuscular condition, the patient needs to avoid exposure to the cold and persons with infections. For more information on muscular dystrophy, visit www.mdausa.org or www.mdac.ca.

Osteoarthritis

Osteoarthritis (OA) is the most common type of connective tissue disorder, affecting more than 20 million people in the United States. The term *arthritis* means inflammation of the joint, but OA is not a primary inflammatory process. Therefore, some health-care providers may refer to this disorder as *degenerative joint disease.* This term better reflects its pathophysiology.

TABLE 46.3 OSTEOARTHRITIS AND RHEUMATOID ARTHRITIS SUMMARY

	Osteoarthritis	Rheumatoid Arthritis
Pathophysiology	Articular cartilage and bone ends deteriorate Joint is inflamed	Inflammatory cells cause synovitis Synovium becomes thick and fluid accumulates, causing swelling and pain Joint becomes deformed
Etiology	Primary (idiopathic): • Cause unknown • Risk factors include age, obesity, activities causing joint stress Secondary: • Causes include trauma, sepsis, congenital abnormalities, metabolic disorders (Paget's disease), rheumatoid arthritis	Autoimmune disease Can occur at any age (including juvenile rheumatoid arthritis) Cause unknown Familial history possible
Signs and Symptoms	Joint pain and stiffness Pain increases with activity and decreases with rest Nodes on joints of fingers (Heberden's nodes, Bouchard's nodes)	Symptoms vary according to disease process Early symptoms: • Bilateral and symmetrical joint inflammation • Redness, warmth, swelling, stiffness, pain • Stiffness after resting (morning stiffness) • Activity decreases pain and stiffness • Low-grade fever, weakness, fatigue, anorexia (mild weight loss) • Organ system involvement Late symptoms: • Joint deformity • Secondary osteoporosis
Therapeutic Interventions	Medication: • NSAIDs • Acetaminophen • Muscle relaxants • Cox-2 inhibitors Balanced rest and exercise Splinting of joint to promote rest Heat and cold Diet for weight loss Complementary therapies Surgery for total joint replacement	Medication: • Salicylates • NSAIDs • Gold treatment • Methotrexate • Prednisone Heat and cold Balanced rest and activity Surgery for total joint replacement
Possible Nursing Diagnoses	Chronic pain Impaired physical mobility Body image disturbance	Chronic pain Self-care deficits Ineffective health maintenance

ADLs = activities of daily living; NSAIDs = nonsteroidal anti-inflammatory drugs.

Pathophysiology

Osteoarthritis occurs when the articular cartilage and bone ends of joints slowly deteriorate (Table 46.3). The joint space narrows, bone spurs develop, and the joint may become somewhat inflamed. The repair process is not able to overcome the rapid loss of cartilage and bone, eventually resulting in joint deformities, pain, and immobility, leading to the patient's functional decline. Weight-bearing joints (hips and knees), hands, and the vertebral column are most often affected (Fig. 46.13).

Causes and Types

The most common type of OA is primary (idiopathic) osteoarthritis. The cause of OA is unknown, but several risk factors have been identified. Aging, obesity, and physical activities that create mechanical stress on joints are major risks. Each of these factors cause prolonged or excessive "wear and tear" on synovial joints. The majority of people older than 60 years of age have some degree of symptomatic joint degeneration. Native Americans are affected more often than other groups, but the reason for this is unknown.

Patients with secondary osteoarthritis develop joint degeneration as a result of trauma, sepsis, congenital anomalies, certain metabolic diseases (such as Paget's disease), or systemic inflammatory connective tissue disorders such as rheumatoid arthritis.

Signs and Symptoms

The patient usually seeks medical attention when joint pain and stiffness become severe or the patient has problems with everyday activities. One or more joints may be affected, most commonly in the hands, hips, knees, spine, and feet. Joint pain intensifies after physical activity but lessens following rest. If the vertebral column is involved, the patient

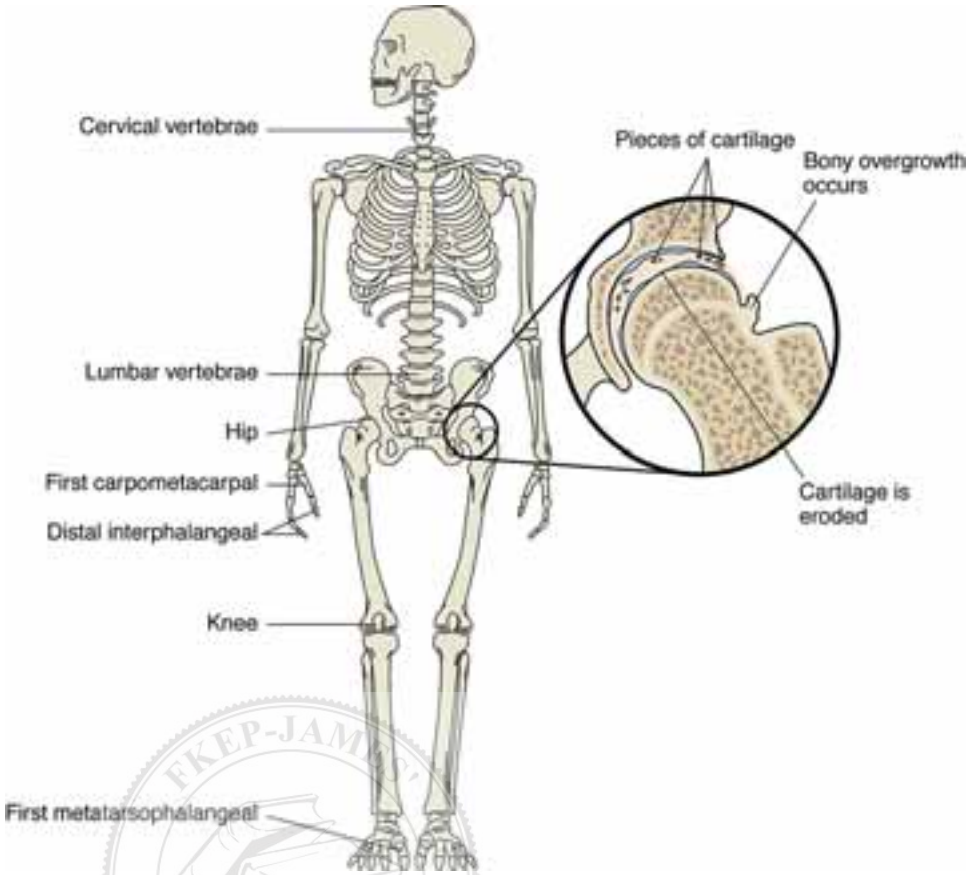

FIGURE 46.13 Common joints affected by osteoarthritis and the changes that result in the joint.

complains of radiating pain and muscle spasms in the extremity innervated by the area affected.

About half of patients with OA have bony nodes on the joints of their fingers, called Heberden's and Bouchard's nodes. Women tend to have them more often than men, and they may or may not be painful. The nodes have a familial tendency and are often a cosmetic concern to female patients.

Diagnostic Tests

X-ray examinations are useful in outlining joint structure and detecting bone changes. A computed tomographic (CT) scan or magnetic resonance imaging (MRI) may be used to diagnose various joint involvement. Analysis of synovial fluid can aid in the diagnosis of OA while ruling out other pathological conditions of the joint.

Therapeutic Interventions

There is no curative therapy currently available for OA. Management of patients with OA centers on pain control, which is accomplished by drug therapy, other pain relief measures, or ultimately surgery. An interdisciplinary approach is needed to prevent decreased mobility and preserve joint function.

Synvisc is injected directly into osteoarthritic knees and acts like healthy, cushioning synovial fluid. Pain is relieved and flexibility restored when the knee joint is again lubricated and cushioned. For more information about this therapy, visit www.synvisc.com.

CRITICAL THINKING

Mr. Dennis

Mr. Dennis is a 59-year-old overweight carpenter who visits his physician with complaints of knee and wrist pain. He has noticed that it is becoming increasingly difficult to climb a ladder or use a hammer. The physician suspects osteoarthritis.

1. What data collection questions should be included in a patient history?
2. What risk factors does he have?
3. What other signs and symptoms might he have?

Suggested answers at end of chapter.

MEDICATION. Drug therapy, often used in combination with other therapies to reduce pain, is commonly used for patients with OA. The most typically used drugs are nonsteroidal anti-inflammatory drugs (NSAIDs) (Table 46.4). These drugs have analgesic and anti-inflammatory effects but may cause side effects if not carefully monitored. Common side effects include gastrointestinal (GI) distress; bleeding tendencies, which can be severe; and sodium and fluid retention. Older adult patients receiving NSAIDs on a routine basis should be carefully monitored for congestive heart failure or high blood pressure as a result of fluid reten-

TABLE 46.4 COMMON DRUGS USED TO TREAT CONNECTIVE TISSUE DISEASES: OSTEOARTHRITIS, RHEUMATOID ARTHRITIS, AND OTHERS

Medication Class/Action	Examples	Route	Side Effects	Nursing Implications
Nonsteroidal anti-inflammatory drugs (NSAIDs)				
Block activity of enzyme cyclooxygenase (COX-1, COX-2), which makes prostaglandins that produce inflammation, fever, pain; support platelets, and protect stomach lining (COX-1 only)	Acetylsalicylic acid (aspirin)	PO	Vary with drug: Nausea, vomiting, diarrhea, constipation, anorexia, rash, dizziness, headache, drowsiness, edema, ulcers, bleeding	Teach risk of GI bleeding greatest with COX-1 inhibitors Those with asthma higher risk for allergic reaction. Avoid use in children/teens with chickenpox or influeneza to prevent Reye's syndrome
	Diclofenac sodium (Voltaren)	PO		
	Diflunisal (Dolobid)	PO		
	Etodolac (Lodine; osteoarthritis only)	PO		
	Fenoprofen (Nalfon)	PO		
	Flurbiprofen (Ansaid)	PO		
	Ibuprofen (Motrin)	PO		
	Indomethacin (Indocin)	PO		
	Ketoprofen (Orudis)	PO		
	Naproxen (Aleve, Naprosyn)	PO		
	Oxaprozin (Daypro)	PO		
	Piroxicam (Feldene)	PO		
	Nabumetone (Relafen)	PO		
	Sulindac (Clinoril)	PO		
	Tolmetin (Tolectin)	PO		
Corticosteroids				
Reduce inflammation and swelling	Prednisone (Cortan, Deltasone, Orasone)	PO	Weight gain, fat deposits, edema, hypertension, infection, fractures, poor wound healing, GI bleeding, depression, mood swings	Daily weight Monitor I&O. Assess for infection. Give with food/milk Medic Alert ID Not used for osteoarthritis
Disease-modifying antirheumatic drugs (DMARDs)				
For rheumatoid arthritis, ankylosing spondylitis, lupus. Reduce symptoms, prevent joint damage, and preserve joint function by suppressing immune or inflammatory systems.			Vary with drug: Infection, alopecia, bone marrow suppression, kidney/liver damage.	Slow-acting drugs may take months for effect. Other drugs used to control symptoms until effective. Effect stops when drug stops
Gold Preparations	Auranofin (Ridaura)	PO		
	Aurothioglucose (Solganal)	IM		
Immunosuppressives	Azathioprine (Imuran)	PO		
	Cyclophosphamide (Cytoxan)	IV, PO		
	Cyclosporine (Sandimmune, Neoral)	PO		
	Methotrexate (Mexate)	IM also		
	Leflunomide (Arava; rheumatoid arthritis only)	PO		
	d-Penicillamine (Cuprimine, Depen).	PO		
	Sulfasalaine (Azaline, Azulfidine, Sulfzine)	PO		
Antitumor Necrosing Factor	Etanercept (Enbrel)			
Antimalarials	Chloroquine (Aralen)	PO, IM		
	Hydroxychloroquine (Plaquenil)	PO		

tion. Topical creams such as capsaicin (ArthriCare) may also be ordered and applied to the joints. COX-1 and COX-2 inhibitors previously were frequently ordered for OA but ongoing concerns related to adverse cardiac events have resulted in a voluntary recall by the manufacturers, and therefore they are typically not being prescribed for patients with OA.

REST AND EXERCISE. Joint pain from OA tends to decrease with rest; therefore, pain is less severe in the morning. Activities should be scheduled at this time. A severely inflamed joint may be splinted by the occupational or physical therapist to promote rest to a selected joint. However, rest must be balanced with exercise to prevent muscle atrophy from disuse. Exercise has been identified as a means to maintain general health and weight, range of motion, and muscle strength, while decreasing anxiety and depression. To minimize muscle atrophy and to stabilize and protect arthritic joints, patients should be encouraged to perform exercises to strengthen their quadriceps if they have OA of the knee.

Joints should always be placed in their functional position—that is, a position that does not lead to contractures. For example, only a small pillow should be placed under the head when sleeping to prevent excessive neck flexion.

HEAT AND COLD. The patient with OA usually prefers heat therapy unless the joint is acutely inflamed. Hot packs, warm compresses, warm showers, moist heating pads, and paraffin dips provide sources of heat for the patient. Cold therapy minimizes inflammation while altering cutaneous pain receptors, thereby decreasing pain. Cold packs should be applied for no longer than 20 minutes at a time.

Diet

The obese or overweight patient benefits from losing weight to decrease joint stress on weight-bearing joints, thereby reducing pain. If the patient is on medications that can alter fluid volumes (corticosteroids), a diet low in sodium may be appropriate.

COMPLEMENTARY THERAPIES. The popularity of complementary therapies to reduce pain and stress has grown tremendously. Imagery, music therapy, acupressure, acupuncture, and other holistic modalities that foster the mind-body-spirit connection work well for many people. Homeopathic therapies such as glucosamine and chondroitin have been suggested to improve OA. Recent studies have demonstrated that these two therapies are effective in OA therapy; however, further research must be conducted before they become an accepted and recommended therapy for OA.

SURGERY. If the patient's pain is not successfully managed, a total joint replacement (TJR) may be indicated. A TJR is the most common type of **arthroplasty** (see section on musculoskeletal surgery).

arthroplasty: arthro—joint + plasty—creation of

Nursing Process for the Patient with Osteoarthritis

ASSESSMENT/DATA COLLECTION. The patient's complaint of pain is assessed and the joints observed for signs of inflammation or deformity. Also assessed are function, alterations in activities of daily living (ADLs), and mobility (see Chapter 45).

NURSING DIAGNOSIS, PLANNING, IMPLEMENTATION, AND EVALUATION. Chronic pain related to chronic inflammatory disease

EXPECTED OUTCOME: Patient will state pain is within tolerable levels (pain assessment scale 0 to 10).

- Ensure patient is aware that his or her pain is acknowledged by the nurse so that he or she knows the pain is accepted.
- Provide analgesics as ordered *to help alleviate painful sensations.*
- Collaborate with interdisciplinary team such as pain clinic to explore alternative pain relief measures such as surgery.
- Consider alternative methods of therapy such as guided imagery, distraction, acupuncture, and biofeedback to use all possible methods of pain control.

Activity intolerance related to pain

EXPECTED OUTCOME: Patient will participate in ADLs as tolerated.

- Promote as much independence as possible *to promote activity.*
- Assist with ADLs as necessary *to ensure patient does not become exhausted.*
- Provide pain relief measures prior to activity, which will help them increase their activity level.
- Ensure nursing interventions are performed in "groups" *to minimize patient exertion.*
- Collaborate with interdisciplinary team (e.g., occupational therapy, home care physiotherapy) *to utilize their resources and knowledge.*

Chronic sorrow related to altered body image, altered role, pain, and ongoing losses

EXPECTED OUTCOME: Patient will verbalize improvement in feelings of sorrow

- Allow for time to discuss feelings and anticipate trigger events *to ensure the patient is aware of what may increase his or her feelings of sorrow.*
- Encourage use of interdisciplinary team such as social worker, psychologist, clergy, or spiritual advisor *to provide alternate methods of dealing with sorrow.*
- Encourage use of support groups to enable the patient to discuss his or her concern with others experiencing the same problems.

Disturbed body image related to changes in joint function and structure

EXPECTED OUTCOME: Patient will demonstrate acceptance of changes in body image.

- Encourage patient to discuss feelings and concerns *so patient knows nurse understands what patient is experiencing.*
- Provide information and clarify misconceptions *to ensure that the patient is aware of the expected problems and concerns.*
- Encourage socialization *to improve on the person's perceptions of how he or she "looks" to others.*
- Encourage sharing with support groups so that the patient discusses his or her concerns with others experiencing the same problems.

Impaired physical mobility related to altered joint function and pain

EXPECTED OUTCOME: Patient will demonstrate improved physical mobility.

- Administer analgesics and anti-inflammatory agents as ordered *to improve joint function and decrease pain.*
- Encourage active ROM exercises *to prevent or minimize further alteration in joint function*
- Ensure proper positioning and alignment *to promote joint function and decrease pain.*
- Use interdisciplinary team such as physiotherapy and occupational therapy *to utilize resources and knowledge from other sources.*

Self-care deficit related to chronic degenerative joint disease

EXPECTED OUTCOME: Patient will be able to provide own self-care.

- Encourage independence to decrease feelings of despair about being unable to care for self.
- Assist when necessary to minimize frustration when patient unable to perform self-care function.
- Teach patient about assistive devices *to help with ADLs to promote self-care.*
- Collaborate with interdisciplinary team such as home care, occupational therapy, or physiotherapy *to acquire assistive devices and use alternate resources.*

EVALUATION. The outcome is met if patient reports pain is within tolerable levels on pain assessment scale of 0 to 10, verbalizes improvement in feelings of sorrow, demonstrates acceptance of changes in body image, demonstrates improved physical mobility, and is able to provide own self-care.

PATIENT EDUCATION. A vital function of each member of the health-care team is health teaching. The patient with OA is seldom admitted to the hospital for treatment of OA unless surgery is scheduled. However, many patients with OA are admitted for other reasons, and their arthritis needs must also be considered in the comprehensive plan of care. Most patients residing in nursing homes also have OA, which can affect their participation in recreational activities, as well as their ADLs.

In any setting, including the home, patients can be taught ways to protect their joints and conserve energy. Nurses need to teach patients and their families how to promote health. For information on educational materials and self-help courses, visit the Arthritis Foundation at www.arthritis.org.

Rheumatoid Arthritis

Rheumatoid arthritis (RA) is a chronic, progressive, systemic inflammatory disease that destroys synovial joints and other connective tissues, including major organs. It affects women three times more often than men and Native Americans more often than other ethnic groups. Rheumatoid arthritis can occur at any age; when it occurs in children it is called juvenile RA (JRA). The peak onset of RA is 30 to 60 years of age, and it affects 1% to 3% of the population in the United States. The etiology of RA is still unknown; however, there are indications that genetic predisposition and the environment play a role in triggering its development.

Pathophysiology

Inflammatory cells and chemicals cause **synovitis,** an inflammation of the synovium (the lining of the joint capsule). As the inflammation progresses, the synovium becomes thick and fluid accumulation causes joint swelling and pain. A destructive pannus (new synovial tissue growth infiltrated with inflammatory cells) erodes the joint cartilage and eventually destroys the bone within the joint (Fig. 46.14). Ultimately the pannus is converted to bony tissue, resulting in loss of mobility. Joint deformity and bone loss are common in late RA (see Table 46.3).

Synovial joints are not the only connective tissues involved in RA. Any connective tissue may be affected, including blood vessels, nerves, kidneys, pericardium, lungs, and subcutaneous tissue. The result of body system involvement is malfunction or failure of the organ or system. Death can occur if the disease does not respond to treatment.

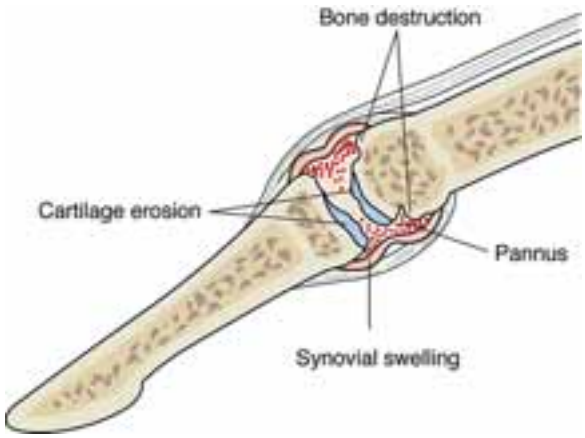

FIGURE 46.14 Rheumatoid arthritis.

Many patients experience spontaneous remissions and exacerbations (flare-ups) of RA. The symptoms of the disease may disappear without treatment for months or years. Then the disease may exacerbate just as unpredictably. Exacerbations usually occur when the patient experiences physical or emotional stress, such as surgery or infection.

Etiology

The exact cause of RA is unknown. An autoimmune response occurs that affects the synovial membrane of the joints; it is unknown what triggers the initial response. Antibodies (called rheumatoid factor) are often found in patients with RA. It is suggested that these antibodies join with other antibodies and form antibody complexes. These complexes lodge in synovium and other connective tissues, causing local and systemic inflammation, and may be responsible for the destructive changes of RA in body tissues.

The origin of the rheumatoid factor is not clear, but a genetic predisposition is likely. RA affects people with a family history of the disease two to three times more often than the rest of the population.

Signs and Symptoms

Signs and symptoms vary as the disease progresses differently in patterns and rates from person to person. In general, the signs and symptoms can be divided into early and late manifestations.

The typical pattern of joint inflammation is bilateral and symmetrical. The disease usually begins in the upper extremities and progresses to other joints over many years (Fig. 46.15). Affected joints are slightly reddened, warm, swollen, stiff, and painful. The patient with RA often has morning stiffness lasting for up to an hour, and those with severe disease may complain of stiffness all day. Generally, activity decreases pain and stiffness.

Because of the systemic nature of RA, the patient may have a low-grade fever, malaise, depression, lymphadenopathy, weakness, fatigue, anorexia, and weight loss. As the disease worsens, major organs or body systems are affected. Joint deformities occur as a late symptom, and secondary osteoporosis (bone loss) can lead to fractures.

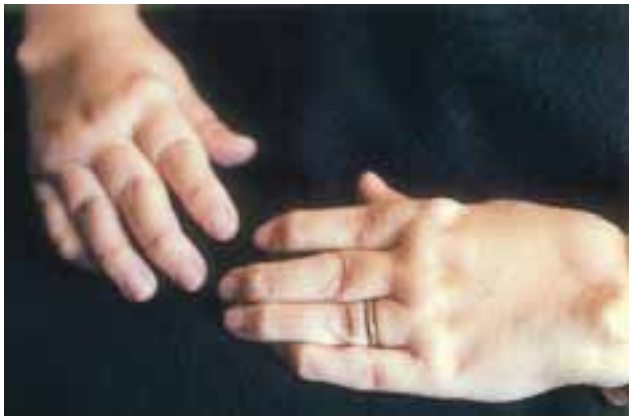

FIGURE 46.15 Joint abnormalities in hands of patient with rheumatoid arthritis.

Several associated syndromes are seen in some patients with rheumatoid arthritis. For example, Sjögren's syndrome is an inflammation of tear ducts (causing dry eyes) and salivary glands (causing dry mouth). Felty's syndrome is less common and is characterized by an enlarged liver and spleen and leukopenia (decreased white blood cell count).

Diagnosis

No specific diagnostic test confirms RA, but several laboratory tests help support the diagnosis. An increase in white blood cells and platelets is typical, unless the patient has Felty's syndrome. A group of immunologic tests are usually performed, and typical findings for patients with RA include the following:

- Presence of rheumatoid factor (RF) in serum
- Decreased red blood cell (RBC) count
- Decreased C4 complement
- Increased erythrocyte sedimentation rate (ESR)
- Positive antinuclear antibody (ANA) test
- Positive C-reactive protein (CRP) test

RF can indicate the aggressiveness of the disease. However, it is not specific to RA and can also be found in systemic lupus erythematosus, connective tissue disease, and myositis. The ESR is also obtained to evaluate the effectiveness of treatment. If the disease responds to treatment, the ESR decreases. The higher the ESR, the more active the disease process.

LEARNING TIP

ESR is a general screening test for inflammation. It measures the amount of time it takes for RBCs to settle to the bottom of a test tube. In the presence of inflammation, RBCs settle faster in the tube. Therefore, the ESR increases with the presence of inflammation.

X-ray examination and MRI detect joint damage and bone loss, especially in the vertebral column. A bone or joint scan assesses the extent of joint involvement throughout the body. For some patients, an **arthrocentesis** may be performed; the synovial fluid is cloudy, milky, or dark yellow with inflammatory cells present.

Therapeutic Interventions

Like patients with osteoarthritis, patients with RA experience chronic joint pain. Pain can interfere with mobility or the ability to perform ADLs. Drug therapy is often needed to relieve or reduce pain as well as to slow the progression of the disease.

MEDICATION. Treatment for RA includes disease-modifying antirheumatic drugs (DMARDs), which can prevent joint destruction, deformity, and disability with early single or combination drug use; NSAIDs; and corticosteroids. (See Table 46.4.) Newer DMARDs such as leflunomide (Arava) and etanercept (Enbrel) are used to slow the

progression of RA. Leflunomide taken orally has antiproliferative and anti-inflammatory properties. Etanercept inhibits tumor necrosis factor, which is involved in the inflammatory process, and is given subcutaneously twice a week. Low-dose methotrexate (MTX) or gold therapy is given to induce disease remission. NSAIDs such as aspirin and ibuprofen are prescribed for pain and stiffness, although they do not slow the disease process. Prednisone is a corticosteroid used to induce disease remission. Many of these medications have potentially serious side effects that must be monitored carefully.

Complementary therapies that may help decrease inflammation or pain include capsaicin cream, fish oil, magnetic therapy, and antioxidants such as vitamin C, vitamin E, and beta carotene (see Chapter 4).

HEAT AND COLD. Heat applications or hot showers help decrease joint stiffness and make exercise easier for the patient. For acutely inflamed, or "hot," joints, cold applications are preferred. As for patients with osteoarthritis, a program that balances rest and exercise later in the day is most beneficial for the patient.

SURGERY. If nonsurgical approaches are not effective in relieving arthritic pain, the patient may have a total joint replacement (discussed later). In general, patients with RA who have surgery are not as successful when compared with patients with osteoarthritis. The presence of a systemic disease predisposes patients with RA to more postoperative complications.

Nursing Process for the Patient with Rheumatoid Arthritis

ASSESSMENT/DATA COLLECTION. A thorough history and physical assessment are needed for the patient with RA because the disease can involve every system of the body. In addition to assessing physical signs and symptoms, assess the patient for psychosocial, functional, and vocational needs.

After having the disease for approximately 15 years, fewer than half of RA patients are totally independent in their ADLs. These limitations may place a burden on family members, who must be included in the care of the patient with RA. Many patients with the disease are young or middle aged. RA can impair their ability to work, depending on the type of job they have. The health-care team assesses the patient's work skills to determine the need for changes in the workplace or a need to train for a new type of work.

NURSING DIAGNOSIS, PLANNING, AND IMPLEMENTATION. Acute pain related to chronic disease process

EXPECTED OUTCOME: Patient will report relief from pain.

- Provide analgesics as ordered *to relieve pain.*
- Ensure proper positioning and alignment *to minimize discomfort and promote pain relief.*
- Teach alternative measure of pain relief to maximize means *to relieve pain.*
- Encourge maintenance of normal weight *to prevent excess wear and tear of joints.*

Disturbed body image related to changes resulting from disease process

EXPECTED OUTCOME: Patient will come to accept alterations in body.

- Encourage patient to discuss feelings and concerns *to provide the nurse with an understanding of what the patient is experiencing.*
- Provide information and clarify misconceptions *to ensure that the patient is aware of the expected problems and concerns.*
- Encourage socialization *to improve on the person's perceptions of how they "look" to others.*
- Encourage sharing with support groups *so that the patient discusses their concerns with others experiencing the same problems.*

Fatigue related to chronic pain and suffering and difficulty with mobilization

EXPECTED OUTCOME: Patient will have decreased episodes of fatigue.

- Ensure regular rest periods throughout the day *to not overexert the patient.*
- Assist as required *to minimize the amount of energy the patient needs to use.*
- Teach patient the need to delegate *to ensure they do not overexert.*
- Teach energy conservation techniques *to reduce workload.*

Self-care deficit related to chronic degenerative disease process

EXPECTED OUTCOME: Patient will be able to provide own self-care.

- Encourage independence *to decrease feelings of despair about being unable to care for self.*
- Assist when necessary *to minimize frustration when patient unable to perform self-care function.*
- Teach patient about assistive devices to help with ADL *to promote self-care.*
- Collaborate with interdisciplinary team such as home care, occupational or physiotherapy *to acquire assistive devices and use alternate resources.*

Impaired physical mobility related to chronic inflammation of joints

EXPECTED OUTCOME: Patient will have improved physical mobility.

- Administer analgesics and anti-inflammatory agents *to reduce pain and increase mobility*
- Administer heat and cold therapy *to aid in joint function and movement.*
- Encourage continued mobilization *to minimize complications of immobility.*
- Collaborate with other disciplines *to help with maintaining mobility.*

EVALUATION. The outcome is met if patient reports pain is within acceptable levels on pain assessment scale of

0 to 10, demonstrates acceptance of changes in body image, has decreased episodes of fatigue, is able to provide own self-care, and demonstrates improved physical mobility.

CRITICAL THINKING

Mrs. Summers

■ Mrs. Summers is a 48-year-old nurse who has had upper extremity joint pain and swelling for about 4 years. She was recently diagnosed with rheumatoid arthritis (RA) but has no systemic involvement other than extreme fatigue at this time. She is concerned that she will have to give up providing direct patient care on a busy medical unit in the local hospital.

1. What questions might you ask her at this time about her illness?
2. What should you teach her about pain management?

Suggested answers at end of chapter.

Patient Education

The patient with RA needs extensive patient education regarding the disease process, medication management, and the comprehensive plan of care. Many fads and myths published in popular tabloids are available, and some publicized "cures" can actually be harmful to the patient.

In collaboration with health team members, help the patient plan a daily schedule that balances rest and exercise. Child care responsibilities and other day-to-day activities need to be scheduled. A vocational counselor may be necessary for job training if the patient needs to pursue a different occupation. Patients who are unable to work may be able to qualify for disability benefits through the Social Security program.

Inform the patient about community resources. For example, the local chapter of the Arthritis Foundation provides support groups, information, and other resources for patients with RA and other types of connective tissue disorders. (See Web link in section on osteoarthritis.)

MUSCULOSKELETAL SURGERY

Some health problems cannot be managed conservatively and require surgery. Other disorders are initially treated medically but may need surgery if treatment is unsuccessful. The most common surgeries are discussed here.

Total Joint Replacement

Total joint replacement (TJR) is most often performed for patients who have some type of connective tissue disease in which their joints become severely deteriorated. TJR may also be done for patients on long-term steroid therapy, such as patients with SLE or asthma. Long-term use of steroids, trauma, and complications of joint replacement can cause **avascular necrosis** (AVN), a condition in which bone tissue dies (usually the femoral head) as a result of impaired blood supply. Advanced AVN is very painful and usually does not respond to conservative pain relief measures. The primary goal of TJR is to relieve severe chronic pain and improve ability to carry out ADLs when no other treatment is successful.

The most common surgeries are the total hip replacement (THR) and total knee replacement (TKR), although any synovial joint can be replaced. Another term used for joint replacement is *arthroplasty.* The replacement devices, sometimes referred to as prostheses, are made of metal, ceramic, plastic, or a combination of these materials. Some prostheses are held in place by cement. Others are secured by the patient's bone as it grafts and connects to the prosthesis. Bone substitutes, also called biologics, are being used more often when the amount of available bone is insufficient to provide a good base of support for the replacement devices. Bone glues and fillers such as Osteoset or Pro Osteon and bone stimulants such as Allomatrix help in providing better support for the prosthetics used.

Total Hip Replacement

A THR uses a two-piece device consisting of an acetabular cup that is inserted into the pelvic acetabulum and a femoral component that is inserted into the femur to replace the femoral head and neck (Fig. 46.16). The average life span of a cemented THR is about 10 years. Noncemented prostheses used in younger patients may last longer.

PREOPERATIVE CARE. Total joint surgery is an elective procedure and scheduled far enough in advance to allow ample time for preoperative teaching and screening. A case

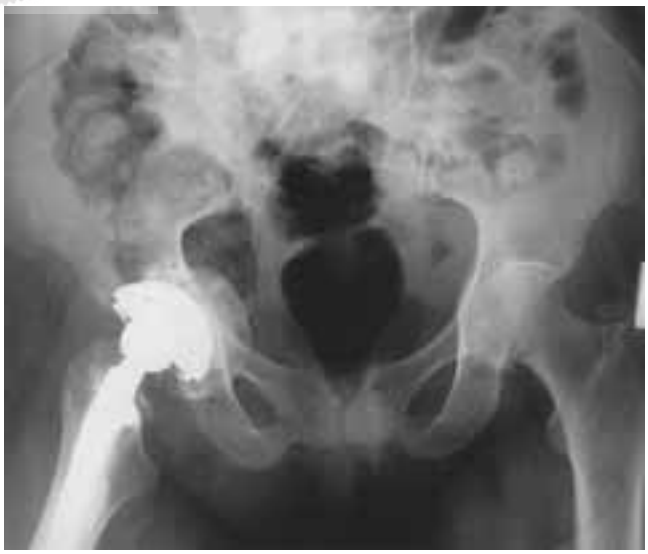

FIGURE 46.16 Total hip arthroplasty of arthritic right hip. *(From McKinnis, LN: Fundamentals of Orthopedic Radiology. F.A. Davis, Philadelphia, 1997, with permission.)*

avascular necrosis: a—without + vascular—blood + necrosis—death

manager (registered nurse or social worker) may be assigned to assess the patient's needs and the support systems that are available postoperatively. It is important for the patient to have a caregiver who can assist the patient after surgery.

In addition to the normal preparations for preoperative care (see Chapter 11), the orthopedic patient requires some preoperative baseline assessments. The nurse assesses the neurovascular status (circulation, sensation, mobility) of the extremity to be operated on as well as the patient's level of pain preoperatively. Preoperative mobility can also be assessed to help determine the effectiveness of the surgery postoperatively. The patient may require an IV to be started as the surgeon frequently orders a prophylactic antibiotic preoperatively to minimize the chance of an infection (especially osteomyelitis) developing. The patient is taught about the surgery and what to expect postoperatively. Some patients are scheduled to meet with the physical therapist to learn postoperative exercises and how to ambulate with a walker or crutches. Some institutions have total joint education programs, which are a series of educational sessions designed to make the recovery process smoother and more effective for the patient.

Depending on the amount of blood loss during surgery, some patients receive postoperative blood transfusions. Because total joint surgery is an elective procedure, the physician may order autologous blood donation by the patient. The patient donates blood before surgery per guidelines (e.g., time frames specified, hemoglobin levels normal), which is then available for reinfusion postoperatively as needed. This predeposited blood donation is cost effective and reassures patients who are concerned about receiving blood from other donors.

Patients are often admitted to the hospital the morning of surgery. The patient's length of stay is about 3 to 5 days, depending on the patient's age and progress. Some hospitals have joint camp programs where a group of patients undergoing joint replacements are admitted on the same day, undergo their surgery, and then recover together during activities such as physical therapy with each other for support. Patients have been known to recover more easily in this type of supportive environment and are typically discharged in about 3 days.

POSTOPERATIVE CARE. In addition to providing the general postoperative care that all patients undergoing general or epidural anesthesia require, plan and implement interventions to help prevent the following common complications of THR (see Chapter 11).

Hip Dislocation. The most common postoperative complication for the patient having a THR is subluxation (partial dislocation) or total dislocation. Dislocation occurs when the femoral component becomes dislodged from the acetabular cup. Frequently, if a dislocation occurs, there is an audible "pop" followed by immediate pain in the affected hip. In addition to the pain, the patient experiences shortening of the surgical leg, and possibly rotation of the surgical leg. If any of these signs and symptoms occur, notify the surgeon immediately and keep the patient in bed. Additional analgesics may be ordered until the patient can be taken to the operating room. Under anesthesia, the surgeon manipulates the hip back into alignment and immobilizes the leg until healing occurs.

Prevention of dislocation is a major nursing responsibility. Correct positioning of the surgical leg is critical. The primary goals are to prevent hip adduction (across the body's midline) and hyperflexion (bending forward more than 90 degrees). To accomplish these goals, place the patient returning from the postanesthetic care unit (PACU) in a supine position with the head slightly elevated. A trapezoid-shaped abduction pillow (sometimes called a triangular pillow), splint, wedge, or regular bed pillows may be used between the legs to prevent adduction (Fig. 46.17). The patient can be turned to either side (even the operative side if the patient is comfortable enough) or to the side specified by the physician, with hip adduction avoided. The patient is turned with the abductor pillow or three regular pillows (one proximal and two distal) in place between the legs. When turning, it is important to turn the hip and legs simultaneously to minimize the chance of dislocation. Support for the leg and abductor pillow is also required when the patient is turned on his or her side to decrease the chance of dislocation.

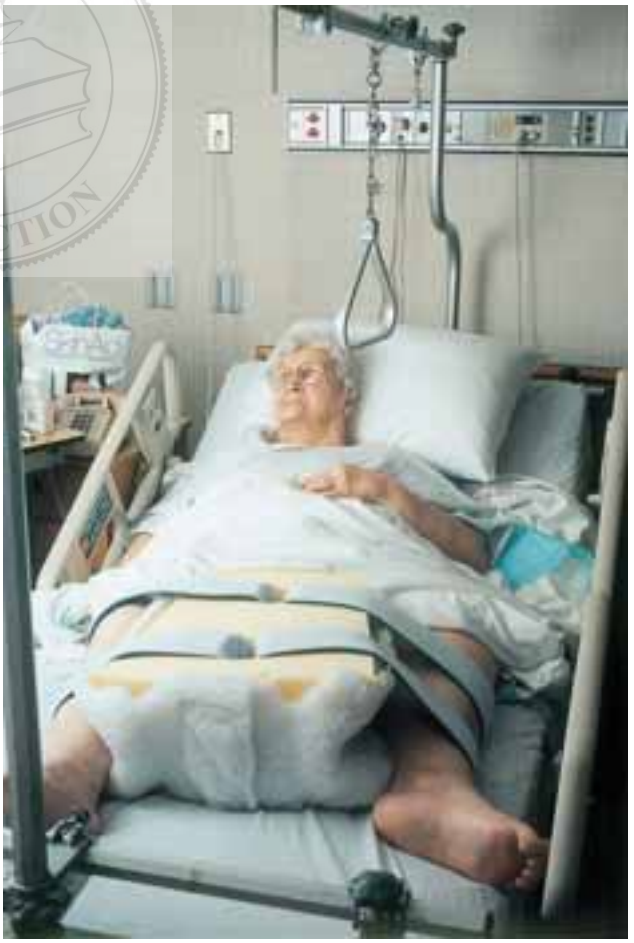

FIGURE 46.17 Abductor pillow is used to prevent adduction and hip dislocation.

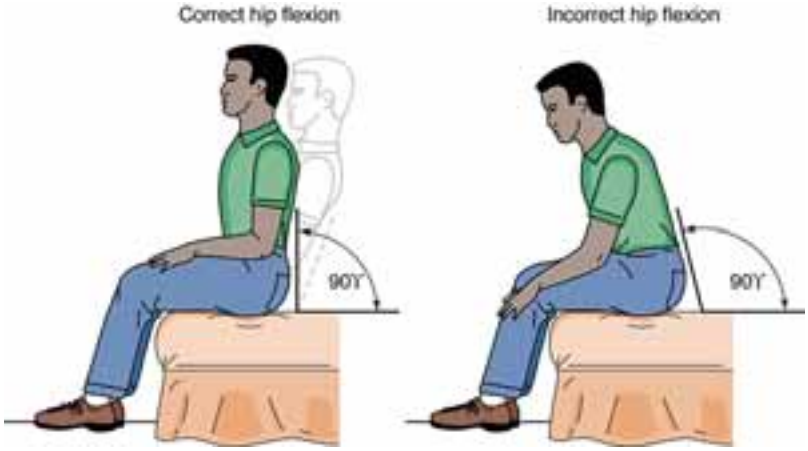

FIGURE 46.18 Hip flexion after total hip replacement should be 90 degrees or less to prevent dislocation.

To prevent hyperflexion, some surgeons initially allow the patient to sit at no more than a 60-degree angle in a reclining chair. The patient's position is progressed to 90 degrees, the maximum allowed to prevent hyperflexion (Fig. 46.18). While the patient is on bedrest, the use of a fracture (also called a slipper) pan when toileting the patient is recommended to minimize discomfort and to prevent the possibility of dislocation.

Skin Breakdown. Because most patients having total joint replacements are older, skin breakdown is a major concern as part of postoperative care. Turning the patient at least every 2 hours (more often if high risk) and keeping the heels off the bed are the key nursing interventions to prevent pressure ulcers. Heels, elbows, and the sacrum are vulnerable and can break down in 24 hours. A reddened area that does not blanch is a stage 1 pressure ulcer and must be treated aggressively to prevent progression to other stages. Prophylactic application of DuoDerm dressings, as well as heel protectors help to decrease the chance of skin breakdown of the heels.

Patients who are incontinent must be kept clean and dry. Toileting the patient every 2 hours and using a protective barrier cream also help prevent skin problems related to incontinence. Adequate diet and hydration are also important to prevent skin breakdown. Box 46.7 (Nursing Interventions Following Total Hip Replacement) describes additional nursing interventions that meet the needs of postoperative patients recovering from THR.

Infection. Orthopedic surgery patients are at an increased risk for infection because of the nature of the surgery and because the patients are often older adults with an already increased risk for postoperative complications. In addition to the preoperative prophylactic intravenous antibiotic, the surgeon can administer antibiotics intraoperatively, and may continue antibiotics for 24 hours postoperatively.

Depending on the institution's policies, the surgeon may or may not remove the initial dressing. Regardless of who removes the dressing, meticulous aseptic care of the surgical wound is important to minimize the chance of infection. Care of the incision, as well as exit sites for drains, needs to be performed aseptically. When doing dressing changes, observe the incision routinely for signs and symptoms of infection (redness, swelling, warmth, odor, pain, drainage [yellow, green, or brown tinged]). Monitor temperature carefully. An older patient may not experience a fever but may appear confused instead.

Infection may not occur during the patient's hospital stay but can occur 1 or more years later. If this late infection

Box 46.7

Nursing Interventions Following Total Hip Replacement

- Ensure hip that the hip is not allowed to become adducted. Use triangular (abductor) pillow or pillows.
- Turning patient requires abductor pillow to remain in place. Turn patient as a whole, not allowing hip or legs to fall forward or backward. Use pillows to support raised limb.
- Monitor for skin integrity of opposite heel (often used to help mobilize in bed so is prone to friction and pressure sores. Apply protective devices for heels.
- Ensure limb remains in abduction when moving patient out of bed.
- Prevent postoperative pneumonia by encouraging deep breathing and coughing and use of incentive spirometer.
- Pain control is of the utmost importance. Provide regularly scheduled analgesics and ensure breakthrough analgesia is provided prn. Decreased pain allows for earlier mobilization and less complications of immobility.
- Monitor level of consciousness and orientation. Many older patients have alterations in their mental status after surgery due to anaesthetics, analgesics, blood loss, and environmental changes.

does not respond to antibiotics, the prosthesis may be removed and replaced. To prevent infection, antibiotics are often instilled directly into the wound during surgery as beads, as part of the cement mixture, or as an irrigating solution.

CRITICAL THINKING

Mrs. Jacobs

■ Mrs. Jacob's is 78 years old and has had a left THR 3 days ago. When changing her dressing you notice a purulent discharge. Cefaclor (Ceclor) 500 mg PO q8hr is ordered. It is available as a 375-mg/5-mL suspension. How many milliliters should Mrs. Jacobs be given?

Suggested answers at end of chapter.

Bleeding. Like any surgical wound, some bleeding is expected. In joint replacement surgery, up to two-thirds of the blood loss can occur postoperatively. The patient often has at least one surgical drain (e.g., Hemovac or Jackson-Pratt) that is emptied every 8 to 12 hours or as required for the first day or two. Monitor the dressing for signs of bleeding and reinforce the dressing if needed. On the second or third postoperative day, the patient's hemoglobin and hematocrit may decrease to the point that blood transfusion is needed. The patient may receive the preoperatively donated autologous blood or may receive salvaged operative or postoperative blood. Using a cell saver (sometimes called an orthopat, which stands for orthopedic patient auto-transfusion) during surgery, about 50% of blood that is lost can be recovered and saved for reinfusion into the same patient. Postoperatively, blood can be replaced by collecting shed blood via suction into a reservoir, then filtering and reinfusing it within 6 hours of collection. Monitoring for blood loss and signs of shock is an important nursing consideration.

Neurovascular Compromise. For any musculoskeletal surgery or injury, frequent neurovascular checks for circulation (color, warmth, pulses), sensation, and movement are performed distal to the surgical procedure or injury (and compared to the unaffected side) when vital signs are checked. The procedure and significance of these assessments are described in Chapter 45.

Pain. Because patients undergoing THR are in chronic pain preoperatively, some patients report that they have less pain postoperatively than they had before surgery. Initially pain is typically managed by epidural analgesia, patient-controlled analgesia (PCA), or injections with analgesics. After the first postoperative day, the patient usually progresses to oral opioid analgesia with a drug (such as Percocet or Tylenol with codeine). Proper positioning also helps minimize surgical discomfort.

Ambulation. Care for the patient having a THR is interdisciplinary. The patient usually gets out of bed and into a chair the night of surgery or early the next day. Ensure that the patient does not adduct or hyperflex the surgical hip during transfer to the chair. The chair should have a straight back and be high enough to prevent excessive flexion. The toilet seat should also be raised for the same purpose. Permitted amounts of weight bearing depend on the type of prosthesis that is used. In general, weight bearing as tolerated or full weight bearing is used for cemented prostheses. If an uncemented device is used, the patient may be restricted to toe-touch, or partial weight bearing, or featherweight bearing.

Early ambulation helps prevent postoperative complications such as atelectasis and deep vein thrombosis (DVT). The physical therapist works with the patient for ambulation with a walker or crutches. Crutches are reserved for young patients. After 4 to 6 weeks, the patient is progressed to a cane. The patient does not need an ambulatory device if there is no limping.

Thromboembolitic Complications. Patients having hip surgery are at greatest risk for DVT or pulmonary embolus (PE). Older adult patients are especially at risk because of compromised circulation. Obese patients and those with a history of thromboembolitic (TE) problems are also at an exceptionally high risk for potentially fatal problems.

Thigh-high elastic stockings and sequential compression devices (SCDs) may be used while the patient is hospitalized (see Chapter 11). The surgeon orders an anticoagulant medication to help prevent clot formation, including subcutaneous low molecular weight heparin (such as enoxaparin [Lovenox], dalteparin [Fragmin]) or oral warfarin (Coumadin). Occasionally, heparin is still used, and if so, it is important to monitor for heparin-induced thrombocytopenia, which can occur as early as 3 days after the start of heparin therapy. The ordered daily dosage of these drugs is determined by coagulation studies. Partial thromboplastin times are monitored for patients on heparin. International normalized ratio (INR) reported with prothrombin time is monitored when giving warfarin.

NURSING CARE TIP

When giving enoxaparin or dalteparin, follow manufacturer's instructions for administration. The air bubble should not be removed from the prefilled syringe before administration to ensure the whole dose is given.

Because most DVTs occur in the lower extremities, leg exercises are started in the immediate postoperative period and continued until the patient is fully ambulatory. The physical therapist teaches the patient how to perform foot and ankle exercises such as heel pumping, foot circles, and straight-leg raises (SLRs). The patient also performs quadri-

ceps-setting exercises (quad sets) by straightening the legs and pushing the back of the knees toward the bed. Remind the patient to do several sets of these exercises each day to improve muscle tone and to help prevent blood clots in the leg.

Self-Care. Because of restrictions in hip flexion, patients are instructed not to bend forward to tie shoes or put on pants. The occupational therapist provides adaptive or assistive devices, such as dressing sticks and long-handled shoe horns, to assist the patient in being independent in activities of daily living.

If the patient is medically stable, he or she is discharged home for rehabilitation or to a subacute care unit, rehabilitation unit, or nursing home for short-term rehabilitation, lasting a week or less. The rehabilitation program that began in the hospital continues after discharge until the patient is independent in ambulation and self-care.

Before hospital discharge, the interdisciplinary team provides patient education for home care, including hip precautions that need to be used until the surgeon reevaluates the patient at the 6- to 8-week follow-up visit (Box 46.8 Educating the Patient After Total Hip Replacement and Home Health Hints).

Total Knee Replacement

The knee is the second most commonly replaced joint. It requires three components for replacement: a femoral component, a tibial component, and a patellar button (Fig. 46.19).

Care for the patient with a TKR is similar to that required for a patient with a hip replacement except dislocation and, therefore, preventive positioning are not a concern. Postoperatively, there is usually a bulky dressing along with the normal surgical drain in place. Once again, it is important to monitor for bleeding along with the normal postoperative interventions. Although precautions to prevent dislocation are not applicable for the patient with a knee replacement, other medical complications described for THR, such as deep vein thrombosis, may be seen in the patient undergoing knee replacement (see Box 46.7 Nursing Interventions Following Total Hip Replacement).

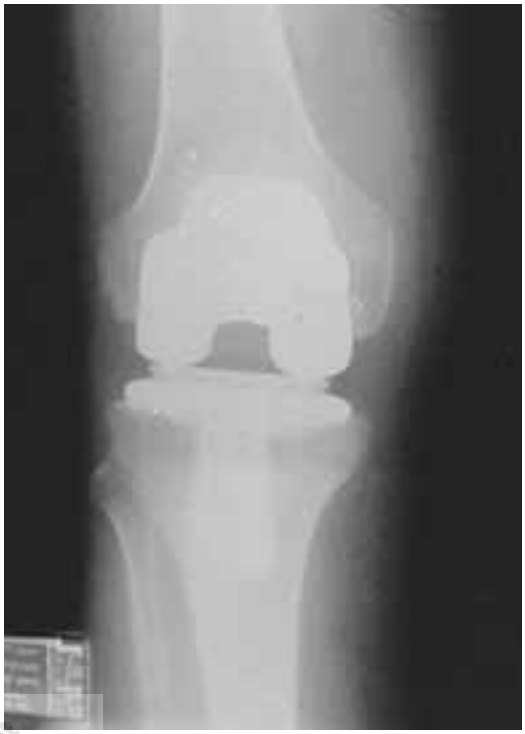

FIGURE 46.19 Knee joint replacement. *(From Richardson, JK, and Iglarsh, ZA: Clinical Orthopaedic Physical Therapy. Saunders, Philadelphia, 1994, p 651, with permission.)*

Postoperatively, a continuous passive motion machine (CPM) may be used for the operative leg. This motorized machine has a flexible extremity rest (for either the leg or arm) that glides back and forth on a track (Fig. 46.20). The CPM is set at the degree of flexion and speed ordered by the physician and is usually begun in the PACU. The CPM can be applied by a nurse, physical therapist, or technician and is used either intermittently up to 8 to 12 hours a day or continuously while the patient is in bed. The purpose of CPM is to keep the knee joint mobile. Nursing care associated with the use of the machine is summarized in Box 46.9 Application of a Continuous Passive Motion (CPM) Machine. A postoperative knee splint may be worn until straight leg raises (indicating leg strength has returned) can be done by the patient.

Amputation

Simply defined, an amputation is the removal of a body part, which can be as limited as removing part of a finger or as devastating as removing nearly half the body. Amputations may be surgical as a result of disease or traumatic as a result of an accident. Surgical amputations are the most common type and are most often scheduled as elective surgery.

Box 46.8

Educating the Patient After Total Hip Replacement

Safety Measures to Prevent Hip Dislocation

- Keep legs abducted (away from center of body) with pillows.
- Bending at the waist (hip) cannot be greater than 90 degrees.
- Getting up from a sitting position requires pushing straight up off of the chair or bed without leaning forward.
- Walkers can be used to assist walking.
- Physiotherapy and occupational therapy can provide equipment that aids in putting on socks and shoes.
- Sleep with pillows between legs until physician states otherwise.
- Sexual activity can be started when tolerated provided hip safety measures followed.

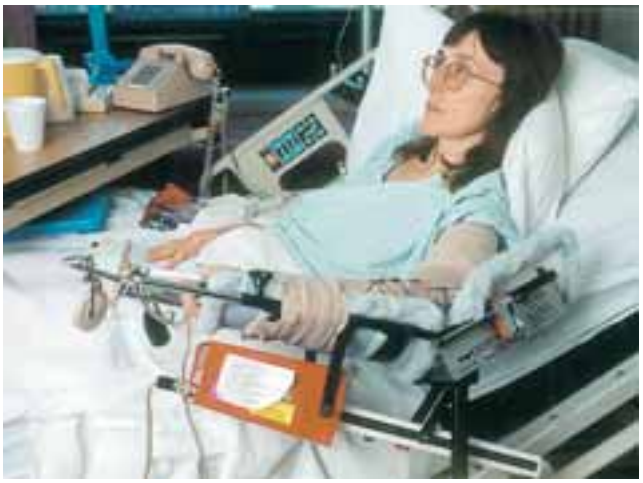

FIGURE 46.20 A continuous passive motion machine can be used following knee or elbow (as shown here) joint replacement to increase joint mobility and enhance recovery. The CPM machine slowly moves along the track at the set degree of flexion and speed.

SURGICAL AMPUTATIONS. The main indication for surgical amputations is ischemia from peripheral vascular disease in the older adult. The rate of lower extremity amputation is much greater in the diabetic patient than in the nondiabetic patient (see discussion of diabetes in Chapter 40). Surgical amputations may also be done for bone tumors, thermal injuries (frostbite, electric shock), crushing injuries, congenital problems, or infections.

TRAUMATIC AMPUTATIONS. Traumatic amputations occur from accidents, often in young and middle-aged adults. Industrial machinery, motor vehicles, lawn mowers, chain saws, and snow blowers are common causes of accidental amputation.

Because in these patients the amputated part is usually healthy, attempts at **replantation** may occur. One of the most common replantations is one or more fingers. The current recommendation for prehospital care of the severed body part is to wrap it in a cool, slightly moist cloth and place it in a sealed plastic bag. The bag may be submerged in cold water until the body part is transported to the hospital.

The surgical procedure is performed by specialists who operate using a microscope. Nerves, vessels, and muscle must be reattached. These procedures are generally performed at large tertiary care centers that have specialty practitioners and equipment for replantation.

LEVELS OF AMPUTATION. The most common surgical amputation is part of the lower extremity. The loss of any or all of the small toes presents little problem. However, the loss of the great toe is more important because balance and gait are affected. Midfoot amputations are preferred over below-the-knee amputations (BKAs) for peripheral vascular disease. For the Syme amputation, the surgeon removes most of the foot but leaves the ankle intact for ambulation and weight bearing.

If the lower leg is amputated, a BKA is preferred over an above-the-knee amputation (AKA) to preserve joint function. The higher the level of amputation, the more energy is required for ambulation. Hip disarticulation (removal through the hip joint) and **hemipelvectomy** (removal through part of the pelvis) are reserved for young patients who have cancer or severe trauma. Rarely, a hemicorporectomy (hemipelvectomy plus a translumbar amputation) is performed as a last resort for young patients with cancer. This radical surgery removes nearly half of the body and requires both bowel and urinary diversion surgeries (ostomies) as well.

Upper extremity amputations are usually more significant than lower extremity amputations and more often result from trauma. The arms and hands are necessary for performing activities of daily living. Early replacement with a prosthesis is crucial for the patient with an upper extremity amputation.

PREOPERATIVE CARE. Patients who are scheduled for elective amputations have the advantage of time for preoperative teaching, prosthesis fitting, and adjustment to the loss of part of their bodies. Preoperative teaching is started in the surgeon's office. Postoperative and rehabilitative care is reviewed with the patient and family or significant other. Those patients experiencing a traumatic amputation have no opportunity to prepare for the significant changes that will result from the accident. Preoperative care will not only involve physical needs being met but also significant psy-

Box 46.9

Application of a Continuous Passive Motion (CPM) Machine

- Position joint (knee) over flexion point of machine.
- Padding (e.g., sheepskin) is particularly important at proximal end near gluteal fold.
- Ensure speed and angle settings are correct and monitored according to facility policy. A minimum of every shift is required.
- The patient is provided the controls to stop the machine prn unless he or she is mentally incompetent to do so. If unable to self monitor, ensure patient is checked frequently.
- Assess how well patient tolerates the speed and angle of movement.
- Speed and angle adjustments are determined by agency policy, physiotherapist, or the physician.
- Ideal utilization is three times a day for at least 1 hour per session.

replantation: re—again + plant—to plant + ation—process
hemipelvectomy: hemi—half + pelv—pelvis + ectomy—removal of

chological and emotional concerns will have to be addressed (this will also have to continue postoperatively).

Preoperatively, the patient should be referred to a certified prosthetist-orthotist (CPO) to begin plans for replacing the removed body part with a prosthesis.

Disturbed body image is a common nursing diagnosis for the patient having an amputation. If possible, it is helpful for the preoperative patient to meet with a rehabilitated amputee. Assess the patient's reaction to having an amputation with the expectation that the patient will experience many of the stages of loss and grieving. Support systems and coping mechanisms are identified that can help the patient through the surgery and postoperative period. Ensure that appropriate support is provided by other disciplines such as social work and clergy.

POSTOPERATIVE CARE. In addition to the general postoperative care, plan and implement interventions to help prevent postoperative complications (see Chapter 11).

Hemorrhage. When a patient loses part of the body, either by surgery or trauma, blood vessels are severed or damaged. The patient returns from surgery with a large pressure dressing that is secured with an elastic wrap. Assess the closest proximal pulse between the heart and the amputated body part for strength and compare findings with the nonsurgical extremity. Assess the bulky dressing for bloody drainage. If blood is on the dressing when the patient is admitted to the PACU or the surgical unit, circle, date, and time the area of drainage and closely monitor for enlargement. If bleeding continues, the surgeon is notified immediately. A tourniquet should be readily available in the event that severe hemorrhage occurs.

After the dressing is removed, observe for adequate perfusion to the skin flap at the end of the residual limb, referred to as the stump. The skin should be pink in a light-skinned patient and not discolored (lighter or darker than other skin pigmentation) in a dark-skinned patient. The residual limb should be warm but not hot.

Infection. Infection of the wound can be problematic, especially if the infection enters the bone (**osteomyelitis**). Inspect the wound for intense redness or drainage. Localized infections usually do not cause an increase in body temperature. If temperature is elevated, it could indicate a serious wound infection, a systemic infection, or some other type of infection. Traumatic amputations are at risk for developing infection due to the nature of the injury and the likelihood of exposure to environmental pathogens from the source of the amputation.

Pain. In addition to the usual incisional pain that is expected following a surgical procedure, phantom limb pain occurs in as many as 80% of all amputees (surgical or traumatic). The patient complains of severe pain where the removed body part was located. The pain may be described as either intense burning, a crushing sensation, or cramping.

Phantom limb pain can be triggered by touching the residual limb, feeling fatigued, or experiencing emotional stress. It is reported that phantom limb pain can also be triggered by pressure or changes in the weather. Although it occurs most often in the immediate postoperative period, phantom limb pain may occur at any time during the first postoperative year or sometimes even years after the amputation. The pain may be mild to severe. The cause is not clear.

Never doubt that the patient is experiencing phantom limb pain. Treat the pain aggressively with medications and complementary therapies. The surgeon prescribes medication based on the type of pain sensation the patient experiences. For example, anticonvulsants, such as phenytoin (Dilantin), are used for knifelike pain. Beta-blocking agents, such as propranolol (Inderal), are appropriate for burning sensations, and gabapentin (Neurontin) or amitriptyline (Elavil) can be used for nerve pain. To complement traditional therapy, a number of therapies may be useful, including biofeedback, massage, imagery, hypnosis, acupuncture, acupressure, and distraction.

Mobility and Ambulation. To reduce surgical swelling, cold application may be ordered. Alternately, the residual limb may be elevated on a pillow for 24 hours or less. Continued use of a pillow for elevation can lead to flexion contractures, especially for patients with a BKA or an AKA. If the hip becomes contracted, using a prosthesis will not be possible because the patient will not be able to walk. Check the limb periodically to ensure that it lies completely flat on the bed. The patient should avoid positions of flexion such as sitting for long periods. If the patient is able, lying prone (on stomach) for 30 minutes four times daily helps prevent contracture.

Postoperative care of the patient experiencing an amputation is interdisciplinary, often requiring an extensive rehabilitation program in a subacute unit, nursing home, or on an ambulatory basis. The physical therapist teaches the patient muscle-strengthening exercises that help with ambulation and transfers and prevent flexion contractures. A trapeze and overhead bed frame aid in strengthening the upper extremities and help the patient move around in the bed.

Prosthesis. The residual limb must be prepared for wearing the prosthesis. A temporary prosthesis may be worn until the swelling subsides.

The residual limb is wrapped at least every 8 hours using an elastic wrap (such as an Ace wrap) in a figure-of-eight fashion (Fig. 46.21). It is important to perform neurovascular checks and assess the residual limb for infection and alterations in tissue integrity at each rewrapping. Begin with the most distal portion and proceed proximally until the bandage is secured to the most proximal joint. The bandage should be tighter at the distal end.

The prosthesis requires special care which the patient should be taught:

osteomyelitis: osteo—bone + myel—bone marrow + itis—inflammation

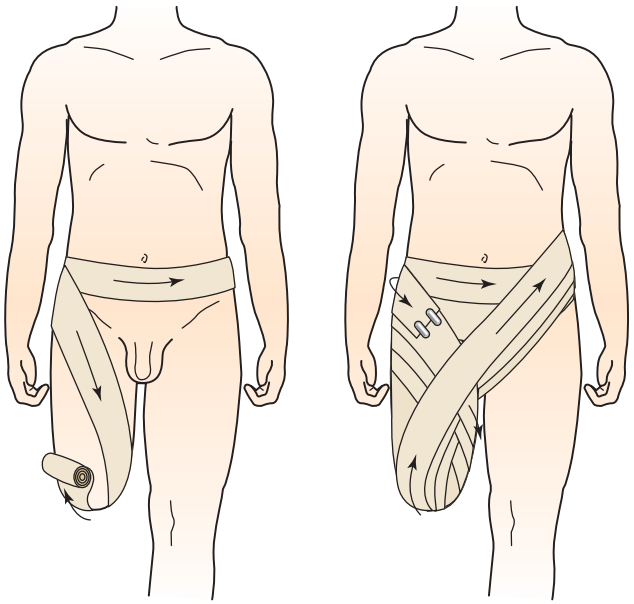

FIGURE 46.21 Application of elastic wraps on an above-the-knee amputation helps mold the stump for a prosthesis.

- The prosthesis socket is cleaned with mild soap/water and dried.
- Clean inserts and liners regularly.
- Use garters to keep socks in place.
- Grease parts as instructed.
- Shoes are replaced when worn out with same height and type.

Lifestyle Adaptation. The patient may feel that life will be markedly changed as a result of the amputation. With the technological advances in prostheses, most patients who worked before surgery are able to return to their jobs after surgery. If the discharge planner or case manager thinks it is needed, a job analysis may be conducted by a vocational analyst or specialized case manager. Many patients with amputations are able to bowl, ski, hike, and experience all the recreational hobbies that they were able to do before surgery.

A supportive family or significant other is vital to help the patient adjust to body image change. Consider the need for a sexual counselor or psychologist if indicated. For any patient with an amputation, help the patient set realistic expectations.

For the patient who is not a candidate for a prosthesis, home adaptations for a wheelchair may be needed. The patient must have access to toileting facilities and areas necessary for self-care. Structural changes in the living environment may be necessary before the patient can be discharged from rehabilitation.

A small percentage of amputees return to their nursing home environment without prostheses. These patients need rehabilitation to ensure that they can be as independent as possible.

Home Health Hints

- Instruct the patient with rheumatoid arthritis to rest during acute inflammations and to stop activity if pain develops.
- If equipment or modifications to the home are needed following hospitalization for an orthopedic problem, it is best if they can be arranged or obtained before discharge. Equipment can include raised toilet seats, handheld reachers, walkers, canes, wheelchairs, and hand rails.
- Physical and occupational therapy are usually ordered for the orthopedic patient discharged from the hospital. They can work with them to help with ambulation, activities of daily living, teaching them how to use assistive devices, and also obtaining the above listed assistive devices.
- Physical and/or occupational therapy can also be ordered to assist the patient regain strength following surgery. The home health nurse can work with the therapist to educate the patient on the prescribed exercises.
- Peak incidents of DVT after hip or knee surgery is highest by the fifth postoperative day and that risk persists for up to 12 weeks. Be alert for signs of DVT: warmth, redness, edema, Homans' sign, and protective behavior of the affected leg.
- Many times the patient is discharged home still requiring Lovenox injections to prevent DVT formation. The nurse needs to educate the patient on how to administer the injection in the abdomen. If the patient cannot do this and no one is available to teach him or her, the home health nurse can make visits in order to administer the injection.
- Home health nurses frequently remove staples and sutures. Always carry several of each type of removal device in your car. Remember staples, scissors, or other items that are "sharp" need to be disposed of in a biohazard container.
- Research has shown that pain or fear of falling may prevent a patient from moving and functioning to maximum potential. Encourage patients to wear flat, sturdy, rubber-soled shoes to prevent slipping, tripping, or turning an ankle.
- Encourage the patient to dispose of all throw rugs, unnecessary furniture, or other possible fall hazards in the home.
- Patients who use walkers can get pressure ulcers on their palms. One way to relieve the pressure is to wear padded cycling gloves that leave the fingers free.

- A patient on crutches can use the crutch to prop a casted leg or foot.
- Patients who are having a difficult time putting on antiembolism stockings can be instructed on an easy way of slipping them on. Using a plastic grocery bag, instruct the patient to tie a knot on the closed end. Slip the bag over the foot, and then put the stocking on over the bag. Once the stocking is on over the heel, the patient or caregiver can pull the bag out using the knot that was tied.

REVIEW QUESTIONS

1. The nurse is caring for a patient who just had a plaster cast applied. Which action should the nurse take to facilitate cast drying?
   a. Cover the cast with blankets to provide extra warmth.
   b. Turn the patient every 2 hours.
   c. Increase the room temperature.
   d. Apply a heating pad.

2. A patient with multiple fractures of the femur returns from surgery for surgical repair with an external fixation device in place. Which of the following nursing interventions would be appropriate to properly care for the pins inserted into the patient's leg?
   a. Do not touch the pins.
   b. Follow agency protocol for pin care.
   c. Cleanse with hydrogen peroxide qid.
   d. Loosen the screws holding the pins when cleaning.

Multiple response item. Select all that apply.

3. Which of the following actions can the nurse take to help prevent osteomyelitis for a patient with an open fracture?
   a. Wash hands prior to dressing changes.
   b. Wear a protective gown.
   c. Wear a mask.
   d. Wear goggles.
   e. Wear sterile gloves to apply new dressing.

4. A patient is postmenopausal, has osteoporosis, has lost 2 inches of height, is thin, and has never exercised regularly. Which of these interventions should be included in the plan of care to prevent further bone loss?
   a. Decrease participation in ADLs.
   b. Decrease weight-bearing activities.
   c. Encourage regular exercise.
   d. Encourage weight gain.

5. A priority nursing diagnosis for the patient with Paget's disease includes which of the following?
   a. Pain
   b. Deficient knowledge
   c. Excess fluid volume
   d. Deficient fluid volume

6. Which of the following lab values would the nurse expect to be elevated in the patient with gout?
   a. WBC
   b. RBC
   c. Uric acid
   d. Ammonia

7. A butterfly rash is a classic symptom of which of the following disorders?
   a. Lupus
   b. Paget's disease
   c. Rheumatoid arthritis
   d. Osteosarcoma

8. A patient with osteoarthritis who had a right total knee replacement tells the nurse that her other knee is becoming painful. Which of these is the most appropriate instruction to help the patient preserve function of her left knee?
   a. Reduce dietary purines.
   b. Maintain ideal body weight.
   c. Maintain normal uric acid levels.
   d. Begin a jogging program.

9. A patient is scheduled for a right total hip replacement. The nurse should include which of the following postoperative leg positions in the preoperative teaching plan?
   a. Maintain legs in adduction.
   b. Maintain legs in abduction.
   c. Maintain internal leg rotation.
   d. Maintain more than 90-degree hip flexion.

10. Following amputation, which of these assessments should the nurse consider a priority to monitor for potential postoperative amputation complications?
    a. Sacral edema
    b. Level of consciousness
    c. Stump dressings
    d. Blood sugars

11. Which of the following findings would indicate a complication of a left fibula fracture?
    a. The patient has an increased red blood cell count.
    b. The patient has a decreased pulse, respiration and BP.
    c. The patient has a decreased CD4 lymphocyte count.
    d. The patient has an absent left pedal pulse.

12. A patient has a 36-hour-old fractured femur. He had morphine 5 mg intramuscularly 1 hour ago and is reporting severe unrelieved pain. Which nursing action is most appropriate?
    a. Give pain medication.
    b. Adjust the traction.
    c. Bivalve the cast.
    d. Notify the physician.

13. A patient who had a total knee replacement is to receive Toradol 15 mg intramuscularly every 6 hours as needed for pain. The Toradol comes as 30 mg/mL. How many milliliters should the nurse give?

    _____ mL

SUGGESTED ANSWERS TO

CRITICAL THINKING

Mrs. Brown

1. When documenting, answer (either explicitly or implicitly by professional knowledge, in narrative or flow sheet format) what, why, when, where, who, and how for completeness.
   What? Patient found on the floor lying on her left side, moaning and holding her leg, crying out with any movement.
   Why = Fell
   When = 10 a.m. on Date
   Where = Dayroom
   Who = Mrs. Brown (patient)

DATE 1000 Found on floor in dayroom lying on left side, moaning and holding left leg, crying out with any movement. Stated, "I fell. I think my leg is broken." Supervisor immediately notified, and paramedics and Dr. Jones called. Vital signs BP 150/84, P 100, R 20. Left leg shorter than right. Remained with patient and instructed not to move until paramedics arrive. Blankets applied and pillow placed under head for comfort. 1030 taken by ambulance to Grace Hospital. I. Smith, LPN

2. The purpose of the traction is to reduce the muscle spasms that often accompany fractures and to increase comfort.
3. Nursing responsibilities include the following:
   a. Check neurovascular status frequently.
   b. Check equipment, including rope, pulleys, knots, and weights at least every shift.
   c. Do not allow the weights to rest on the floor.
   d. Do not allow the traction to be impeded in any way.
   e. Monitor the patient's skin often for areas of potential breakdown.
   f. Remove and rewrap the elastic bandages, maintaining the traction, at least every shift. Provide skin care during this time.
   g. Monitor area of the fracture for bruising and increased diameter of the limb.
   h. Monitor for pain (using pain assessment scale) frequently.
   i. Turn and position regularly.
4. Her restlessness is most likely the result of pain. She may be unable to state that she is in pain. Evaluate behaviors such as restlessness and other nonverbal cues to evaluate pain management needs. She may also be experiencing shock as a result of blood loss from the fracture. Monitor vital signs, and check the area of the fracture for increased signs of bruising or swelling.

Tommy Martin

1. Possible nursing diagnoses may include:
   a. Pain related to injury and immobility
   b. Potential for social isolation related to extended need for immobilization
   c. Potential complications of inactivity: Constipation, impaired skin integrity related to extended need for traction
   d. Deficient diversional activity related to extended need for bedrest
2. Nursing interventions may include:
   a. Monitor pain level, provide analgesics as ordered, assess pain relief. Assess position for comfort. Provide backrubs prn.
   b. To address social isolation, encourage Tommy's friends to come visit; have an occupational therapist assess Tommy's needs; and alternate family visitors.
   c. To avoid complications of inactivity, ensure Tommy's diet includes fiber and adequate hydration 1.5 to 2 L/day; give stool softener especially if on opioids as ordered; monitor daily defecation; ensure Tommy does the exercises recommended by occupational and physical therapists; reposition him every 2 to 3 hours; have trapeze set up for Tommy to use; use skin assessment tool to determine risk for skin breakdown; assess for pressure points and signs and symptoms of skin breakdown.
   d. To alleviate boredom, encourage Tommy to listen to music; encourage visitors; and ensure access to hobbies, videos, books, magazines, and comics.

Mr. Andrews

1. Nursing assessments should include the following:
   a. Perform a neurovascular check.
   b. Perform a further pain assessment.
   c. Ask Mr. Andrews to move his limb and see if the pain worsens.
   d. Take his vital signs.
   e. Assess for the 6 *P*s (pulselessness, paresthesia, paralysis, pallor, pain, poikilothermia).
2. He might be experiencing compartment syndrome.
3. Interventions may include the following:
   a. Bivalving cast
   b. Possible fasciotomy

Mr. Wolf

4. Give one 2.5-mg tablet and five 5-mg tablets in the morning and evening. Although response number 3 could have been done, there is an increased chance of administering less than ordered when you have to split a tablet in half (especially if it is not scored). Also there are less pills to administer in response d which also provides a psychological advantage to the patient's thinking. Responses a and b do not follow the doctor's order of giving equal doses.

Mr. Dennis

1. "What is your typical day on the job like?"
   a. "Do certain activities increase joint pain?"
   b. "When is your pain worse—after activity or after rest?"
   c. "How long have you experienced joint pain?"
   d. "What relieves the joint pain?"
2. Risk factors include that he is overweight, is in late middle age, and has a physically demanding job.
3. Other signs and symptoms may include bony nodules on his fingers (such as Heberden's nodes) and secondary inflammation causing joint swelling.

Mrs. Summers

1. Ask:
   a. The nature of her pain
   b. If it is worse after activity or rest
   c. If she experiences joint stiffness and, if so, when

Follow the WHAT'S UP? method of pain assessment.

2. Teach her to do the following:
   a. Balance rest with exercise.
   b. Use ice for very hot, swollen joints.
   c. Use heat to decrease stiffness.

Mrs. Jacobs

Unit Analysis Method:

$$\frac{500\ \cancel{\text{mg}} \mid 5\ \text{mL}}{375\ \cancel{\text{mg}}} = 6.7\ \text{mL}$$

Unit Twelve Bibliography

1. American Association of Orthopedic Surgeons. (November 2004). Osteogenesis Imperfecta. http://orthoinfo.aaos.org/fact/thr_report.cfm?Thread_ID=308&topcategory=About%20Orthopaedics&all=all.
2. Bajnoczy, S: Artificial disc replacement—evolutionary treatment for degenerative disc disease. AORN J 82:192–206, 2005.
3. Bailey, J: Getting a fix on orthorpedic care. Nursing 33:58, 2003.
4. Campbell, S (commentator): Review: wearing graduated compression stockings during air travel reduces the risk of deep venous thromboembolism. Evid Based Nurs 9:18. doi:10.1136/ebn.9.1.18, 2006.
5. Curry, L, and Hogstel, M: Osteoporosis. Am J Nurs 102:26, 2002.
6. Forster, F (commentator): Relaxing hip precautions increased patient satisfaction and promoted quicker return to normal activities after total hip arthroplasty. Evid Based Nurs 8:115. doi:10.1136/ebn.8.4.115, 2005
7. Forster, F (commentator): Older African-Americans with osteoarthritis of the knee preferred to avoid total knee replacement surgery. Evid Based Nurs 8: 32, 2005.
8. Freeman, TR: Teriparatide: A novel agent that builds new bone. J Am Pharmaceut Assoc 43:535–537, 2003.
9. Griffiths, P (commentator): Review: evidence from individually randomised trials shows that hip protectors do not reduce hip fractures in elderly people. Evid Based Nurs 8:24, 2005.
10. Ho, KT, and Reveille, JD: The clinical relevance of autoantibodies in scleroderma. Arthritis Res Ther 5:80–93, 2003.
11. McDonald, H (commentator): Patients who wore standard magnetic bracelets reported reduced pain from osteoarthritis of the hip or knee compared with patients wearing placebo bracelets. Evid Based Nurs 8:89. doi:10.1136/ebn.8.3.89, 2005.
12. Miller, R: KidsHealth. Childhood Cancer: Osteosarcoma. http://kidshealth.org/parent/medical/cancer/cancer_osteosarcoma_p3.html.
13. Morrison, RS, Magaziner, J, McLaughlin, MA, et al: The impact of post-operative pain on outcomes following hip fracture. Pain 103(3):303-11, 2003.
14. Olofsson, B, Lundstrom, M, Borssen, B, et al: Delirium is associated with poor rehabilitation outcome in elderly patients treated for femoral neck fractures. Scand J Caring Sci 19:119–127, 2005.
15. Pasero, C, and McCaffery, M: Pain in the critically ill. Am J Nurs 102:59, 2002.
16. Schuurmans, MJ. Duursma, SA, Shortridge-Baggett, LM, et al: Elderly patients with a hip fracture: The risk for delirium. Appl Nurs Res 16:75–84, 2003.
17. van Schoor, N, Smit JH, Twisk JW, et al: Prevention of hip fractures by external hip protectors. JAMA 289: 1957–1962, 2003.
18. Warden, V, Hurley, AC, and Volicer, L: Development and psycometric evaluation of the pain assessment in advanced dementia (painad) scale. J Am Med Dir Assoc 4:9–15, 2003.