CHAPTER 41 Nursing Care of Clients with Musculoskeletal Trauma

LEARNING OUTCOMES

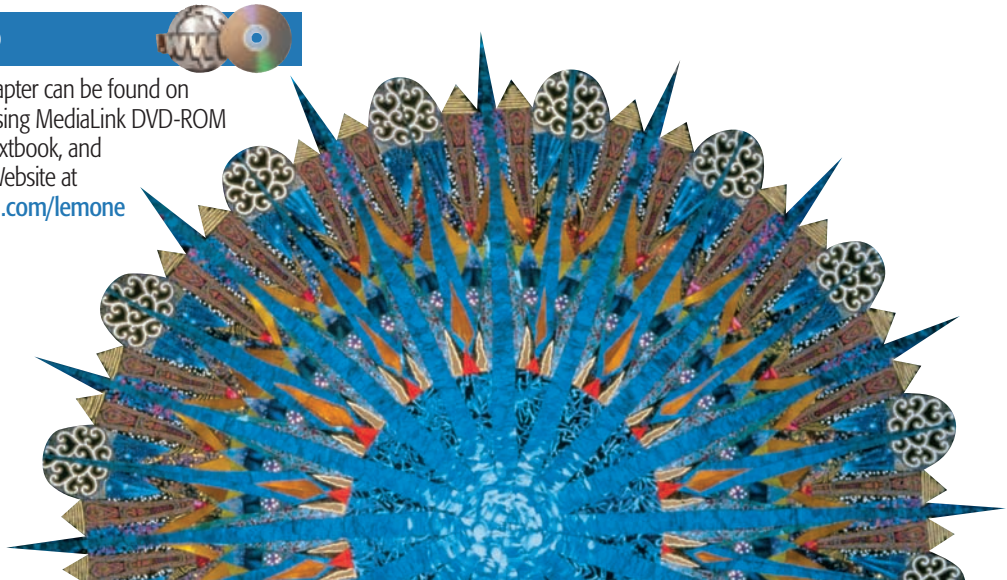
- Compare and contrast the causes, risk factors, pathophysiology, manifestations, interdisciplinary care, and nursing care of contusions, strains, sprains, joint dislocations, and fractures.
- Describe the stages of bone healing.
- Explain the pathophysiology, manifestations, and related treatment for complications of bone fractures: compartment syndrome, fat embolism syndrome, deep venous thrombosis, infection, delayed union and nonunion, and reflex sympathetic dystrophy.
- Discuss the purposes and related nursing interventions for casts, traction, and stump care.
- Explain the causes, levels, types, and potential complications (infection, delayed healing, chronic stump pain, phantom pain, and contractures) of an amputation.
- Describe the pathophysiology, interdisciplinary care, and nursing care for repetitive use injuries: carpal tunnel syndrome, bursitis, and epicondylitis.

CLINICAL COMPETENCIES

- Assess functional health status of clients with musculoskeletal injuries, and monitor, document, and report abnormal manifestations.
- Use evidence-based research to plan and implement nursing care for clients with skeletal pin sites.
- Determine priority nursing diagnoses, based on assessed data, to select and implement individualized nursing interventions for clients with musculoskeletal injuries.
- Provide skilled cast care, traction care, and stump care.
- Integrate interdisciplinary care into care of clients with musculoskeletal trauma.
- Provide teaching appropriate for prevention and self-care of traumatic injuries of the musculoskeletal system.
- Revise plan of care as needed to provide effective interventions to promote, maintain, or restore functional health status to clients with traumatic injuries of the musculoskeletal system.

MEDIALINK

Resources for this chapter can be found on the Prentice Hall Nursing MediaLink DVD-ROM accompanying this textbook, and on the Companion Website at http://www.prenhall.com/lemone



KEY TERMS

amputation, *1421*
bursitis, *1428*
compartment syndrome, *1403*
contracture, *1423*
contusion, *1399*
dislocation, *1400*
fat embolism syndrome (FES), *1406*
flail chest, *1414*
fracture, *1401*
nonunion, *1407*
phantom limb pain, *1423*
sprain, *1399*
strain, *1399*
subluxation, *1401*
Volkmann's contracture, *1406*

Musculoskeletal trauma is an injury to muscle, bone, or soft tissue that results from excessive external force. The external force transmits more kinetic energy than the tissue can absorb, and injury results. The severity of the trauma depends not only on the amount of force but also on the location of the impact, because different parts of the body can withstand different amounts of force. A wide variety of external forces can cause trauma, and the force involved can vary in severity (e.g., a step off the curb, a fall, being tackled in a football game, and a motor vehicle crash). See Chapter 11 for a detailed discussion of the results of different forces and types of injury from trauma.

Traumatic musculoskeletal injuries include blunt tissue trauma, alterations in tendons and ligaments, and fractures of bones. Various forces that cause musculoskeletal trauma are typical for a specific environment, activity, or age group. For example, motorcycle crashes resulting in fractures of the distal tibia, midshaft femur, and radius are common in young men. Sports injuries, resulting from either overuse or acute trauma, are seen more often in adolescents and young adults. Falls are the most common cause of injury in people age 65 or older, with fractures of the vertebrae, proximal humerus, and hip seen most often (Porth, 2005). Regardless of the cause, the injury may require rehabilitation and temporary or permanent changes in lifestyle.

Musculoskeletal trauma can result in mild or severe injuries. A client may experience a soft tissue injury, a fracture, and/or a complete amputation. In addition, trauma to one part of the musculoskeletal system often produces dysfunction in adjacent structures. For example, a fracture of the femur prevents the adjacent muscles from abducting and adducting. Nursing care helps minimize the effects of trauma, prevents complications, and hastens restoration of function. This chapter discusses fractures, amputations, soft tissue injuries, dislocations, and repetitive use injuries.

TRAUMATIC INJURIES OF THE MUSCLES, LIGAMENTS, AND JOINTS

THE CLIENT WITH A CONTUSION, STRAIN, OR SPRAIN

Contusions, strains, and sprains are among the most commonly reported injuries. They account for about 50% of work-related injuries, with lower back injuries being the most commonly reported occupational injury. However, many sprains and strains are not work related and often are not reported. The lower back and cervical region of the spine are the most common sites for muscle strains; the ankle is the most commonly sprained joint, usually caused by forced inversion of the foot.

Pathophysiology and Manifestations

A **contusion,** the least serious form of musculoskeletal injury, is bleeding into soft tissue that results from a blunt force, such as a kick or striking a body part against a hard object. The skin remains intact, but small blood vessels rupture and bleed into soft tissues. A contusion with a large amount of bleeding is referred to as a hematoma**.** The manifestations of a contusion include swelling and discoloration of the skin. The blood in the soft tissue initially results in a purple and blue color commonly referred to as a *bruise*. As the blood begins to reabsorb, the area involved becomes brown and then yellow until it disappears.

A **strain** is a stretching injury to a muscle or a muscle-tendon unit caused by mechanical overloading. A muscle that is forced to extend past its elasticity will become strained. Lifting heavy objects without bending the knees, or a sudden acceleration-deceleration, as in a motor vehicle crash, can cause strains. The most common sites for a muscle strain are the lower back and cervical regions of the spine. The manifestations of a strain include pain, limited motion, muscle spasms, swelling, and possible muscle weakness. Severe strains that partially or completely tear the muscle or tendon are painful and disabling.

A **sprain** is a stretch and/or tear of one or more ligaments surrounding a joint. Forces going in opposite directions cause the ligament to overstretch and/or tear. The ligaments may be partially or completely torn. Although any joint may be involved, sprains of the ankle and knee are most common, with more than 25,000 people spraining an ankle each day in the United States (National Institute of Arthritis and Musculoskeletal and Skin Diseases [NIAMS], 2004). Manifestations include loss of the ability to move or use the joint, a feeling of a "pop" or tear, discoloration, pain, and rapid swelling. Motion increases the joint pain. The intensity of the manifestations depends on the severity of the sprain. A comparison of sprains and strains is presented in Box 41–1.

INTERDISCIPLINARY CARE

The goal of the initial stage of treating soft tissue trauma is to reduce swelling and pain. Clients should follow a regimen of rest, ice, compression, and elevation (RICE) for the first 24 to 48 hours (see Table 41–1 for RICE therapy). Severe sprains may require

BOX 41–1 Comparison of Sprains and Strains

Sprain
- Defined as an injury to a ligament that results from a twisting motion.
- Can cause joint instability.
- Pain, edema, and swelling are present.
- Motion increases the joint pain.

Strain
- Defined as a microscopic tear in the muscle.
- Sharp or dull pain is present.
- Pain increases with isometric contraction of the muscle.
- Swelling and local tenderness are present.

surgical repair. Ankle sprains may be immobilized with an air cast, with no limitations on weight bearing. A knee injury often requires a knee immobilizer. If an upper extremity is injured, a sling is provided. Physical therapy may be recommended for rehabilitation. Time required for healing depends on the severity of the injury; for example, a mild ankle sprain may require up to 3 to 6 weeks of rehabilitation, whereas a severe sprain may require up to 8 to 12 months to return to full activities (NIAMS, 2004).

When soft tissue trauma is suspected, x-rays are taken to rule out soft tissue injury, and magnetic resonance imaging (MRI) may be done if further assessment is necessary. Medications used to treat soft tissue trauma include nonsteroidal anti-inflammatory drugs (NSAIDs) and analgesics.

NURSING CARE

The nursing care of each client is individualized. A strain or sprain may not be as devastating to an attorney as it is to a professional athlete; therefore, the nurse should determine what the injury means to the particular client.

Nursing Diagnoses and Interventions

Nursing diagnoses focus on providing information about self-care to decrease pain and return physical mobility to preinjury levels.

Acute Pain

The pain that results from soft tissue trauma is due primarily to the injury to the muscle or ligament and secondarily to bleeding and edema at the injury site.

- Teach the client to use RICE (rest, ice, compression, elevation) therapy to care for the injury. *The interventions included in RICE therapy allow the injured muscle, ligament or tendon to heal (rest), cause vasoconstriction and reduce pain (ice), decrease edema formation and pain (compression), and promote venous return to decrease edema and pain (elevation).*

Impaired Physical Mobility

Pain causes the client to avoid using or bearing weight with the injured extremity. Always observe the client's use of assistive devices; if the device is inappropriate, the client can face a greater risk of falling. Also consider that the device may be appropriate, but the client may not be using it correctly or safely. As a person ages, muscle mass in the upper extremities declines. As a result, the older client with a sprained ankle may not be able to use crutches, because crutches require that the person distribute body weight along the upper extremities. Older clients may therefore find a walker more useful.

- Teach the correct use of crutches, walkers, canes, or slings if prescribed. *Use of the correct technique increases safety and encourages use of these devices.*
- Encourage follow-up care. *Severe sprains may require further evaluation to determine if surgical intervention is indicated.*

THE CLIENT WITH A JOINT DISLOCATION

A **dislocation** is an injury of a joint in which the ends of bones are forced from their normal position. Dislocations usually follow trauma such as a fall or blow, with the bone ends displaced or separated from their normal position in the joint capsule. They commonly are seen in people who take part in contact sports such as football or from falls during activities such as skiing. Although dislocations may occur in any joint, they occur most frequently in the shoulder and acromioclavicular joints. Dislocations may

TABLE 41–1 RICE Therapy for Musculoskeletal Injuries

ACTION	CLIENT AND FAMILY EDUCATION
Rest	■ Decrease regular activities of daily living and exercise as needed. ■ If advised by your healthcare provider, do not put weight on the injured area for 48 hours. ■ Crutches may help if you can't put weight on an ankle or knee. ■ If you use a cane or crutch for an ankle injury, use it on the uninjured side so you can lean away from and relieve weight on the injured ankle.
Ice	■ Apply an ice pack to the injured area for 20 minutes at a time, four to eight times a day. ■ An ice bag, cold pack, plastic bag filled with ice, or a bag of frozen peas may be used. ■ Do not apply the ice pack for longer than 20 minutes to avoid cold injury and frostbite.
Compression	■ Compression often helps reduce swelling. The kind you use will depend on the recommendation of your healthcare provider. ■ Examples of compression bandages include Ace wraps, special boots, air casts, and splints.
Elevation	■ Keep the injured extremity elevated on a pillow above heart level, to help reduce swelling and pain.

also result from a disease such as rheumatoid arthritis. A **subluxation** is a partial dislocation in which the bone ends are still partially in contact with each other.

Pathophysiology

Dislocations may be congenital, traumatic, or pathologic. Congenital dislocations are present at birth and are seen in the hip and knee. Traumatic dislocations result from falls, blows, or rotational injuries. Pathologic dislocations result from disease of the joint, including infection, rheumatoid arthritis, paralysis, and neuromuscular diseases.

Manifestations

The manifestations of a dislocation include pain, deformity, and limited motion.

INTERDISCIPLINARY CARE

Care of the client with a dislocation focuses on relieving pain, correcting the dislocation, and preventing complications. The dislocation is diagnosed by physical examination and x-rays. The joint is most often reduced (bone ends realigned) by means of manual traction.

Treatment of a shoulder joint dislocation depends on the severity of the dislocation. Immobilization is no longer recommended, and only the most severe dislocations are surgically reduced. A dislocated hip requires immediate reduction in the emergency room to prevent necrosis of the femoral head and injury to the sciatic and femoral nerves. After reduction, the client is placed on bed rest. In some cases, traction is needed for several weeks. If a hip dislocation is accompanied by a fracture, the client will undergo surgery to increase mobility, decrease complications, and rapidly stabilize the joint.

NURSING CARE

Nursing care of the client with a dislocation or subluxation is individualized to the cause of injury, the type of dislocation, and the age of the client. It is important to teach clients to seek immediate medical attention, to splint the joint to prevent further damage, and to put ice on the injured joint (Mayo Clinic, 2006).

Nursing Diagnoses and Interventions

Nursing diagnoses focus on relieving pain and preventing complications.

Risk for Injury

The client with a dislocation requires frequent assessments to ensure that neurovascular compromise does not develop.

- Monitor neurovascular status by assessing the 5 "P's": pain, pulses, pallor, paralysis, and paresthesia. *Neurovascular compromise is indicated by increased pain, decreased or absent pulses, pale skin, inability to move a body part or extremity, and changes in sensation (such as "pins and needles" sensations, or loss of sense of sharp/dull touch).*
- Maintain immobilization after reduction. *Immobilization prevents the joint from dislocating again.*

Community-Based Care

Joint dislocations often tend to be recurring injuries for clients actively participating in contact sports and other vigorous physical activities. Prolonged immobilization (for several weeks after the injury) and aggressive rehabilitation following the initial dislocation can reduce the risk of recurrent dislocation. The following topics should be addressed in preparing the client for community-based care:

- Importance of complying with the prescribed length of immobilization
- Skin care and ways to prevent skin-to-skin contact, particularly in the axillary area
- Prescribed rehabilitation exercises that will strengthen muscles and other supportive structures in the shoulder, decreasing the risk of future dislocations
- Alternatives to activities that precipitate recurrent dislocations
- Instructions or referrals to physical therapy if needed for further teaching about using assistive devices
- Referrals to physical and occupational therapy and home health services as needed.

TRAUMATIC INJURIES OF BONES

THE CLIENT WITH A FRACTURE

A **fracture** is any break in the continuity of a bone. Fractures vary in severity according to the location and the type of fracture. Although fractures occur in all age groups, they are more common in people who have sustained trauma and in older clients.

Pathophysiology

Any of the 206 bones in the body can be fractured. A fracture occurs when the bone is subjected to more kinetic energy than it can absorb. Fractures may result from a direct blow, a crushing force (compression), a sudden twisting motion (torsion), a severe muscle contraction, or disease that has weakened the bone (called a *stress* or *pathologic fracture*). Two basic mechanisms produce fractures: direct force and indirect force. With direct force, the kinetic energy is applied at or near the site of the fracture. The bone cannot withstand the force. With indirect force, the kinetic energy is transmitted from the point of impact to a site where the bone is weaker. The fracture occurs at the weaker point.

Fractures in adults are classified in the following ways:

- If the skin is intact, the fracture is considered a *closed (simple) fracture*. If the skin integrity is interrupted, the fracture is considered an *open (compound) fracture* (Figure 41–1 ■). An open fracture allows bacteria to enter the injured area and increases the risk of complications.
- The fracture line may be *oblique* (at an angle to the bone) or *spiral* (curves around the bone). An *avulsed* fracture occurs when the fracture pulls bone and other tissues away from the point of

Figure 41–1 ■ *A*, An open fracture. *B*, A closed fracture.

MEDIALINK Case Study: A Client with Fractures

attachment. It may also be described as *comminuted* (the bone breaks in many pieces), *compressed* (the bone is crushed), *impacted* (the broken bone ends are forced into each other), or *depressed* (the broken bone is forced inward) (Figure 41–2 ■).

- *Complete* fractures involve the entire width of the bone, whereas *incomplete* fractures involve only a part of the width of the bone.
- A *stable* (nondisplaced) fracture is one in which the bones maintain their anatomic alignment. An *unstable* (displaced) fracture occurs when the bones move out of correct anatomic alignment. If a fracture is displaced, immediate interventions are required to prevent further damage to soft tissue, muscle, and bone.

Fractures may also be classified by point of reference on the bone, such as midshaft, middle third, and distal third. The point of reference may also be specific, such as intra-articular or diaphyseal.

Fracture Healing

Regardless of classification or type, fracture healing progresses over three phases: the inflammatory phase, the reparative phase, and the remodeling phase. (See *Pathophysiology Illustrated* on pages 1404–1405). The bleeding and inflammation that develop at the site of the fracture initiate the inflammatory phase. A hematoma forms between the fractured bone ends and around the bone surfaces. The osteocytes at the bone ends die as the hematoma clots, obstructing blood flow and depriving them of oxygen and nutrients. Necrosis of the cells heightens the inflammatory response, which in turn leads to vasodilation and edema. In addition, fibroblasts, lymphocytes, macrophages, and even osteoblasts from the bone migrate to the fracture site. Fibro-blasts form a fibrin meshwork and promote the growth of granulation tissue and capillary buds. The lymphocytes and macrophages wall off the area, localizing and containing the inflammation. The capillary buds invade the fracture site and supply a source of nutrients to promote the formation of collagen. The collagen allows calcium to be deposited.

Once calcium is deposited, a callus begins to form. In this reparative phase, osteoblasts promote the formation of new bone, and osteoclasts destroy dead bone and assist in the synthesis of new bone. Collagen formation and calcium deposition continue. During the remodeling phase, excess callus is removed and new bone is laid down along the fracture line. Eventually, the fracture site is calcified, and the bone is reunited.

The age, physical condition of the client, and the type of fracture sustained influence the healing of fractures. Other factors influence bone healing either positively or negatively and may be grouped according to their local or systemic influence (Box 41–2). Healing time varies with the individual. An uncomplicated fracture of the arm or foot can heal in 6 to 8 weeks. A fractured vertebra will take at least 12 weeks to heal. Healing of a fractured hip may take from 12 to 16 weeks.

Manifestations

Fractures are often accompanied by soft tissue injuries that involve muscles, arteries, veins, nerves, or skin. The degree of soft tissue involvement depends on the amount of energy or

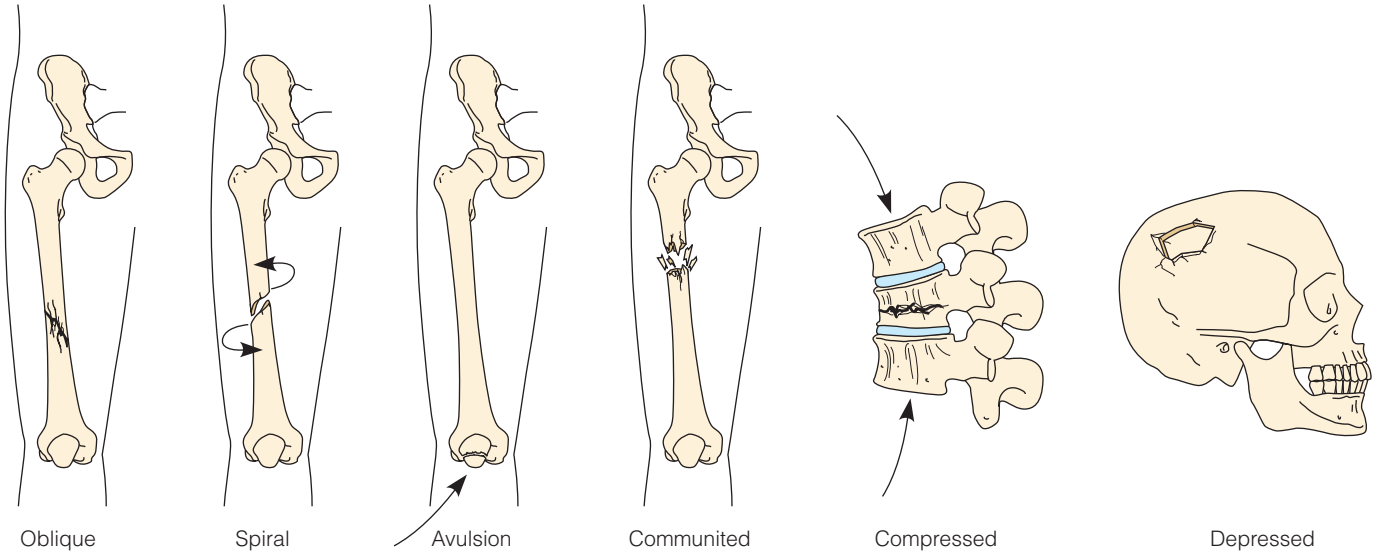


Figure 41–2 ■ Types of fractures.

BOX 41–2 Factors Influencing Bone Healing

Positive Factors

Local

- Immobilization
- Timely correction of displacement
- Application of ice
- Electrical stimulation

Systemic

- Adequate amounts of growth hormone, vitamin D, and calcium
- Adequate blood supply
- Absence of infection or diseases
- Younger age
- Moderate activity level prior to injury

Negative Factors

Local

- Delay in correction of displacement
- Open fracture (increases risk of infection)
- Presence of foreign body at fracture site

Systemic

- Immunocompromised status
- Decreased circulation (as in diabetes or peripheral vascular disease)
- Malnutrition
- Osteoporosis
- Advanced age

force transmitted to the area. Fracture manifestations and their causes are outlined in the Manifestations box on this page.

Complications

Complications of musculoskeletal trauma are associated with pressure from edema and hemorrhage, development of fat emboli, deep venous thrombosis, infection, loss of skeletal integrity, or involvement of nerve fibers. Bone fragments may also result in further injury or complications.

Compartment Syndrome

A compartment is a space enclosed by a fibrous membrane or fascia. The fascia lines the compartment within the limbs and is nonexpandable. Compartments within the limbs may enclose and support bones, nerves, and blood vessels. **Compartment syndrome** occurs when excess pressure in a limited space constricts the structures within a compartment, reducing circulation to muscles and nerves. Acute compartment syndrome may result from hemorrhage and edema within the compartment following a fracture or from a crush injury, or from external compression of the limb by a cast that is too tight. Increased pressure within the confined space of the compartment results in entrapment of nerves, blood vessels, and muscles.

Entrapment of the blood vessels limits tissue perfusion, beginning a cycle of events that may result in the loss of the limb. Inadequate oxygen supply causes cellular acidosis, which intensifies as cellular energy requirements are met through anaerobic metabolism. The capillaries inside the compartment dilate in an attempt to increase the supply of blood and oxygen. Additional blood and oxygen are not available, and plasma proteins leak out into the interstitial tissues. The interstitial tissue then pulls fluid in to balance the protein load. As a result, edema within the compartment increases. The edema causes further compression of the vascular network, and the cycle continues. Uninterrupted, this cycle threatens the client's limb and increases the risk of sepsis. Compartment syndrome usually develops within the first 48 hours of injury, when edema is at its peak. Manifestations of compartment syndrome are listed in the box below. It is important to note that arterial pulses may remain normal, even when pressure within the compartment is high enough to significantly impair tissue perfusion.

MANIFESTATIONS of Fracture

MANIFESTATION	CAUSE
Deformity	Abnormal position of bones secondary to fracture and muscles pulling on fractured bone
Swelling	Edema from localization of serous fluid and bleeding
Pain/tenderness	Muscle spasm, direct tissue trauma, nerve pressure, movement of fractured bone
Numbness	Nerve damage or nerve entrapment
Guarding	Pain
Crepitus	Grating of bones or entrance of air in an open fracture. *Note:* Do not manipulate the extremity to elicit crepitus; doing so may cause additional damage.
Hypovolemic shock	Blood loss or associated injuries
Muscle spasms	Muscle contraction near the fracture
Ecchymosis	Extravasation of blood into the subcutaneous tissue

MANIFESTATIONS of Compartment Syndrome

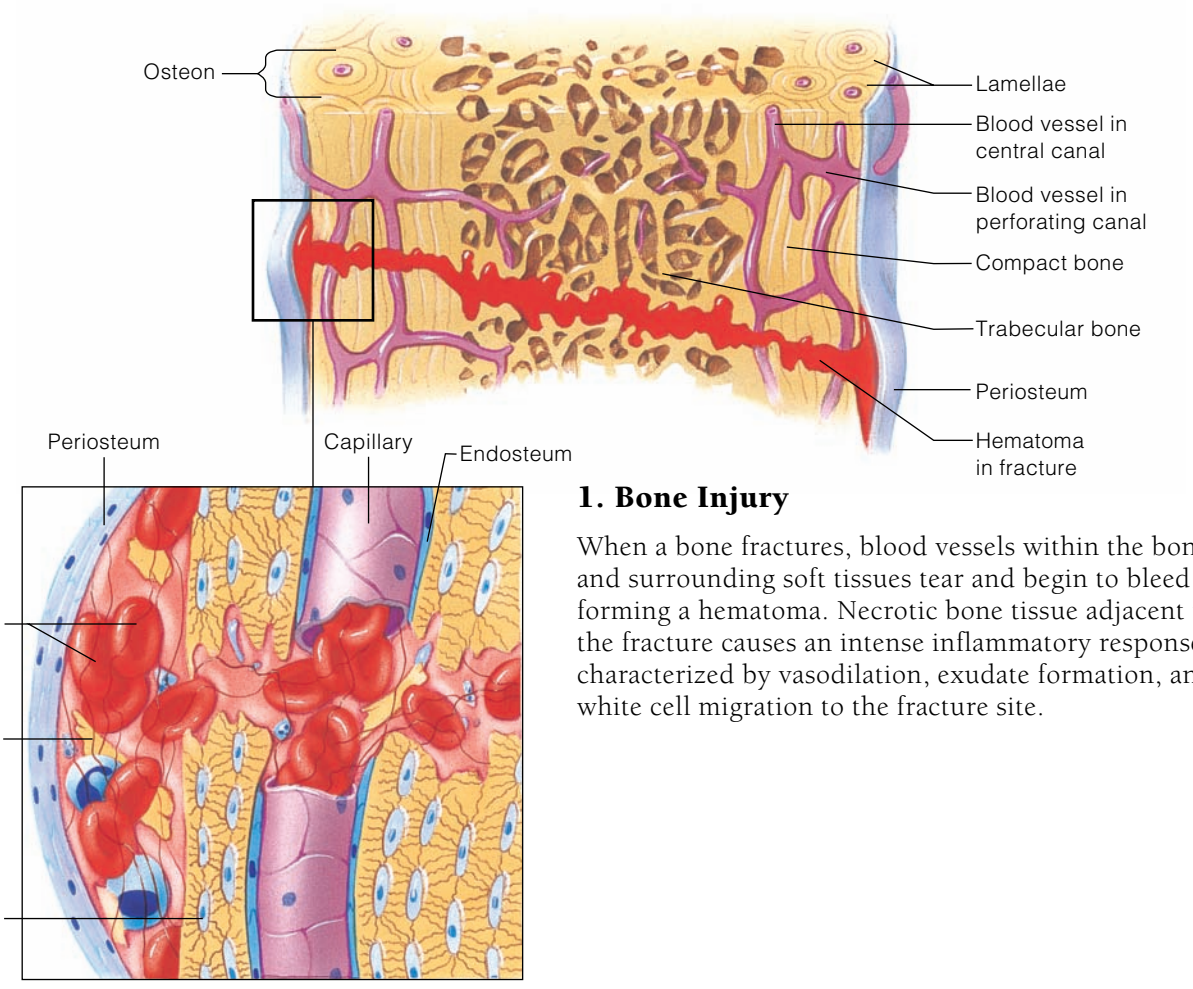
EARLY MANIFESTATIONS

- Pain
- Normal or decreased peripheral pulse

LATER MANIFESTATIONS

- Cyanosis
- Tingling, loss of sensation (paresthesias)
- Weakness (paresis)
- Severe pain, especially when the extremity is passively flexed
- Eventual renal failure (due to release of myoglobin into the bloodstream; myoglobin molecule is too large for effective filtration and excretion by kidney, and renal failure results)

Bone Healing



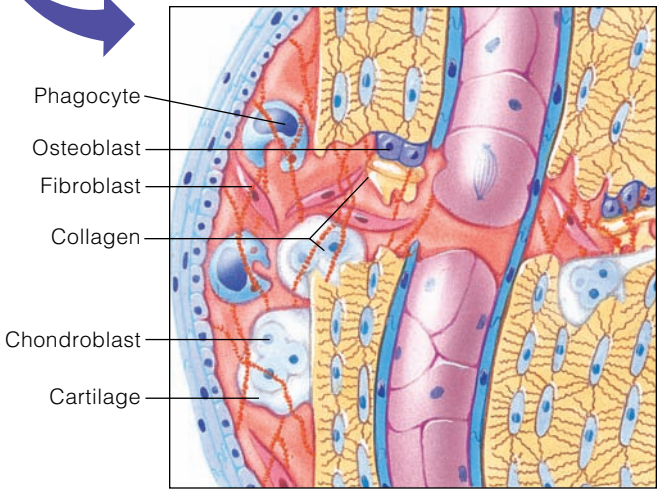
1. Bone Injury

When a bone fractures, blood vessels within the bone and surrounding soft tissues tear and begin to bleed, forming a hematoma. Necrotic bone tissue adjacent to the fracture causes an intense inflammatory response characterized by vasodilation, exudate formation, and white cell migration to the fracture site.

2. Fibrocartilaginous Callus Formation

Clotting factors within the hematoma form a fibrin meshwork. Within 48 hours, fibroblasts and new capillaries growing into the fracture form granulation tissue that gradually replaces the hematoma. Phagocytes begin to remove cell debris.

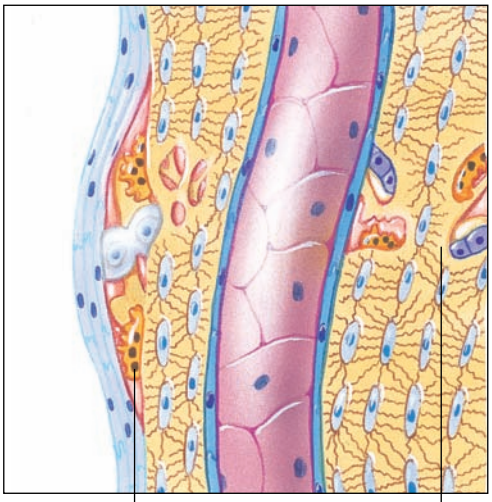
Osteoblasts, bone-forming cells, proliferate and migrate into the fracture site, forming a fibrocartilaginous callus. The osteoblasts build a web of collagen fibers from both sides of the fracture site that eventually unites to connect bone fragments, thus splinting the bone. Chondroblasts lay down patches of cartilage that provide a base for bone growth.

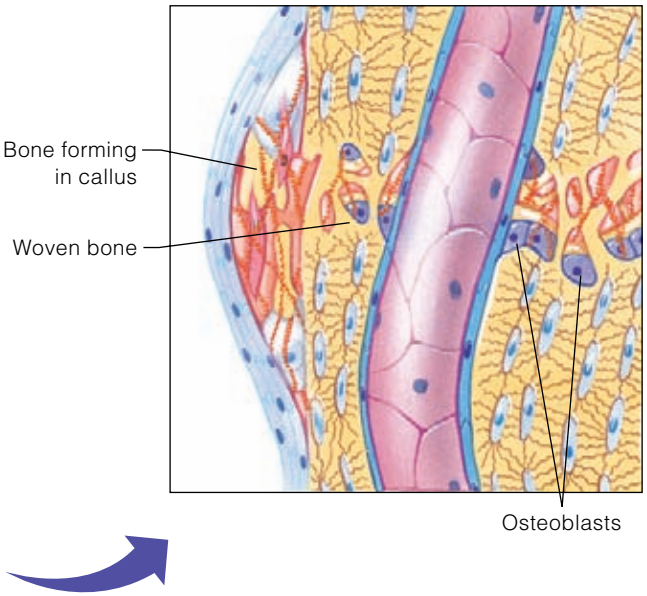


4. Bone Remodeling

Osteoblasts continue to form new woven bone, which is in turn organized into the lamellar structures of compact bone. Osteoclasts resorb excess callus as it is replaced by mature bone.

As the bone heals and is subjected to the mechanical stress of everyday use, osteoblasts and osteoclasts respond by remodeling the repair site along the lines of force. This ensures that the repaired section of bone eventually resembles the structure of the uninjured part.





3. Bony Callus Formation

Osteoblasts continue to proliferate and synthesize collagen fibers and bone matrix, which are gradually mineralized with calcium and mineral salts to form a spongy mass of woven bone. The trabeculae of woven bone bridge the fracture. Osteoclasts migrate to the repair site and begin removing excess bone in the callus. Bony callus formation usually continues for 2 to 3 months.

MEDIALINK
Bone Healing Animation

If compartment syndrome develops, interventions to alleviate pressure will be implemented; these may include removal of a tightly fitting cast. If the pressure is internal, a *fasciotomy*, a surgical intervention in which muscle fascia is cut to relieve pressure within the compartment, may be necessary. After a fasciotomy, the incision is left open, and passive ROM exercises are performed on the extremity.

Volkmann's contracture, a common complication of elbow fractures, can result from unresolved compartment syndrome. Arterial blood flow decreases, leading to ischemia, degeneration, and contracture of the muscle. Arm mobility is impaired, and the client is unable to completely extend the arm.

Fat Embolism Syndrome

Fat emboli occur when fat globules lodge in the pulmonary vascular bed or peripheral circulation. **Fat embolism syndrome (FES)** is characterized by neurologic dysfunction, pulmonary insufficiency, and a petechial rash on the chest, axilla, and upper arms. Long bone fractures and other major trauma are the principal risk factors for fat emboli; hip replacement surgery also poses a risk for FES.

When a bone is fractured, pressure within the bone marrow rises and exceeds capillary pressure; as a result, fat globules leave the bone marrow and enter the bloodstream. Another contributing factor may be the stress-induced release of catecholamine, which causes the rapid mobilization of fatty acids. Once the fat globules are released, they combine with platelets and travel to the brain, lungs, kidneys, and other organs, occluding small blood vessels and causing tissue ischemia.

Manifestations usually develop within a few hours to a week after injury. The manifestations result from the occlusion of the blood supply and the presence of fatty acids. Altered cerebral blood flow causes confusion and changes in level of consciousness. Pulmonary circulation may be disrupted, and free fatty acids damage the alveolar-capillary membrane. Pulmonary edema, impaired surfactant production, and atelectasis can result in significant respiratory insufficiency and manifestations of acute respiratory distress syndrome (see Chapter 39 ∞). Fat droplets activate the clotting cascade, causing thrombocytopenia. Petechiae (pin-sized purplish areas from bleeding under the skin) appearing on the skin, buccal membranes, and conjunctival sacs are thought to result from either microvascular clotting or the accompanying thrombocytopenia.

Early stabilization of long bone fractures is preventive for FES. Prompt identification and treatment of the syndrome are necessary to maintain adequate pulmonary function. In severe cases, the client may require intubation and mechanical ventilation to prevent hypoxemia. Fluid balance is closely monitored. Corticosteroids may be administered to decrease the inflammatory response of lung tissues, stabilize lipid membranes, and reduce bronchospasm (Porth, 2005).

Deep Venous Thrombosis

A *deep venous thrombosis (DVT)* is a blood clot that forms along the intimal lining of a large vein. Three precursors linked to DVT formation are (1) venous stasis, or decreased blood flow; (2) injury to blood vessel walls; and (3) altered blood coagulation (Table 41–2). Any or all of these precursors can cause a DVT to form. Damage to the lining of the vein causes the platelets to aggregate or clump together, forming the thrombus. Fibrin, white blood cells (WBCs), and red blood cells (RBCs) begin to cling to the thrombus, and a tail forms. This tail or the entire thrombus may dislodge and move to the brain, lungs, or heart. Five percent of DVTs dislodge and enter the pulmonary circulation to form a pulmonary embolus. If the thrombus remains in the vein, venous insufficiency may result from scarring and valve damage.

TABLE 41–2 **Precursors of Deep Venous Thrombosis**

PRECURSOR	IMPLICATIONS FOR FRACTURES
Decreased blood flow	Common in fracture clients, who are immobilized and less active. Bed rest alone can decrease venous flow by 50%.
Injury to blood vessel wall	May occur as a direct result of the force that caused the fracture or from surgical manipulation.
Altered blood coagulation	May result from active blood loss. The body's attempt to maintain homeostasis leads to increased production of platelets and clotting factor.

If a DVT is present, there may be swelling, leg pain, tenderness, or cramping. Not all clients experience manifestations, however. For this reason, diagnostic tests, such as a venogram or Doppler ultrasound of lower extremities, may be required. A venogram requires intravenous administration of dye in the radiology department, whereas a Doppler ultrasound study is noninvasive and can be performed at the client's bedside. Doppler ultrasonography uses sound waves to form an image on a computer screen.

The best treatment for DVT is prevention. Early immobilization of the fracture and early ambulation of the client are imperative. The extremity should be elevated above the level of the heart. Frequent assessments of the injured extremity may lead to early recognition of DVT and prevent the formation of pulmonary embolus. Prophylactic anticoagulant administration is beneficial. Antiembolism stockings and compression boots increase venous return and prevent stasis of blood. Constrictive clothing should be avoided.

The diagnosis of DVT requires rapid intervention. The client is placed on bed rest for 5 to 7 days to prevent dislodgment of the clot. Fibrinolytic agents, which dissolve the clot, may be administered. Heparin may be administered intravenously to prevent more clots from forming. A vena cava filter may be placed to prevent the existing clot from entering the pulmonary circulation and forming a pulmonary embolus. In extreme cases in which anticoagulation therapy is contraindicated, a thrombectomy (surgical removal of the clot) may be necessary. See Chapter 35 ∞ for further discussion of DVT.

Infection

Infection is more likely to occur in an open fracture than a closed fracture, but any complication that decreases blood supply increases the risk of infection. Infection may result from contamination at the time of injury or during surgery.

Pseudomonas, Staphylococcus, or *Clostridium* organisms may invade the wound or bone. *Clostridium* infection is particularly serious because it may lead to severe gas gangrene and cellulitis, but any infection may delay healing and result in osteomyelitis, infection within the bone that can lead to tissue death and necrosis. (See Chapter 42 ∞ for a discussion of osteomyelitis.)

Delayed Union and Nonunion

Delayed union is the prolonged healing of bones beyond the usual time period. Many factors may inhibit bone healing, including poor nutrition, inadequate immobilization, prolonged reduction time, infection, necrosis, age, immunosuppression, and severe bone trauma resulting in multiple fragments. Delayed union is diagnosed by means of serial x-ray studies. It is important to note that x-ray findings may lag 1 to 2 weeks behind the healing process; for example, a client may be completely healed by week 13, but this fact may not be apparent on the x-ray until week 14.

Delayed union may lead to **nonunion**, which can cause persistent pain and movement at the fracture site. Nonunion may require surgical interventions, such as internal fixation and bone grafting. If infection is present, the bones are surgically debrided. Electrical stimulation of the fracture site may be as effective as bone grafting.

Reflex Sympathetic Dystrophy

Reflex sympathetic dystrophy may occur after musculoskeletal or nerve trauma. This term refers to a group of poorly understood post-traumatic conditions involving persistent pain, hyperesthesias, swelling, changes in skin color and texture, changes in temperature, and decreased motion. Diagnosis is made by the client's history and physical examination. X-rays may demonstrate spotty osteoporosis, and bone scans may reveal increased uptake of radionuclide. Treatment with a sympathetic nervous system blocking agent often alleviates the manifestations.

INTERDISCIPLINARY CARE

A fracture requires treatment to stabilize the fractured bone(s), maintain bone immobilization, prevent complications, and restore function. The diagnosis of a fracture is primarily based on physical assessments and x-rays.

Emergency Care

Emergency care of the client with a fracture includes immobilizing the fracture, maintaining tissue perfusion, and preventing infection. In the case of serious trauma, normal body alignment must be maintained and may involve cervical immobilization. Once the client is in a secure location, he or she is assessed for instability or deformity of the bone. If any deformity or instability is detected, the extremity is rapidly immobilized. Open wounds are covered with sterile dressings, and bleeding may be controlled with a pressure dressing. The extremities are assessed for the presence of pulses, movement, and sensation. The joint above and below the deformity is immobilized. Pulses, movement, and sensation are reevaluated after splinting.

The fracture is splinted to maintain normal anatomic alignment and prevent the fracture from dislocating. Splinting relieves pain and prevents further damage to the arteries, nerves, and bones. Splinting can be accomplished with air splints. If equipment is not available, the limb may be secured to the body. For example, an arm may be secured to the torso with a sling, or one leg may be strapped to the other leg.

Diagnosis

Diagnosis of a fracture begins with the history and initial assessment and usually is confirmed by radiographic tests. X-rays and bone scans are used to identify fractures (Figure 41–3 ■). Blood chemistry studies, complete blood count (CBC), and coagulation studies may be used to assess blood loss, renal function, muscle breakdown, and the risk of excessive bleeding or clotting. Diagnostic tests are described in Chapter 40 ∞.

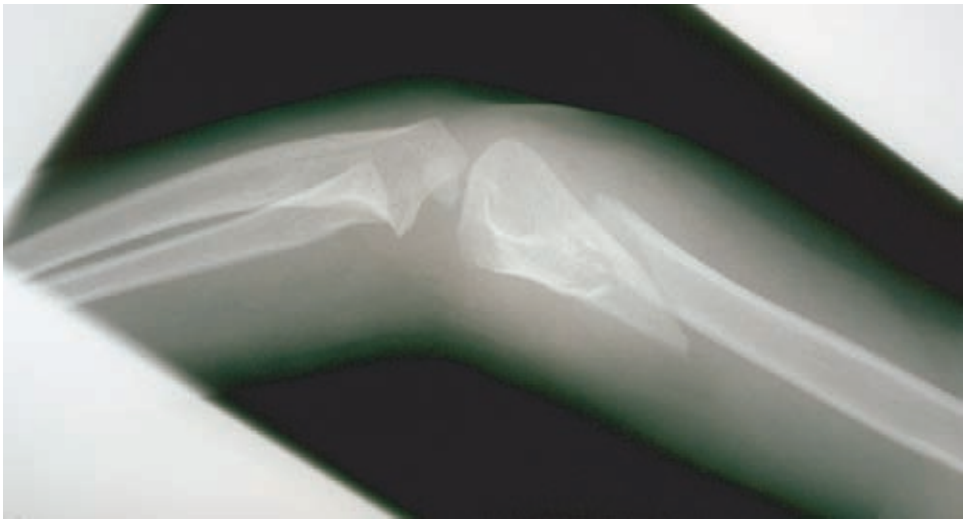


Figure 41–3 ■ X-ray of an oblique fracture of the femur.

Source: Charles Stewart and Associates.

Medications

Most clients with a fracture require pharmacologic interventions. The priority intervention focuses on relieving pain. In the case of multiple fractures or fractures of large bones, narcotics are administered initially. As healing progresses, the client begins to take oral medication for pain. Pain management for the client with a fracture is described in Box 41–3.

Stool softeners may be administered to decrease the risk of constipation secondary to narcotics and immobility. Clients who have sustained trauma are often placed on antiulcer medications or antacids. NSAIDs may be prescribed to decrease inflammation. Antibiotics may be administered prophylactically, particularly to clients with open or complex fractures. Anticoagulants may be prescribed to prevent DVT.

Treatments

Fracture treatment may involve a closed reduction and the application of a cast, or may include one or more of the following: traction, casts, surgery, and electrical bone stimulation.

TRACTION Muscle spasms usually accompany fractures and may pull bones out of alignment. Traction is the application of a straightening or pulling force to return or maintain the fractured bones in normal anatomic position. Weights are applied to maintain the necessary force (Figure 41–4 ■). Types of traction are as follows:

- In *manual traction,* the hand directly applies the pulling force.
- *Skin traction* (also called straight traction) is used to control muscle spasms and to immobilize a part of the body before surgery, with traction exerting its grabbing and pulling force through the client's skin. The most common type of skin traction is Buck's traction, in which traction tape or a foam boot is applied to the lower portion of a client's leg and a free-hanging weight is attached to the taped or booted area (Figure 41–4A). Buck's traction is used to immobilize the leg before surgery to repair a fracture of the proximal femur. The advantage of skin traction is the relative ease of use and ability to maintain comfort. The disadvantage is that the weight required to maintain normal body alignment or fracture alignment cannot exceed the tolerance of the skin, about 6 lb per extremity. It is important to ensure that the weights remain hanging freely; they should never rest on the bed or the floor. The nurse may have to reposition the client or the weights if this occurs.
- *Balanced suspension traction* involves more than one force of pull. Several forces work in unison to raise and support the client's injured extremity off the bed and pull it in a straight line away from the body (Figure 41–4B). The advantage of this type of traction is that it increases mobility without threatening joint continuity. The disadvantage is that the increased use of multiple weights makes the client more likely to slide down in the bed.
- *Skeletal traction* is the application of a pulling force through placement of pins into the bone (Figure 41–4C). The client may receive a local, spinal, or general anesthetic, and the pins are inserted into the bone. This type of traction must be applied under sterile conditions because of the increased risk of infection. One or more pulling forces may be applied with skeletal traction. The advantage of this type of traction is that more weight can be used to maintain the proper anatomic alignment if necessary. The disadvantages include increased anxiety, increased risk of infection, and increased discomfort. The weights used for skeletal traction are not removed by the nurse. Nursing interventions for clients receiving traction are described in Box 41–4.

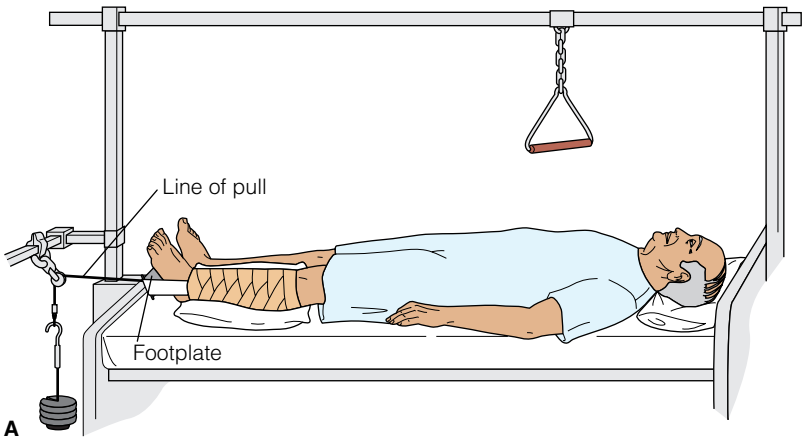
BOX 41–3 **Pain Management in the Client with a Fracture**

The client who has had musculoskeletal trauma experiences pain from many different causes:

- The interruption in the continuity of the bone itself
- Damage to ligaments and tendons
- Swelling of tissues around the trauma site
- Muscle spasms
- Tissue anoxia from swelling inside a cast, splint, or the muscle fascia sheath
- Hematoma formation
- Pressure over bony prominences from casts or splints.

The pain is often severe and may be described as sharp, aching, or burning. Carefully assess any complaint of pain; pain may be an indication of a serious complication, such as compartment syndrome, decreased tissue perfusion and neurovascular impairment, or pressure ulcers. Do not administer analgesics until the location, character, and duration of pain have been carefully assessed. After the cause of the pain has been identified, the following nursing interventions may be implemented:

1. Administer prescribed analgesics, which may include NSAIDs and narcotic analgesics. For serious fractures or following orthopedic surgery, patient-controlled analgesia (PCA) or epidural methods of providing pain relief may be used. If medications are used on an as-needed basis, tell the client to request the medication before the pain is severe; alternatively, offer the medications at regular intervals for the first 24 to 48 hours. Reassure the client that addiction does not result from taking medications to relieve fracture or surgical pain. Most clients require only oral analgesics by the third or fourth day after orthopedic surgery.
2. Elevate the involved extremity, and apply cold (if prescribed) to help decrease swelling.
3. Monitor and drain the accumulated fluids in any drainage devices to ensure patency and to decrease the possibility of hematoma formation.
4. Encourage the client to wiggle fingers or toes on an extremity in a cast or traction to improve venous return and decrease edema.
5. Assist the client to change positions to relieve pressure and use pillows to provide support.
6. Teach the client alternative methods of pain management, such as relaxation and guided imagery.
7. Notify the physician of unrelieved pain, which may indicate a serious complication such as compartment syndrome or neurovascular impairment.



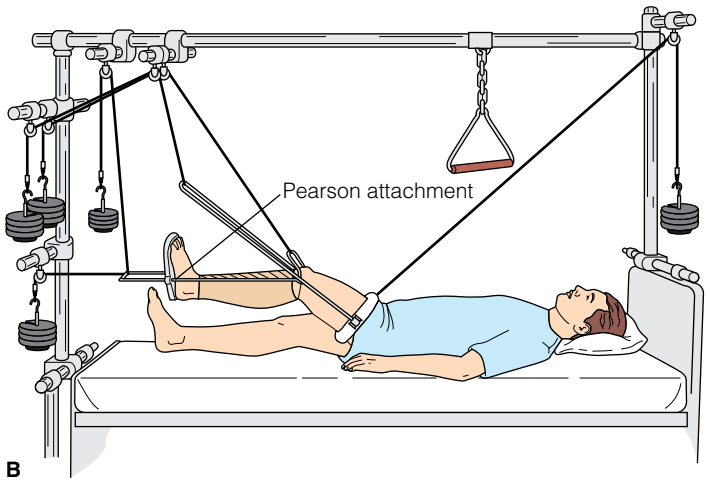


Figure 41–4 ■ Traction is the application of a pulling force to maintain bone alignment during fracture healing. Different fractures require different types of traction. *A,* Skin traction (also called straight traction) such as Buck's traction shown here, is often used for hip fractures. *B*, Balanced suspension traction is commonly used for fractures of the femur. *C*, Skeletal traction, in which the pulling force is applied directly to the bone, may be used to treat fractures of the humerus.

BOX 41–4 Nursing Interventions for Clients in Traction

- In skeletal traction, never remove the weights.
- In skin traction, remove weights only when intermittent skin traction has been ordered to alleviate muscle spasm.
- For traction to be successful, a countertraction is necessary. In most instances, the countertraction is the client's weight. Therefore, do not wedge the client's foot or place it flush with the footboard of the bed.
- Maintain the line of pull:
  a. Center the client on the bed.
  b. Ensure that weights hang freely and do not touch the floor.
- Ensure that nothing is lying on or obstructing the ropes. Do not allow the knots at the end of the rope to come into contact with the pulley.
- If a problem is detected, assist in repositioning. The area of the fracture must be stabilized when the client is repositioned.
- In skin traction:
  a. Frequently assess skin for evidence of pressure, shearing, or pending breakdown.
  b. Protect pressure sites with padding and protective dressings as indicated.
- In skeletal traction:
  a. Frequent skin assessments should include pin care per policy.
  b. Report signs of infection at the pin sites, such as redness, drainage, and increased tenderness.
  c. The client may require more frequent analgesic administration.
- Perform neurovascular assessments frequently.
- Assess for common complications of immobility, including formation of pressure ulcers, formation of renal calculi, deep venous thrombosis, pneumonia, paralytic ileus, and loss of appetite.
- Teach the client and family about the type and purpose of the traction.

CASTS A cast is a rigid device applied to immobilize the injured bones and promote healing. The cast immobilizes the joint above and the joint below the fractured bone so that the bone will not move during healing. A fracture is first reduced manually (by hand) and a cast is then applied. Casts are applied on clients who have relatively stable fractures

The cast, which may be composed of plaster or fiberglass, is applied over a thin cushion of padding and molded to the normal contour of the body. The cast must be allowed to dry before any pressure is applied to it; simply palpating a wet cast with the fingertips will leave dents that may cause pressure ulcers. A plaster cast may require up to 48 hours to dry, whereas a fiberglass

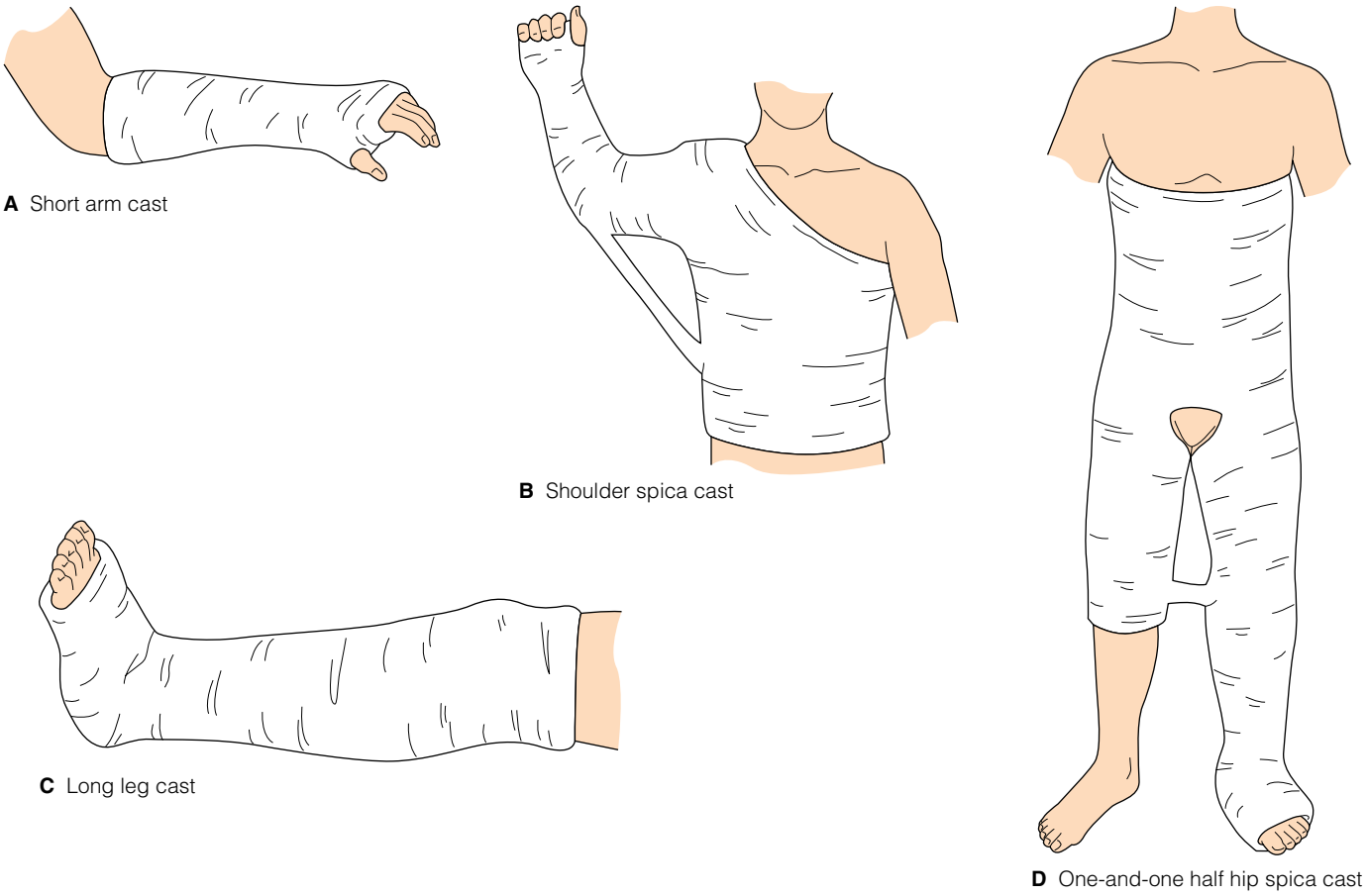


Figure 41–5 ■ Examples of types of casts used to immobilize fractures

cast dries in less than 1 hour. The type of cast applied is determined by the location of the fracture (Figure 41–5 ■). Nursing care of the client with a cast is discussed in the box below. During follow-up appointments, the physician may x-ray the bone to assess alignment and healing, and possibly remove the cast for skin assessment.

SURGERY Surgery is indicated for a fracture that requires direct visualization and repair, a fracture with common long-term complications, or a fracture that is severely comminuted and threatens vascular supply.

The simplest form of surgery is done by external fixation with an external fixator device. An external fixator consists of a frame connected to pins that are inserted perpendicular to the long axis of the bone (Figure 41–6 ■). The number of pins inserted varies with the type and site of the fracture, but in all cases the same number of pins is inserted above and below the

NURSING CARE OF THE CLIENT WITH A **Cast**

NURSING INTERVENTIONS

- Perform frequent neurovascular assessments.
- Palpate the cast for "hot spots" that may indicate the presence of underlying infection.
- Report any drainage promptly.

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- Do not place any objects in the cast.
- If the cast is made of plaster, keep it dry.
- If the cast is made of fiberglass, dry it with a blow dryer on the cool setting if it becomes wet.
- Assess the injured extremity for coolness, changes in color, increased pain, increased swelling, and/or loss of sensation.
- Use a blow dryer on the cool setting to relieve itching by blowing cool air into the cast.
- If a sling is used, it should distribute the weight of the cast evenly around the neck. Do not roll the sling; this can impair circulation to the neck.
- If crutches are used, arrange for physical therapist to teach correct crutch walking.
- When the cast is removed, an oscillating cast remover will be used. A guard prevents the cast remover from penetrating past the depth of the cast, so it will not cut the client. It is noisy, and the client will feel vibration.

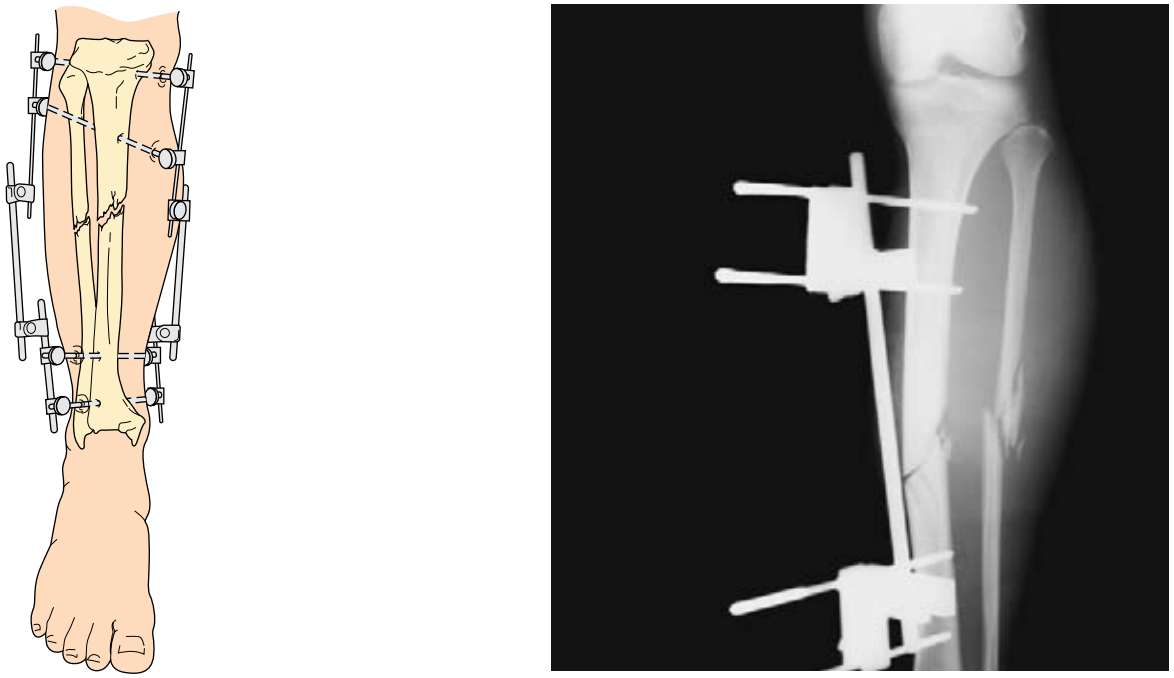


Figure 41–6 ■ In external fixation, pins are placed through the bone above and below the fracture site to immobilize the bone. External fixation rods hold the pins in place.

fracture line. The pins require care similar to that of skeletal traction pins. The client is monitored for infection, and frequent neurovascular assessment is performed. The fixator increases independence while maintaining immobilization.

Internal fixation can be accomplished through a surgical procedure called an *open reduction and internal fixation (ORIF).* In this procedure, the fracture is reduced (placed in correct anatomic alignment) and nails, screws, plates, or pins are inserted to hold the bones in place (Figure 41–7 ■). Open fractures of the arms and legs are most commonly repaired in this way. Hip fractures in older clients are almost always repaired with ORIF to prevent complications and to allow early rehabilitation. Interventions for postoperative nursing care are presented in Box 41–5.

ELECTRICAL BONE STIMULATION Electrical bone stimulation is the application of an electrical current at the fracture site. It is a painless method of treating fractures that are not healing appropriately. The electrical stress increases the migration of osteoblasts and osteoclasts to the fracture site. Mineral deposition increases, promoting bone healing. Electrical bone stimulation can be accomplished invasively or noninvasively (Figure 41–8 ■). In invasive stimulation, the surgeon inserts a cathode and a lead

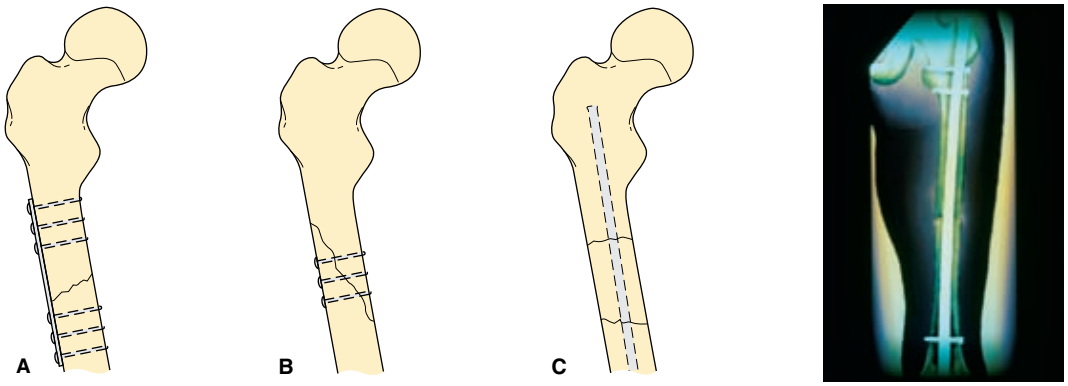


Figure 41–7 ■ Internal fixation hardware is entirely within the body. *A,* Fixation of a short oblique fracture using a plate and screws above and below the fracture. *B,* Fixation of a long oblique fracture using screws through the fracture site. *C,* Fixation of a segmental fracture using a medullary nail.

BOX 41–5 Nursing Interventions for Clients with Internal Fixation

- Expect the client to have sutures and at least one Hemovac drain.
- Perform neurovascular assessments frequently.
- Assess the following:
  a. Wounds for drainage
  b. Hemovac for drainage of serosanguineous fluid
  c. Bowel sounds
  d. Lung sounds.
- Administer medications, such as analgesics and antibiotics, per physician's orders.
- In hip fractures, place an abductor pillow between client's legs to prevent dislocation of the hip joint.
- Arrange for physical and occupational therapy, as ordered.
- Assist with weight-bearing program, if ordered.
- Encourage early mobilization, coughing, and deep breathing, as appropriate to help prevent complications.

wire at the fracture site. The lead wire is attached to an internal or external generator, which delivers electricity through the lead wire to the cathode 24 hours a day. In noninvasive inductive stimulation, a treatment coil encircles the cast or skin directly over the fracture site. The coil is attached to an external generator that runs on batteries. The electricity goes through the skin to the fracture site. The time period for external stimulation can vary from 3 to 10 hours per day. The client may be taught to self-administer the noninvasive electrical stimulation. Electrical bone stimulation is contraindicated in the presence of infection and for upper extremities if the client has a pacemaker.

Fractures of Specific Bones or Bony Areas

Causes, manifestations, complications, treatment and selected nursing interventions are described for the following fractures: skull, face, spine, clavicle, humerus, elbow, radius/ulna, wrist/hand, ribs, pelvis, femur, hip, tibia/fibula, and ankle/foot.

Fracture of the Skull

The skull may be fractured as a result of either a fall or a direct blow. The client must be assessed for neurologic damage and any loss of consciousness (LOC) must be documented. A complete neurologic assessment is conducted: Pupillary reaction to light, movement and strength of all extremities, complaints of nausea and vomiting, LOC, and orientation to person, place, and time are noted. A displaced skull fracture, which is referred to as depressed, may press on the brain and cause neurologic damage. Brain injuries related to skull fractures are discussed in Chapter 44 ∞.

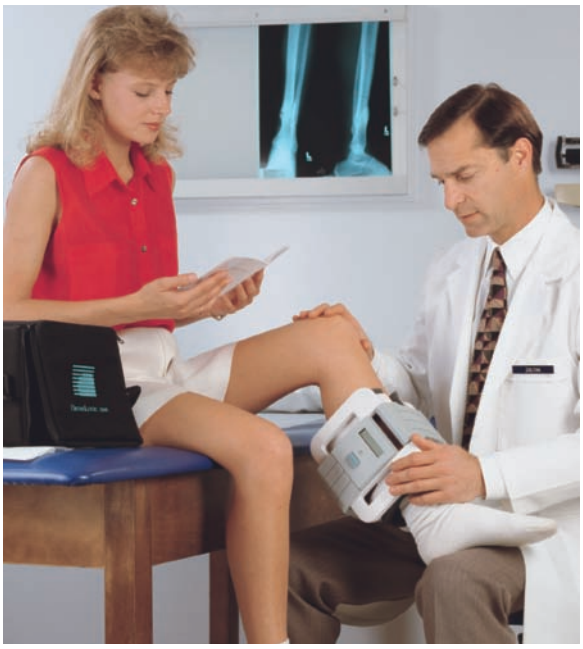


Figure 41–8 ■ External electrical bone growth stimulator.
Courtesy of Orthologic, Inc.

Fracture of the Face

Fracture of the facial bones may result from a direct blow. The client presents with hematomas, pain, edema, and bony deformity. Nondisplaced fractures are monitored to ensure the airway is not compromised. The client is observed for any neurologic deficits. Severely displaced or multiple facial fractures are treated with ORIF with wires or plates.

Nursing care focuses on maintaining the airway by helping the client clear secretions from the oropharynx. The nurse monitors the client's breathing for increased effort or tachypnea and notifies the physician immediately if these findings are noted. Pain is treated with analgesics, and body image disturbances are addressed. If the client asks to see his or her face, the nurse should plan to stay with the client and answer questions while the client looks in a mirror.

Fracture of the Spine

The spine can be injured in many ways, including sports injuries, falls, and motor vehicle crashes. The spine can be fractured in the cervical, thoracic, lumbar, or sacral area. The most severe complication of spine fracture is injury to the spinal cord (discussed in Chapter 45 ∞). A fracture to the vertebrae may cause the bones to become displaced and apply pressure on the spinal cord. This pressure on the spinal cord may result in permanent paralysis.

A nondisplaced cervical spinal fracture may be treated with a cervical collar or a halo immobilizing brace. The displaced cervical fracture is reduced by manual or skeletal traction and, eventually, application of a brace and/or surgical stabilization of the bones with plates and screws. Immobilization after a spinal fracture may last as long as 6 months.

Fracture of the Clavicle

A fracture of the clavicle commonly results from a direct blow or a fall. The most common location is midclavicular. A person with a midclavicular fracture typically assumes a protective slumping position to immobilize the arm and prevent shoulder movement. A less common fracture occurs along the distal third of the clavicle. This type of fracture may be associated with ligament damage. Injuries to the clavicle may be associated with skull or cervical fractures. The fractured bone, if displaced, may lacerate

the subclavian vessels and result in hemorrhage. The fractured bone may also puncture the lung, resulting in a pneumothorax. Malunion may occur at the fracture site and result in asymmetry of the clavicles. Injury to the brachial plexus may result in numbness and decreased movement of the arm on the affected side.

A deformity may be observed or palpated along the clavicle. Treatment focuses on immobilizing the fractured bone in normal anatomic position by applying a clavicular strap, or a surgical repair may be necessary.

Fracture of the Humerus

The exact location of the fracture, the presence of displacement, and the results of the neurovascular examination determine the severity of a fracture of the humerus and the appropriate interventions. Treatment focuses on immobilizing the fractured bone in normal anatomic position. Common complications of humeral fracture include nerve and ligament damage, frozen or stiff joints, and malunion. Early interventions may prevent permanent damage.

Fractures of the proximal humerus are common in older adults. A simple nondisplaced fracture of the proximal humerus (near the humeral head) with a normal neurovascular assessment can be safely treated with immobilization. A more complicated displaced fracture of the proximal humerus with bone fragmentation requires surgical intervention. The more severe the fracture and damage to soft tissue, the more likely it is that the range of motion (ROM) of the shoulder will be impaired. Rehabilitative measures focus on increasing ROM.

The humerus may also fracture along the shaft, usually as a direct result of trauma. If the humeral shaft fracture is simple and nondisplaced, a hanging arm cast is applied. This cast maintains alignment of the fracture by using the pulling force of gravity; therefore, the client must be instructed not to rest the cast on anything to alleviate the weight. If the client is on bed rest, a hanging arm cast is not applied, because the arm would not be able to hang freely. Instead, the fracture is immobilized with external skeletal traction. This traction places the injured arm in an upright position over the face, and weights are hung off the distal portion of the humerus (see Figure 41–4C). Nursing interventions for clients with fractures of the humerus are presented in Box 41–6.

Fracture of the Elbow

The most common location of an elbow fracture is the distal humerus. Elbow fractures usually result from a fall or direct blow to the elbow. The client guards the injured extremity, holding the arm rigidly in a flexed position or an extended position. Because the radius, ulna, or humerus may be involved in the elbow fracture, all three bones must be visualized by x-ray.

Complications of an elbow fracture include nerve or artery damage and hemarthrosis, a collection of blood in the elbow joint. The most serious complication of an elbow fracture is Volkmann's contracture, which results from arterial occlusion and muscle ischemia. The client complains of forearm pain, impaired sensation, and loss of motor function. Rapid interventions are aimed at relieving pressure on the brachial artery and nerve and preventing muscle atrophy.

Nondisplaced elbow fractures are treated by immobilizing the fracture with a posterior splint or cast. The displaced fracture is first reduced and then immobilized. Nursing interventions focus on alleviating pain, maintaining immobilization, and educating clients in neurovascular assessments.

BOX 41–6 Nursing Interventions for Clients with Fractures of the Humerus

- Perform neurovascular assessments frequently.
- Administer prescribed medications to alleviate pain.
- Encourage exercises for clients with a hanging cast:
  a. Finger exercises: Move each finger of the affected arm through complete range of motion.
  b. Pendulum shoulder exercises: Dangle the affected arm at the side, and move it forward and backward about 30 degrees in each direction.
- If client is discharged, instruct the client and family in cast care and sling application, neurovascular assessments, exercises, prescribed pain medications, and manifestations of complications.
- If client is admitted to the hospital, provide preoperative teaching.

Fracture of the Radius and/or Ulna

Fractures of the radius and ulna may occur as a result of either indirect injury, such as twisting or pulling on the arm, or direct injury, such as that resulting from a fall. The usual treatment of radius fractures depends on the location. The proximal radial head may be fractured from a fall on an outstretched hand. Blood commonly collects in the elbow joint and must be aspirated. If the fracture is nondisplaced, a sling is applied. If the fracture is displaced, surgical intervention is required. After surgical repair of a displaced fracture, the arm is splinted with a posterior plaster splint. The client avoids movement for the first week and then initiates movement gradually.

When both bones are broken, the fracture is usually displaced. The client complains of pain and inability to turn the palm of the hand up. A nondisplaced fracture is casted for about 6 weeks, and either a shorter cast or a brace is then applied for 6 more weeks. If the fracture is displaced, surgical intervention is performed. The physician reduces the fracture and may insert pins or screws to keep the bones in alignment. After the surgery, a cast is applied, and the client is encouraged to exercise the fingers.

Complications after a radius and/or ulnar fracture include compartment syndrome, delayed healing, and decreased wrist and finger movement. After surgery, the client also has an increased risk of infection. Nursing interventions focus on alleviating pain, maintaining immobilization, and educating clients in neurovascular assessments, the importance of elevation, and the need to inform the physician of changes in sensation or an increase in pain.

Fractures in the Wrist and Hand

Wrist fractures often result from a fall onto an outstretched hand or onto the back of the hand. A common type of wrist fracture is *Colles's fracture,* in which the distal radius fractures after a fall onto an outstretched hand. The client with a wrist fracture presents with a bony deformity, pain, numbness, weakness, and decreased ROM of the fingers. The capillary refill and sensation of the hand must be assessed.

The hand is composed of many bones. Most commonly, the metacarpals and phalanges are involved in a hand fracture. The injuring mechanism in a hand fracture varies from striking an object with a closed fist to closing a hand in a door. The client presents with complaints of pain, edema, and decreased ROM.

Comparative x-rays may be obtained to compare left and right wrists and hands. Complications of wrist and hand fractures are compartment syndrome, nerve damage, ligament damage, and delayed union. A wrist fracture is commonly treated with closed reduction, cast application, and elevation of the injured extremity. A hand fracture is splinted and elevated.

Nursing interventions focus on alleviating pain and educating the client in neurovascular assessments, the importance of elevation, and how to exercise the fingers to prevent stiffness. If the dominant hand is injured, the client will require assistance in performing activities of daily living (ADLs).

Fracture of the Ribs

Rib fractures commonly result from blunt chest trauma. The location of the fracture and involvement of underlying organs determine the severity of the injury. Fractures of the first through third ribs may result in injury to the subclavian artery or vein. Fractures of the lower ribs may result in spleen and liver injuries.

The client presents with a history of recent chest trauma. Typically, the client complains of pain along the lateral portion of the rib. Palpation of the rib reveals a bony deformity and increases pain. Deep inspiration also increases pain. The skin over the fracture site may be ecchymotic (bruised).

A complication of rib fractures is a **flail chest**, which results from the fracture of two or more adjacent ribs in two or more places and the formation of a free-floating segment that moves in the opposite direction of the rib cage. The bony instability impairs respirations. Treatment is aimed at stabilizing the flail segment and supporting respirations. Other complications of rib fractures include pneumothorax and/or hemothorax. The fractured rib may pierce the lung and injure it. The lower ribs may pierce the liver or spleen, resulting in intra-abdominal bleeding. Pneumonia may also develop from ineffective clearing of respiratory secretions.

A simple rib fracture is treated with pain medication and instructions for coughing, deep breathing, and splinting. The client is also instructed to return to the emergency room if shortness of breath develops. Nursing interventions focus on alleviating pain and teaching the client about splinting. Because deep inspiration increases pain, clients frequently avoid it. The client may be instructed to splint the injured rib with the hand or a pillow and take deep breaths and cough to decrease the chance of developing pneumonia and/or atelectasis. Incentive spirometry is encouraged.

Fracture of the Pelvis

Pelvic fractures are often caused by trauma, such as a fall or an automobile crash. The client with a pelvic fracture presents with pain in the back or hip area. A single fracture in the pelvis is treated conservatively with bed rest on a firm mattress. Log rolling increases client comfort. A pelvic fracture with two fracture sites is considered unstable and treated with surgery. An external fixator may be applied to stabilize the pelvis. In the client who is not stable for surgery, a pelvic sling may be used. The pelvic sling stabilizes the pelvis and allows the client to move in bed with less pain. Common complications include hypovolemia, spinal injury, bladder injury, urethral injury, kidney damage, and gastrointestinal trauma.

Nursing care focuses on alleviating discomfort, maintaining immobilization, and preparing the client for surgery if necessary. The nurse monitors the client for increased heart rate, decreased blood pressure, and decreasing hemoglobin levels. These findings may indicate impending hypovolemia due to bleeding into the pelvis. Any blood in the urine should be reported to the physician; this may indicate kidney, bladder, or urethral damage.

Fracture of the Shaft of the Femur

A large amount of force, such as from motor vehicle crashes, falls, or acts of violence, is required to fracture the shaft of the femur. Clients with femoral shaft fractures often have associated multiple traumas. A fracture of the femoral shaft is manifested by an edematous, deformed, painful thigh. The client is unable to move the hip or knee. Initial assessment focuses on the circulation and sensation present in the affected extremity. Pedal pulses and capillary refill in the affected extremity are compared to the unaffected extremity. Complications of a femoral shaft fracture include hypovolemia due to blood loss (which may be as great as 1.0 to 1.5 L), fat embolism, dislocation of the hip or knee, muscle atrophy, and ligament damage.

Treatment of fractures of the shaft of the femur initially includes skeletal traction to separate the bony fragments and reduce and immobilize the fracture. Depending on the location and severity of the fracture, traction may be followed by either external or internal fixation. Strength in the affected extremity is maintained through gluteal and quadricep exercises. ROM exercises for unaffected extremities are critical in preparation for ambulation. Although full weight bearing is usually restricted until x-rays demonstrate bone union, the client may be allowed to carry out non-weight-bearing activities with an assistive device.

The nurse assesses pulses in the extremity and compares them bilaterally. Sensation is evaluated by asking whether the client can feel touch and discriminate sharp from dull objects. Nursing interventions include providing pain medication, providing reassurance and decreasing anxiety, and assisting with exercises of the lower legs, feet, and toes.

Fracture of the Hip

A hip fracture refers to a fracture of the femur at the head, neck, or trochanteric regions (Figure 41–9 ■). Hip fractures are classified as intracapsular or extracapsular. *Intracapsular fractures* involve the head or neck of the femur; *extracapsular fractures* involve the trochanteric region. The majority of hip fractures involve the neck or trochanteric regions. The femoral head and neck lie within the joint capsule and are not covered in periosteum; thus, they do not have a large blood supply. Fractures at this location usually fragment, further decreasing blood supply and increasing the risk of nonunion and avascular necrosis. The trochanteric region is covered in periosteum and therefore has more blood supply than the head or neck.

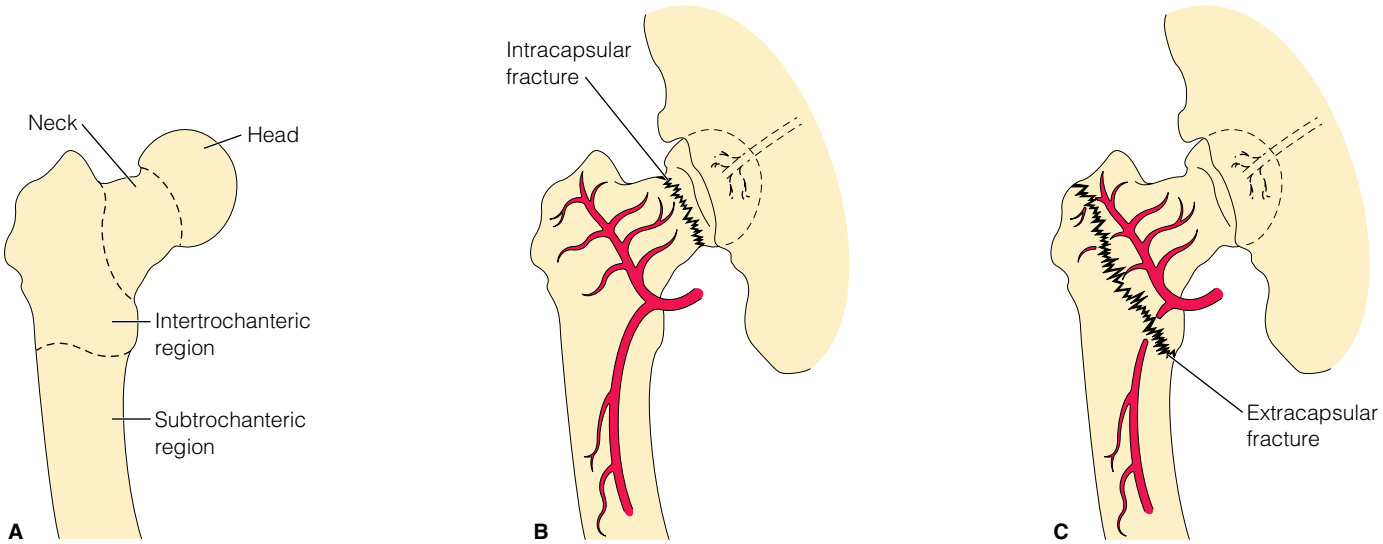


Figure 41–9 ■ Regions where hip fractures may occur: *A,* the head of the femur, the neck of the femur, and the trochanteric regions of the femur. *B,* Intracapsular fractures occur across the head or neck of the femur. *C,* Extracapsular fractures occur across the trochanteric regions. Note how both intracapsular and extracapsular fractures disrupt the blood supply to the bone.

Hip fractures result from falls and are the most common injury in the older population, requiring hospitalization of more than 300,000 older adults each year in the United States. They result in the greatest number of deaths and most serious health problems of all fractures for people 65 years or older (Centers for Disease Control and Prevention, [CDC], 2006). By the year 2040, the number of hip fractures is expected to exceed 500,000, which reflects society's increasing older population. Factors contributing to falls include problems with gait and balance, neurologic and musculoskeletal impairments, dementia, psychoactive medications, and visual impairments. Modifiable risk factors, identified through research, include lower body weakness, problems with walking and balance, and taking four or more medications or any psychoactive medications.

FAST FACTS

Hip Fracture in Older Adults

- More than one-third of all adults over the age of 65 fall each year. Of those, white men have the highest fall-related death rates, followed by white women, black men, and black women.
- Older adults most often fracture the hip from falls; in contrast, motor vehicle crashes are the most common cause in young and middle adults.
- The risk for a fractured hip increases with each decade of life, especially in white postmenopausal women, who have the highest incidence of osteoporosis. Women have about 80% of all hip fractures. Women who smoke are at greater risk, because smoking reduces bone density among menopausal women.
- Complications are related both to the fracture and to the resulting treatment. Only a small number of clients retain their previous mobility, while about 20% require nursing home care.
- Half of all older adults hospitalized for a hip fracture cannot return home or live independently after the fracture.

Data from CDC (2006).

Hip fractures are common in older adults as a result of decreases in bone mass and the increased tendency to fall. Whether the femur breaks spontaneously and causes the fall or whether the fall causes the fracture is not always clear; regardless of the cause of the fracture, rapid interventions are required to prevent bone necrosis. Assessment findings commonly associated with a hip fracture are pain, inability to walk, and shortening and external rotation of the affected lower extremity. Rarely, the fracture dislocates posteriorly; if that occurs, the extremity may internally rotate. However, some patients with a hip fracture have only vague pain in the buttocks, knees, thighs, groin, or back and their ability to walk is unaffected. If the fracture is not visible on x-ray, a bone scan or MRI may be done to confirm the presence of the fracture.

A hip fracture may be treated with traction to decrease muscle spasms, followed by surgery; or surgery may be performed immediately or within the first 24 hours. The goal of surgery is to reduce and stabilize the fracture, thereby increasing mobility, decreasing pain, and preventing complications. Surgery usually consists of ORIF of the fracture. Fixation is accomplished by securing the femur in place with pins, screws, nails, or plates (Figure 41–10A ■). An ORIF works well for fractures in the trochanteric area. Fractures of the femoral neck frequently disrupt blood supply to the femoral head. If blood supply is disrupted, the surgeon will replace the femoral head with a prosthesis (Figure 41–10B). If the acetabulum has been damaged, the surgeon may insert a metal cup. Replacement of either the femoral head or the acetabulum with a prosthesis is called a *hemiarthroplasty*. Replacement of both the femoral head and the acetabulum is a *total hip arthroplasty (THA)*, discussed in Chapter 42 ∞.

Nursing care for a client with a hip fracture focuses on maintaining skin integrity, preventing infection, alleviating pain, maintaining circulation to the injured extremity, and increasing mobility, and is discussed in more detail in the following nursing care section.

Figure 41–10 ■ Surgical fixation of hip fractures. *A,* A surgical nail or screw used to stabilize an intertrochanteric fracture. *B,* Use of a hip prosthesis (artificial hip) to replace a damaged femoral head.

Fracture of the Tibia and/or Fibula

Fractures of the lower extremities often result from a fall on a flexed foot, a direct blow, or a twisting motion. The client presents with edema, pain, bony deformity, and a hematoma at the level of injury.

Circulation and sensation are assessed to rule out common complications of the fracture, including damage to the peroneal nerve or tibial artery, compartment syndrome, hemarthroses, and ligament damage. Peroneal nerve damage may be indicated by the client's inability to point the toe on the affected side upward. Tibial artery damage may be the cause of an absent dorsalis pedis pulse on the affected side. Compartment syndrome may be present if the client develops pain on passive movement and paresthesias. An edematous knee may indicate a collection of blood in the knee joint. Ligament damage may be present if the client cannot move the knee and/or ankle.

If the fracture is closed, a closed reduction and casting are frequently performed. A long leg cast that allows for partial weight bearing is used. Partial weight bearing usually is prescribed by the physician within 10 days of the fracture. A short leg cast will be applied in 3 to 4 weeks. If the fracture is open, either external fixation or ORIF will be performed. After surgery, a cast may be applied, and weight bearing begins according to the physician's orders, usually in about 6 weeks.

Nursing care is designed to increase comfort, monitor neurovascular status, and prevent complications. The nurse instructs the client in cast care, on the use of assistive devices, how to perform neurovascular assessment, and when to follow up with the physician.

Fracture in the Ankle and Foot

The client with an ankle fracture presents with pain, limited ROM, hematoma, edema, and difficulty ambulating. Most ankle fractures are treated by closed reduction and casting. Open fractures are treated by surgical intervention and splinting.

The client with a foot fracture presents with similar symptoms; however, ROM of the ankle is not usually affected. Most foot fractures are nondisplaced and treated with closed reduction and casting. More severe displaced foot fractures may require surgery and the placement of wires to maintain reduction of the fracture.

Nursing care focuses on increasing comfort, increasing mobility, and educating the client. Analgesia is given for pain. The extremity should be elevated, and ice can be applied. The client is taught cast care, neurovascular assessment, and crutch walking.

NURSING CARE

In planning and implementing nursing care for the client with fractures, the nurse should consider the client's response to the traumatic experience. Although each client has individual needs, nursing care commonly focuses on client problems with pain, impaired physical mobility, impaired tissue perfusion, and neurovascular compromise.

Health Promotion

Trauma prevention can save lives. Many communities are educating people of all ages, from grade-schoolers to older adults, in trauma prevention. Young adults face a high risk of sustaining trauma. They need to be taught the importance of safety equipment—such as automobile seat belts, bicycle and motorized vehicle helmets, football pads, proper footwear, protective eyewear, and hard hats—in preventing or decreasing the severity of injury from trauma. Older adults should have regular screenings for osteoporosis (with a bone density test), activity levels, cognitive and affective disorders, vision impairments, and risk for falls. Older adults can reduce their risk of falling by increasing lower body strength and balance through regular physical activity, and by asking their healthcare provider or pharmacist to review their medications. Educational programs about workplace and farm safety, including information about ergonomic principles, can also help prevent musculoskeletal injuries.

Having a regular exercise program and avoiding obesity are important factors in maintaining good bone health in all adults. An adequate intake of calcium is essential to ensure proper growth, development, and maintenance of strong bones throughout life. It is important that women ensure good bone health prior to menopause, because the loss of estrogen during and after menopause decreases calcium use and increases the risk of osteoporosis. Strong bones are formed by calcium in-

take and weight-bearing exercise, both of which are equally important in the postmenopausal woman.

Older clients are at higher risk for musculoskeletal trauma due to falls. For these clients, home assessments must be performed and potential hazards removed. Specific teaching topics for preventing falls in older adults are outlined in the Meeting Individualized Needs box below.

Assessment

Collect the following data through the health history and physical examination (see Chapter 40 ∞).

- *Health History:* Age, history of traumatic event, history of chronic illnesses, history of prior musculoskeletal injuries, medications (ask the older adult specifically about anticoagulants and calcium supplements).
- *Physical Assessment:* Pain with movement, pulses, edema, skin color and temperature, deformity, range of motion, touch. These assessments include the 5 P's of neurovascular assessment, as follows, included in both the initial assessment and ongoing focused assessments:
- *Pain.* Assess pain in the injured extremity by asking the client to grade it on a scale of 0 to 10, with 10 as the most severe pain.
- *Pulses.* Assess distal pulses beginning with the unaffected extremity. Compare the quality of pulses in the affected extremity to those of the unaffected extremity.
- *Pallor.* Observe for pallor and skin color in the injured extremity. Paleness and coolness may indicate arterial compromise, whereas warmth and a bluish tinge may indicate venous blood pooling.
- *Paralysis/Paresis.* Assess ability to move body parts distal to the fracture site. Inability to move indicates paralysis. Loss of muscle strength (weakness) when moving is paresis. A finding of limited range of motion may lead to early recognition of problems such as nerve damage and paralysis.
- *Paresthesia.* Ask the client if any change in sensation such as burning, numbness, prickly feeling, or stinging (all these are paresthesias) has occurred.

Nursing Diagnoses and Interventions

Nursing care for clients with fractures ranges from teaching for home care treatments provided in the emergency or urgent care department (such as manual reduction and cast application) to providing interventions to maintain health and decrease the risk of complications in clients with complex or multiple fractures. Teaching is also necessary for caregivers of the older adult who is discharged home or to a long-term care or rehabilitation facility following a fractured hip. A Nursing Care Plan is included on page 1418.

Acute Pain

Pain is caused by soft tissue damage and is compounded by muscle spasms and swelling.

- Monitor vital signs. *Some analgesics decrease respiratory effort and blood pressure.*
- Ask the client to rate the pain on a scale of 0 to 10 (with 10 as the most severe pain) before and after any intervention. *This facilitates objective assessment of the effectiveness of the chosen pain relief strategy. Pain that increases in intensity or remains unrelieved with analgesics can indicate compartment syndrome.*
- For the client with a hip fracture, apply Buck's traction per physician's orders. Keep the traction weights hanging freely. *Buck's traction immobilizes the fracture and decreases pain and additional trauma.*

PRACTICE ALERT

Do not let weights lie on the bed or the floor. The weights can be removed long enough to move the client up or down in bed to ensure freely hanging weights.

- Move the client gently and slowly. *Gentle moving helps prevent the development of severe muscle spasms.*
- Elevate the injured extremity above the level of the heart. *Elevating the extremity promotes venous return and decreases edema, which decreases pain.*
- Encourage distraction or other noninvasive methods of pain relief, such as deep breathing and relaxation. *Distraction, deep breathing, and relaxation help decrease the focus on the pain and may lessen the intensity of pain.*

MEETING INDIVIDUALIZED NEEDS **Teaching Older Adults to Prevent Falls**

- Begin a regular exercise program; lack of exercise leads to weakness and an increased chance of falling. Exercises that improve balance and coordination (such as t'ai chi) are the most helpful.
- Make your home safer:
  - Remove any items in your pathway, including from stairs, to avoid tripping.
  - Remove small throw rugs or use double-sided tape to keep rugs from slipping.
  - Place frequently used items within easy reach to avoid use of a step stool.
  - Install grab bars next to your toilet and in the tub or shower.
  - Use nonslip mats in the bathtub and on shower floors.
  - Improve lighting, using lamp shades or frosted bulbs to reduce glare.
  - Install handrails and lights in all staircases.
  - Wear shoes that give good support and have thin, nonslip soles. Avoid wearing slippers and athletic shoes with deep treads.
- Ask your healthcare provider to review your medications, including prescriptions and over-the-counter medications. Some medications or a combination of medications may cause dizziness or drowsiness, leading to falls.
- Have your vision checked by an eye doctor. Your glasses may no longer have the correct prescription, or you may have developed an eye condition such as cataracts or glaucoma that limits your vision.

NURSING CARE PLAN A Client with a Hip Fracture

Stella Carbolito is a 74-year-old Italian American with a history of osteoporosis. She is a widow and lives alone in a two-story row home. Mrs. Carbolito is retired and depends on a pension check and social security for her income. She takes pride in making all her own food from scratch.

While walking to the market one day, Mrs. Carbolito falls and fractures her left hip. She is transported by ambulance to the nearest hospital emergency department.

ASSESSMENT

During the initial assessment at the ED, abnormal findings are that Mrs. Carbolito's left leg is shorter than her right leg and is externally rotated. Distal pulses are present and bilaterally strong; both legs are warm. Mrs. Carbolito complains of severe pain but states that no numbness or burning is present. She is able to wiggle the toes on her left leg and has full movement of her right leg. Initial vital signs are as follows: T 98.0°F (36.6°C), P 100, R 18, BP 120/58. Diagnostic tests include CBC, blood chemistry, and x-ray studies of the left hip and pelvis. The CBC reveals a hemoglobin of 11.0 g/dL and a normal WBC count. Blood chemistry findings are within normal limits. The x-ray reveals a fracture of the left femoral neck. Mrs. Carbolito is admitted to the hospital with an order for 10 lb of straight leg traction. An open reduction and internal fixation (ORIF) is planned for the following day.

DIAGNOSES

- *Acute Pain* related to fractured left femoral neck and muscle spasms
- *Impaired Physical Mobility* related to bed rest and fractured left femoral neck
- *Risk for Ineffective Tissue Perfusion* related to unstable bones and swelling
- *Risk for Disturbed Sensory Perception: Tactile* related to the risk of nerve impairment

EXPECTED OUTCOMES

- Verbalize a decrease in pain.
- Verbalize the purpose of traction and surgery.
- Maintain normal neurovascular status.
- Demonstrate postoperative exercises.

PLANNING AND IMPLEMENTATION

- Assess pain on a scale of 0 to 10 before and after implementing measures to reduce pain.
- Administer narcotics per the physician's order.
- Perform neurovascular assessment every 2 to 4 hours, and document findings.
- Apply straight leg traction per physician's order.
- Encourage deep breathing and relaxation techniques.
- Teach the purpose of traction and surgery.
- Teach the purpose of and the procedure for performing isometric and flexion/extension exercises.

EVALUATION

Three days after surgery, Mrs. Carbolito is out of bed and in a chair. She verbalizes a decrease in pain. There have been no abnormal neurovascular assessments. She is able to independently perform isometric and flexion/extension exercises in both lower extremities. Discharge planning includes referrals for home care. A home health nurse will visit, and the social worker at the hospital has ordered a trapeze for her bed, an elevated toilet seat, an elevated cushion for her chair, and a walker.

CRITICAL THINKING IN THE NURSING PROCESS

1. What factors placed Mrs. Carbolito at risk for a hip fracture?
2. Mrs. Carbolito says, "I don't understand why they had to put that heavy thing on my leg before I went to surgery to get my hip fixed." What would you tell her? What preoperative factors might have decreased teaching effectiveness?
3. Describe how each of the following, if manifested by Mrs. Carbolito, would increase her risk for postoperative complications: urinary incontinence, weight more than 20% under normal for her height, chronic constipation. What nursing diagnoses and interventions would you include in her plan of care to decrease the risk?

See Evaluating Your Response in Appendix C.

- Administer pain medications as prescribed. For home care, explain the importance of taking pain medications before the pain is severe. *Analgesics alleviate pain by stimulating opiate receptor sites.*

PRACTICE ALERT
In the case of fracture in an extremity, supporting the extremity above and below the fracture can also decrease pain and muscle spasms.

Risk for Peripheral Neurovascular Dysfunction

In the client with a fracture, compartment syndrome or deep venous thrombosis can impair circulation and, in turn, tissue perfusion.

- Assess the 5 P's every 1 to 2 hours. Report abnormal findings immediately. *Unrelenting pain, pallor, diminished distal pulses, paresthesias, and paresis are strong indicators of compartment syndrome.*

PRACTICE ALERT
Pulses may remain strong, even in the presence of compartment syndrome.

- Assess nail beds for capillary refill. If nails are too thick or discolored, assess the skin around the nail. *Delayed capillary refill may indicate decreased tissue perfusion.*

PRACTICE ALERT
It may not be possible to accurately assess capillary refill in older adults who often have thickened, discolored nails. If so, test nearby skin.

- Monitor the extremity for edema and swelling. *Excessive swelling and hematoma formation can compromise circulation.*
- Assess for deep, throbbing, unrelenting pain. *Pain that is not relieved by analgesics may indicate neurovascular compromise.*

- Monitor the tightness of the cast. *Edema can cause the cast to become tight; a tight-fitting cast may lead to compartment syndrome or paralysis.*
- If cast is tight, be prepared to assist the physician with bivalving (Figure 41–11 ■). *Bivalving, the process of splitting the cast down both sides, alleviates pressure on the injured extremity.*
- If compartment syndrome is suspected, assist the physician in measuring compartment pressure. Normal compartment pressure is 10 to 20 mmHg. *Compartment pressure greater than 30 mmHg indicates compartment syndrome.*
- Elevate the injured extremity above the level of the heart. *Elevating the extremity increases venous return and decreases edema.*
- Administer anticoagulant per physician's order. *Prophylactic anticoagulation decreases the* risk *of clot formation.*

Risk for Infection

The client who undergoes surgical repair will have a postoperative wound. Any break in skin integrity must be monitored for infection. Wound healing in orthopedic patients is affected by the cause of the wound as well as the therapies used to repair musculoskeletal structures. It is important for nurses to understand normal wound healing processes; characteristics of musculoskeletal wounds, contamination, and drainage; and potential complications to plan for and implement appropriate interventions (Harvey, 2005).

- For clients with skeletal pins, follow established guidelines for skeletal pin site care, as outlined in the Evidenced-Based Practice box below. *Pins or wires attached to traction, casts, or external fixators stabilize a segment of bone so optimal healing can occur. However, pin infections of varying severity do occur (Holmes & Brown, 2005, pp. 1–2).*

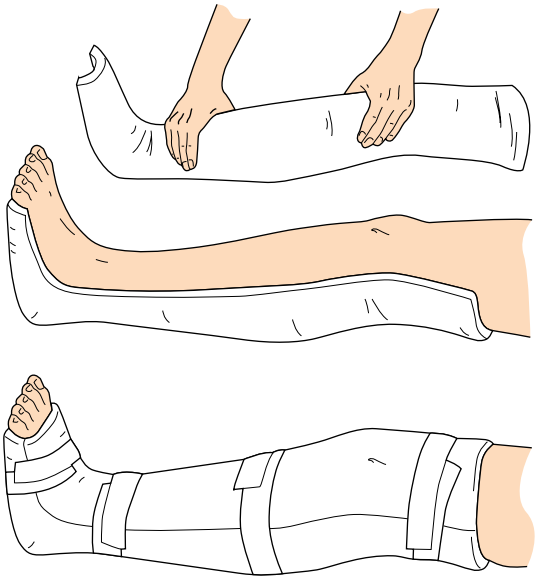


Figure 41–11 ■ Bivalving is the process of splitting the cast down both sides to alleviate pressure on or allow visualization of the extremity.

NURSING RESEARCH **Evidence-Based Practice for the Client with Skeletal Pins**

Clinical guidelines for specific client care interventions, such as skeletal pin care, should be based on research in order to provide the most appropriate evidence-based practice. The recommendations contained in this report from the National Association of Orthopaedic Nurses were made based on published research and are for skin care of areas surrounding the pin insertion sites. Data from the studies provided beginning guidelines, but were not conclusively useful as there were few experimental studies, and the studies were diverse in definitions and variables. However, the following recommendations were made:

- Pins located in areas with considerable soft tissue should be considered at greater risk for infection.
- After the first 48 to 72 hours (when drainage may be heavy), pin site care should be done daily or weekly for sites with mechanically stable bone–pin interfaces.
- Chlorhexidine (2 mg/mL) solution may be the most effective cleansing solution for pin site care.
- Clients and their families should be taught pin site care before discharge from the hospital. They should be required to demonstrate whatever care needs to be done and should be provided with written instructions that include signs and symptoms of infection.

IMPLICATIONS FOR NURSING

Evaluation of the literature by members of this expert panel found scanty evidence on which to base skeletal pin site interventions. The recommendations are therefore broadly stated, but do serve as a base for further research, which should examine factors such as defining pin site infection, risk for pin site infection, pin site care versus no pin site care, showering, managing crusts, skin adherence to the pins, and using dressings. The panel recommends that the guidelines should be individualized to each situation.

CRITICAL THINKING IN CLIENT CARE

1. List factors that may increase the risk for infection of skeletal pin sites. What nursing interventions may be used to reduce this risk?
2. You are caring for a client with skeletal pins for external fixation of a fracture of bones of a lower extremity. There is dried yellow drainage around the pin site. Based on clinical decision making without research to support your actions, would you remove the crusts? Why or why not?
3. You are teaching a client how to do pin care at home. Make a list of manifestations of infection the client may experience. What would you recommend if any of these manifestations occur?

Data from Holmes, S. B., & Brown, S. J. (2005). Skeletal pin site care. National Association of Orthopaedic Nurses guidelines for orthopaedic nursing. *Orthopaedic Nursing, 24*(2), 99–108.

- Monitor vital signs and lab reports of WBCs. *Increases in pulse rate, respiratory rate, temperature, and WBCs may indicate infection.*
- Use sterile technique for dressing changes. *The initial postoperative dressing will be changed by the surgeon. The nurse must change all subsequent dressings without introducing organisms into the operative site.*
- Assess the wound for size, color, and the presence of any drainage. *Redness, swelling, and purulent drainage indicate infection.*
- Administer antibiotics per physician's orders. *Prophylactic antibiotic administration inhibits bacterial reproduction and thereby helps prevent skin flora from entering the wound. In the case of "dirty wounds," such as those occurring from vehicular crashes, antibiotics are routinely administered.*

Impaired Physical Mobility

The client who has experienced a fracture requires immobilization of the fractured bone(s). Immobilization alters normal gait and mobility. The client will need to use assistive devices such as crutches, canes, slings, or walkers.

- Teach or assist client with ROM exercises of the unaffected limbs. *ROM exercises help prevent muscle atrophy and maintain strength and joint function. Flexion and extension exercises prevent the development of foot drop, wrist drop, or frozen joints.*
- Teach isometric exercises, and encourage the client to perform them every 4 hours. *Isometric exercises help prevent muscle atrophy and force synovial fluid and nutrients into the cartilage.*
- Encourage ambulation when able; provide assistance as necessary. *Ambulation maintains and improves circulation, helps prevent muscle atrophy, and helps maintain bowel function.*
- Teach and observe the client's use of assistive devices (such as canes, crutches, walkers, slings) in conjunction with the physical therapist. *Proper use of devices is necessary for safe ambulation and helps prevent the loss of joint function secondary to complications and falls.*
- Turn the client on bed rest every 2 hours. If the client is in traction, teach the client to shift his or her weight every hour. *Turning and shifting weight increase circulation and help prevent skin breakdown.*

Risk for Disturbed Sensory Perception: Tactile

The client who has sustained a fracture is at risk for nerve injury from the initial trauma, as well as from complications such as compartment syndrome.

- Assess the ability to differentiate between sharp and dull touch and the presence of paresthesias and paralysis every 1 to 2 hours. *Paresthesias develop as a result of pressure on nerves and may indicate compartment syndrome.*

PRACTICE ALERT

Paralysis is a late sign of nerve entrapment and requires that the physician be notified immediately.

- Elevate the injured extremity above the level of the heart. *Elevating the extremity decreases swelling and the risk of compartment syndrome and nerve entrapment. Check the cast for fit. A tightly fitting cast can decrease blood flow to distal tissues, compress nerves, and cause compartment syndrome.*
- Support the injured extremity above and below the fracture site when moving the client. *Supporting the injured extremity above and below the fracture site helps prevent displacement of bony fragments and decreases the risk of further nerve damage.*

Using NANDA, NIC and NOC

Chart 41–1 shows links between NANDA nursing diagnoses, NIC, and NOC when caring for the client with a compound fracture.

Community-Based Care

Client and family teaching focuses on individualized needs. The type of fracture and its location determine how much teaching the client and family will require. For example, a client who has a simple nondisplaced tibial fracture may need to be taught only cast care and crutch walking. An older client who has sustained a hip fracture and requires surgical intervention, by contrast, has a wider array of teaching needs, including the use of an abduction pillow, proper bending, and proper sitting. Address the following topics for home care of the client who has fractured a hip:

NANDA, NIC, AND NOC LINKAGES
CHART 41–1 **The Client with a Compound Fracture**

NANDA

Impaired Physical Mobility

↓

NIC

Traction/Immobilization Care

Cast Care: Wet

Cast Care: Maintenance

Self-Care Assistance

Exercise Promotion

Teaching: Prescribed Activity/Exercise

↓

NOC

Mobility Level

Self-Care: ADLs

Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

MEDIALINK Crutch Instruction Video

- Encourage independence in ADLs:
  - Explain that the client should sit only on high chairs to prevent excess flexion of the hip; a high toilet seat can be added to a regular toilet seat.
  - Encourage the client and family to equip the shower with a rail to aid stability and prevent falls.
  - If a walker is needed, teach the client its proper use: Do not carry the walker, but lift it, advance it, and then take two steps, or use a rolling walker.
  - If a cane is needed, instruct the client to use it on the affected side.
- Stress the importance of well-balanced meals, and explain all prescribed medications.

Clients who have experienced a fracture or who have had orthopedic surgery often have a cast and require an extended period of immobilization or limited activities. Address the following topics for home care:

- Do not try to scratch under a cast with a sharp object.
- Do not get a plaster cast wet.
- Follow the physician's order for weight bearing.
- Physical therapy departments or offices often can evaluate the home environment for safety and suggest modifications as needed. Physical therapists also teach crutch walking, limited weight bearing, transferring, and other activities.
- Home care agencies can teach wound care and provide ongoing monitoring of wound healing.
- Local medical equipment and supply sources rent or sell durable equipment such as crutches, walkers, wheelchairs, overhead trapeze units, shower chairs, elevated toilet seats, grab bars, and bedside commodes. Slings or braces may be purchased through medical equipment dealers.
- Local pharmacies are good resources for dressing supplies such as antiseptic solutions or ointments, dressings, and tape.
- Fitness equipment suppliers may be able to provide rehabilitation equipment such as hand or ankle weights for strengthening exercises.

THE CLIENT WITH AN AMPUTATION

An **amputation** is the partial or total removal of an extremity. Amputation may be the result of an acute process, such as a traumatic event, or a chronic condition, such as peripheral vascular disease or diabetes mellitus. Regardless of the cause, an amputation is devastating to the client.

FAST FACTS

Amputation

- It is estimated that 350,000 people with amputations live in the United States, and that 135,000 new amputations occur each year.
- In the United States, the most common causes of lower extremity amputations are disease (70%), trauma (22%), congenital or birth defects (4%), and tumors (4%).
- Upper extremity amputation is usually due to trauma or birth defect.

Data from Moss Rehab Resource Net (2005).

The loss of all or part of an extremity has a significant physical and psychosocial effect on the client and family. Adaptation may take a long time and require much effort. Interdisciplinary health care is always important, but is especially necessary to meet the client's physical, spiritual, cultural, and emotional needs after an unexpected or planned amputation.

Causes of Amputation

Peripheral vascular disease (PVD) is the major cause of amputation of the lower extremities (see Chapter 35 ∞). Common risk factors for the development of PVD include hypertension, diabetes, smoking, and hyperlipidemia. Peripheral neuropathy also places the person with diabetes at risk for amputation. In peripheral neuropathy, loss of sensation frequently leads to unrecognized injury and infection. Untreated infection may lead to gangrene and the need for amputation. These risks are discussed in Chapter 20 ∞.

The incidence of traumatic amputations is highest among young men. Most amputations in this group result from motor vehicle crashes or accidents involving machinery at work. The client presents to the trauma center with an injury that may be life threatening; significant loss of blood and tissue may have already occurred, and shock may develop. (See Chapter 11 ∞ for a discussion of shock and trauma.) Other traumatic events that may necessitate an amputation are frostbite, burns, or electrocution.

Amputations result from or are necessitated by interruption in blood flow, either acute or chronic. In acute trauma situations, the limb is partially or completely severed, and tissue death ensues. However, replantation of fingers, small body parts, and entire limbs has been successful. In chronic disease processes, circulation is impaired, venous pooling begins, proteins leak into the interstitium, and edema develops. Edema increases the risk of injury and further decreases circulation. Stasis ulcers develop and readily become infected because impaired healing and altered immune processes allow bacteria to proliferate. The presence of progressive infection further compromises circulation and ultimately leads to gangrene (tissue death), which requires amputation.

Levels of Amputation

The level of amputation is determined by local and systemic factors. Local factors include ischemia and gangrene; system factors include cardiovascular status, renal function, and severity of diabetes mellitus. The goals are to alleviate symptoms, to maintain healthy tissue, and to increase functional outcome. When possible, the joints are preserved because they allow greater function of the extremity. Figure 41–12 ■ illustrates common sites of amputation.

Types of Amputation

Amputations may be open (*guillotine*) or closed (*flap*). Open amputations are performed when infection is present. The wound is not closed but remains open to drain. When infection is no longer present, surgery is performed to close the wound.

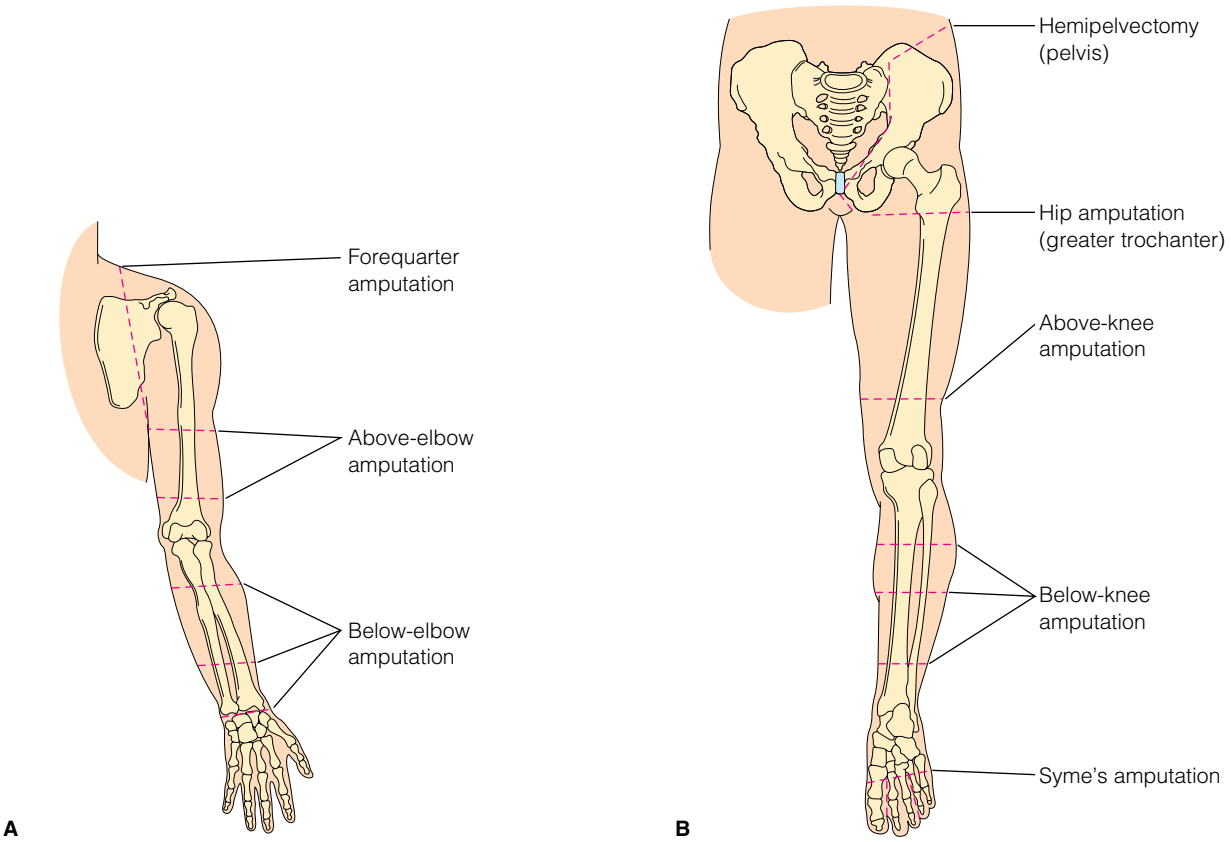


Figure 41–12 ■ Common sites of amputation. *A,* The upper extremities. *B,* The lower extremities. The surgeon determines the level of amputation based on blood supply and tissue condition.

In closed amputations, the wound is closed with a flap of skin that is sutured in place over the stump. Terms used to refer to amputations are defined in Table 41–3.

TABLE 41–3 Amputation Terms

TERM	MEANING
Arm	Amputation of a portion of the arm, either above or below the elbow
Disarticulation	Amputation through a joint
Forequarter	Removal of the entire arm and disarticulation of the shoulder
Closed (flap)	Amputation in which a flap of skin is formed to cover the end of the wound
Open (guillotine)	Perpendicular cutting of the extremity in which the wound is left open; used when infection is present
Leg	Amputation below the knee (BK)
Thigh	Amputation above the knee (AK)
Finger or toe	Amputation of one or all of the fingers or toes
Syme	Modified disarticulation of the ankle
Foot	Amputation of part of the foot and toes

Amputation Site Healing

For the prosthesis to fit well, the amputation site must heal properly. To promote healing, a rigid or compression dressing is applied to prevent infection and minimize edema. A rigid dressing is made by placing a cast on the stump and molding the stump to fit a prosthesis. A soft compression dressing is applied when frequent wound checks are necessary. When this type of dressing is used, a splint is sometimes applied to help mold the extremity to fit the prosthesis. After the wound is dressed, the client is encouraged to toughen the stump skin by pushing it into first soft and then harder surfaces. The stump is wrapped in an Ace bandage to allow a conical shape to form and to prevent edema. The bandage is applied from the distal to the proximal extremity (Figure 41–13 ■).

Complications

Complications that may occur after an amputation include infection, delayed healing, chronic stump pain and phantom pain, and contractures.

Infection

Generally, the client who suffers a traumatic amputation has a greater risk of infection than the person who has a planned amputation. However, even planned amputations carry a risk of infection. The client who is older, has diabetes mellitus, or suffers peripheral neurovascular compromise is at a particularly high

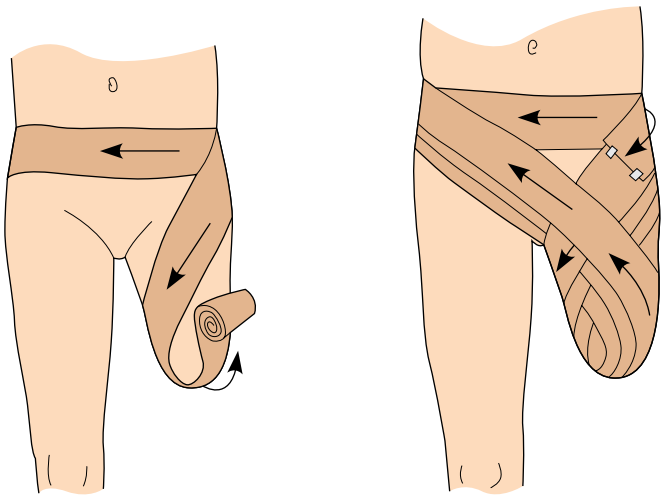


Figure 41–13 ■ Stump dressings increase venous return, decrease edema, and help shape the stump for a prosthesis. With an above-knee amputation, a figure-eight bandage is started by bringing the bandage down over the stump and back up around the hips.

risk for infection. Infection may present itself locally or systemically. Local manifestations of infection include drainage, odor, redness and increased discomfort at the suture line. Systemic manifestations include fever, an increased heart rate, a decrease in blood pressure, chills, and positive wound or blood cultures.

Delayed Healing

If infection is present or if the circulation remains compromised, delayed healing (occuring at a slower rate than expected) will result. In older clients, other preexisting conditions can increase the risk of delayed healing. In clients of any age, electrolyte imbalances can contribute to delayed healing processes, as can a diet that lacks the proper nutrients to meet the body's increased metabolic demands during healing. Smoking compromises healing by causing vasoconstriction and decreasing blood flow to the stump. Deep venous thrombosis and compromised venous return, which may result from prolonged immobilization, are other potential factors. Decreased cardiac output decreases blood flow and thus also delays healing.

Chronic Stump Pain and Phantom Pain

Chronic stump pain is the result of neuroma formation, causing severe burning pain. Interventions to relieve this pain include medications, nerve blocks, transcutaneous electrical nerve stimulation (TENS), and surgical stump reconstruction. **Phantom limb pain** is not the same as phantom limb sensation. A majority of amputees experience phantom limb sensation (sensations such as tingling, numbness, cramping, or itching in the phantom foot or hand) early in the postoperative period. It is often self-limited, but may last for decades in some clients. When phantom limb sensation is painful, it is referred to as phantom limb pain. Although various theories have been proposed, the exact cause of this experience is unknown. Treatments include pain management, TENS, and a variety of surgical procedures. The management of phantom limb pain is difficult for both clients and healthcare professionals. Clients with phantom limb pain often benefit from referral to a pain clinic for a comprehensive pain management program.

Contractures

A **contracture** is an abnormal flexion and fixation of a joint caused by muscle atrophy and shortening. Contracture of the joint above the amputation is a common complication. The client needs to be taught to extend the joint. The client with an above-the-knee amputation should lie prone for periods throughout the day. The client with a below-the-knee amputation should elevate the stump, keeping the knee extended. The same principles apply to the upper extremities. All joints should receive either active or passive ROM exercises every 2 to 4 hours. A trapeze frame should be added to the bed to encourage the client to change position every 2 hours. The client who has an upper extremity amputation should exercise both shoulders. Postural exercises can help prevent the client from hunching over secondary to the loss of weight on the affected side. The client with an above-the-knee amputation should not sit for prolonged periods of time; prolonged sitting can lead to hip contracture.

INTERDISCIPLINARY CARE

Interdisciplinary care is essential for the client who has sustained an amputation. Physical therapy and occupational retraining are necessary, and the client may also benefit from the presence of clergy. The entire healthcare team must view both the positive and the negative effects of amputation; that is, they must see amputation as a means to increase the client's independence and to relieve symptoms. The client should be able to become familiar with the members of the healthcare team and their roles; this allows the client greater control over his or her care and rehabilitation and promotes independence.

Diagnosis

Preoperatively, the client has routine laboratory and diagnostic tests (see Chapter 4 ∞ for care of the client having surgery). Preoperative tests, including Doppler flowmetry, segmental blood pressure determination, transcutaneous partial pressure oxygen readings, and angiography, are performed to assess the circulation present in the limb at different levels and to determine the level of viable tissue. Postoperative tests include CBC to monitor for hemorrhage, WBC count to monitor for infection, blood chemistries to evaluate electrolytes and fluid balance, and a vascular Doppler ultrasonography if a DVT is suspected.

Medications

The client receives medications preoperatively, intraoperatively, and postoperatively. Preoperatively, the physician may prescribe intravenous antibiotics. Intraoperatively, anesthetic agents are administered. It also may be necessary to administer agents to control blood pressure during the surgery. Postoperatively, the client resumes any routinely prescribed medications and in addition may receive antibiotics and analgesics. Steroids may be administered to decrease swelling. A histamine H_2 antagonist may

also be ordered to decrease the risk of peptic ulcer formation. Stool softeners may be administered to prevent constipation.

Prosthesis

The type of prosthesis selected for the client with an amputation depends on the level of the amputation as well as the client's occupation and lifestyle. Each prosthesis is based on a detailed prosthetic prescription and is custom made for the client based on the specific characteristics of the stump. Most are made of plastic and foam materials. Many factors influence the client's use of the prosthesis, including the status of the remaining limb, cognitive status, cardiovascular status, preoperative activity level, and motivation to use the prosthesis.

Clients with a lower extremity amputation are often fitted with early walking aids. Pneumatic devices that fit over the stump are used in the immediate postoperative period to allow early ambulation, decreased postoperative swelling, and improved morale. Clients may begin weight bearing as soon as 2 weeks after surgery. Clients with upper extremity amputations may be fitted for a prosthesis immediately after surgery. Rehabilitation of the client with an amputation is a team effort, involving the client, nurse, physician, physical therapist, occupational therapist, social worker, prosthetist, and vocational counselor.

NURSING CARE

Health Promotion

The goals of health promotion activities focus on preventing the progression of chronic diseases such as PVD and diabetes mellitus, and on safety. Clients with PVD from any cause need education about foot care and early recognition of decreased circulation. Education within both urban and rural populations should provide knowledge about working safely with lawn care equipment as well as farm and occupational machinery.

In addition, it is important that the public know what to do if a traumatic amputation occurs in the home, community, or workplace. The following guidelines may help preserve the amputated part until it can be surgically reattached:

- Keep the person in a prone position with the legs elevated.
- Apply firm pressure to the bleeding area, using a towel or article of clothing.
- Wrap the amputated part in a clean cloth. If possible, soak the cloth in saline (such as contact lens solution).
- Put the amputated part in a plastic bag and put the bag on ice. Do not let the amputated part come into direct contact with the ice or water.
- Send the amputated part to the emergency department with the injured person, and be sure the emergency personnel know what it is.

Assessment

Collect the following data through the health history and physical examination. Further focused assessments are described in the following nursing interventions sections.

- *Health History:* Mechanism of injury, current and past health problems, pain, occupation, ADLs, changes in sensation in the feet, cultural and/or religious guidelines for handling the amputated part.
- *Physical Examination:* Bilateral neurovascular status of the extremities, bilateral capillary refill time, skin over the lower extremities (discoloration, edema, ulcerations, hair, gangrene).

Nursing Diagnoses and Interventions

The goals of nursing care for a person with an amputation are to relieve pain, promote healing, prevent complications, support the client and family during the process of grieving and adaptation to alterations in body image, and restore mobility. Care is individualized, and the circumstances that led to the amputation (e.g., traumatic injury or disease) also must be addressed. (See the accompanying Nursing Care Plan on page 1425.) Applying rehabilitation principles to nursing care is also important.

Acute Pain

Pain from the surgical procedure can be compounded by muscle spasms, swelling, and phantom limb pain.

- Ask the client to rate the pain on a scale of 0 to 10 (with 10 as the most severe pain) before and after any intervention. *This facilitates objective assessment of the effectiveness of the chosen pain relief strategy. Pain that increases in intensity or remains unrelieved with analgesics can indicate compartment syndrome.*
- Splint and support the injured area. *Splinting prevents additional injury by immobilizing the stump and decreasing edema while molding the stump for a good prosthetic fit.*
- Unless contraindicated, elevate the stump on a pillow for the first 24 hours after surgery. *Elevating the stump promotes venous return and decreases edema, which will decrease pain.*

PRACTICE ALERT
Elevating the stump for long periods after the immediate postoperative period increases the risk for hip contractures.

- Move and turn the client gently and slowly. *Gentle moving and turning prevents the development of severe muscle spasms.*
- Administer pain medications as prescribed. A PCA pump may be ordered by the physician. *Analgesics alleviate pain by stimulating opiate receptor sites. PCA pumps increase client control over and allow early relief of pain before it intensifies.*
- Encourage deep breathing and relaxation exercises. *These techniques increase the effectiveness of analgesics and modify the pain experience.*
- Reposition client every 2 hours; turn from side to side and onto abdomen. *Repositioning alleviates pressure from one area and distributes it throughout the body and helps prevent cramping of muscles.*

PRACTICE ALERT
Lying prone prevents hip contracture.

Risk for Infection

The client who has an amputation is at risk for wound infection. Early recognition of infection can lead to early treatment and prevent wound dehiscence.

MEDIALINK Care Plan Activity: Below-the-Knee Amputation

NURSING CARE PLAN A Client with a Below-the-Knee Amputation

John Rocke is a 45-year-old divorcee with no children. He has a history of type 1 diabetes mellitus and poor control of blood glucose levels. Mr. Rocke is unemployed and currently receives unemployment compensation. He lives alone in a second-floor apartment. Mr. Rocke had developed gangrene in the foot and failed to seek prompt medical attention; as a result, a left below-the-knee amputation was necessary.

Mr. Rocke is in his second postoperative day and his vital signs are stable. The stump is splinted and has a soft dressing. The wound is approximating well without signs of infection. He has not performed ROM exercises or turning since his surgery, complaining of severe pain. When the nurse goes into the room, he yells, "Get out! I don't want anyone to see me like this." No one has visited him since his hospitalization. He is tolerating an 1800-kcal diabetic diet and is using a urinal independently. He has an order for meperidine (Demerol), 100 mg IM every 4 hours prn for pain, and cefazolin (Ancef), 1 g IV every 8 hours. He is on blood glucose coverage with regular insulin subcutaneously.

ASSESSMENT

Jane Simmons, RN, has just come on duty. She notes that the client is upset and angry. Mr. Rocke will not let anyone enter the room to give him medication or assess his vital signs.

DIAGNOSES

- *Disturbed Body Image* related to amputation of left lower leg
- *Dysfunctional Grieving* related to anger and loss of left lower leg
- *Situational Low Self-Esteem* related to appearance
- *Risk for Injury from Infection and Contractures* related to refusal of care
- *Acute Pain* related to surgery

EXPECTED OUTCOMES

- Verbalize his feelings about the amputation.
- Allow the staff to monitor his vital signs and administer medications.
- Be allowed to control his pain with a PCA pump.
- Verbalize a decrease in pain.
- Verbalize the importance of turning.
- Turn every 2 hours.

PLANNING AND IMPLEMENTATION

- Encourage verbalization of feelings.
- Actively listen to the client.
- Offer to arrange a visit with a fellow amputee.
- Ask the physician if the client can be placed on a PCA pump.
- Teach the client the importance of turning every 2 hours to prevent contractures.
- Encourage turning and lying prone.
- Teach the importance of antibiotics in preventing and treating infection.

EVALUATION

One week after his surgery, Mr. Rocke is actively participating in his care. He has apologized for his behavior and has explained to Ms. Simmons that he was angry about the loss of his leg. He states, "I thought I knew what to expect but I didn't."

CRITICAL THINKING IN THE NURSING PROCESS

1. Once Mr. Rocke is ready to assist with his stump care, how would you proceed? Would you give him full responsibility for care and dressings, or would you gradually increase his participation? Why?
2. What factors in Mr. Rocke's home environment and medical history may make self-care more difficult? Do you expect Mr. Rocke to follow up on care after his discharge? Why or why not?
3. Mr. Rocke states, "Why should I exercise this leg—it was already cut off!" How would you respond? What is the purpose of exercising the stump?

See Evaluating Your Response in Appendix C.

- Assess the wound for redness, drainage, temperature, edema, and suture line approximation. *Redness is normal in the immediate postoperative period; if it persists, however, it can indicate infection. A hot area that is palpated over the incision or increased drainage may also indicate infection.*
- Take the client's temperature every 4 hours. *Increased body temperature may indicate infection.*
- Monitor WBC count. *The WBC count rises in the presence of infection.*
- Use aseptic technique to change the wound dressing. *Aseptic technique prevents the contamination of the wound with bacteria.*
- Administer antibiotics as ordered. *Antibiotics inhibit bacterial cell replication and help prevent or eradicate infection.*
- Teach the client stump-wrapping techniques. *Correctly wrapping the stump from the distal to proximal extremity increases venous return and prevents pooling of fluid, thereby reducing the chance of infection.*

Risk for Impaired Skin Integrity

Stump care is essential, not only in the postoperative healing period, but also throughout life with a prosthesis. A variety of skin problems may be caused by a prosthesis, including epidermoid cysts, abrasions, blisters, and hair follicle infections. The client must be taught stump care prior to discharge.

- Each day, preferably at night, wash the stump with soap and warm water and dry thoroughly. Inspect the stump for redness, irritation, or abrasions. *It is essential to maintain intact skin to ensure successful use of the prosthesis.*
- Massage the end of the stump, beginning 3 weeks after surgery. *Massage helps desensitize the remaining part of the limb and prevents scar tissue formation. If the skin adheres to the underlying tissue, it will tear when stressed by wearing a prosthesis.*
- Expose any open areas of skin on the remaining part of the limb for 1 hour four times a day. *Air exposure promotes healing.*

- Change stump socks and elastic wraps each day. Wash these in mild soap and water, and allow to completely dry before using again. *Stump socks and elastic wraps must be kept clean and dry to prevent skin breakdown.*

Risk for Dysfunctional Grieving

The client who has lost an extremity is at risk for dysfunctional grieving. Denial of the need for surgery and the inability to discuss feelings compound this risk.

- Encourage verbalization of feelings, using open-ended questions. *Asking open-ended questions allows the client to discuss feelings and communicates the listener's willingness to listen.*
- Actively listen and maintain eye contact. *Active listening and eye contact communicate respect for what the client is expressing.*
- Reflect on the client's feelings. *Reflection statements such as "You seem angry" allow the client to recognize feelings and perhaps develop a plan for resolution.*
- Allow the client to have unlimited visiting hours, if possible. *Unlimited visiting hours allow increased social support.*
- If desired by the client, provide spiritual support by encouraging activities such as visits from a spiritual leader, prayer, and meditation. *These activities often provide support during the grieving process.*

Disturbed Body Image

Although amputation is a reconstructive surgery, the client's body image will be disturbed. Risk for body image disturbance is higher in young trauma clients, in whom body image is a particularly important component of self-image.

- Encourage verbalization of feelings. *This allows the client to communicate concerns and fears and lets the client know the nurse is willing to listen.*
- Allow the client to wear clothing from home. *Familiar clothing provides emotional comfort and helps the client retain a sense of his or her own identity.*
- Encourage the client to look at the stump. *Looking at and touching the stump helps the client face his or her fear of the unknown and move from denial to acceptance.*
- Encourage the client to care for the stump. *Active participation in care increases self-esteem and independence.*
- Offer to have a fellow amputee visit the client. *A support person who has experienced the same change gives the client the hope that he or she can regain independence.*
- Encourage active participation in rehabilitation. *Active participation in rehabilitation increases independence and mobility.*

Impaired Physical Mobility

If time allows, the client should begin strengthening muscles preoperatively. If the amputation is the result of an emergency, exercises begin within 24 to 48 hours of surgery. The return of independent mobility boosts self-esteem and promotes adaptation to amputation.

- Perform ROM exercises on all joints. *ROM exercises help prevent the development of joint contractures that limit mobility.*
- Maintain postoperative stump shrinkage devices. These may be elastic bandages, shrinker socks, an elastic stockinette, or a rigid plaster cast. *Postoperative dressings decrease edema and shape the stump for prosthetic wear.*
- Turn and reposition the client every 2 hours. *The client with a lower extremity amputation should lie prone every 4 hours. Repositioning increases blood flow to muscles, forces synovial fluid into joints, and helps prevent contractures.*
- Reinforce teaching by the physical therapist in crutch walking or the use of assistive devices. *These devices increase mobility by balancing the client and facilitating ambulation.*
- Encourage active participation in physical therapy. *Physical therapy will fatigue the client in the early stage of healing. Encouragement may increase the client's participation in the physical therapy regimen and thereby increase activity tolerance.*

Using NANDA, NIC, and NOC

Chart 41–2 shows links between NANDA nursing diagnoses, NIC, and NOC when caring for the client with an amputation.

Community-Based Care

Client and family teaching includes stump care, prosthesis fitting and care, medications, assistive devices, exercises, rehabilitation, counseling, support services, and follow-up appointments. The depth of teaching depends on the cause and site of the amputation and the needs of the client. See the Meeting Individualized Needs box on the next page.

Holistic nursing care is especially important for the older client with an amputation. The normal aging process decreases

NANDA, NIC, and NOC LINKAGES
CHART 41–2 **The Client with an Amputation**

NANDA

Disturbed Body Image

↓

NIC

Amputation Care
Wound Care
Grief Work Facilitation
Coping Enhancement
Body Image Enhancement

↓

NOC

Grief Resolution
Body Image

Data from *NANDA's Nursing Diagnoses: Definitions & Classification 2005–2006* by NANDA International (2005), Philadelphia; *Nursing Interventions Classification (NIC)* (4th ed.) by J. M. Dochterman & G. M. Bulechek (2004), St. Louis, MO: Mosby; and *Nursing Outcomes Classification (NOC)* (3rd ed.) by S. Moorhead, M. Johnson, and M. Maas (2004), St. Louis, MO: Mosby.

MEETING INDIVIDUALIZED NEEDS The Client with an Amputation

Amputation of a limb has significant long-term consequences for the client. The client will grieve the loss of a body part and must adjust to a new self-image. The client's ability to perform normal ADLs and to maintain his or her usual family and social roles may be significantly affected, at least initially. Depending on the client's occupation, job performance may be affected, necessitating a change of career.

The nurse may be responsible for involving multiple members of the healthcare team in the client's care and rehabilitation and coordinating their activities. Following an amputation, the client may need the services of any or all of the following:

- Social services to help with rehabilitative and financial arrangements
- Physical therapists to teach ambulation techniques, and to provide deep heat or massage
- Occupational therapists to assist the client in developing adaptive techniques to deal with the loss of a limb
- Prosthetists to develop a prosthesis for the missing limb that will meet the client's needs for ADLs and other activities
- Home health services for nursing care such as assessments and wound care
- Support group services to assist in adapting to the body image change and effects of amputation on ADLs.

ASSESSING FOR HOME CARE

Preparing the amputee for home care includes a careful assessment of the client family and support services, and the home for possible barriers to the client's safety and independence.

Assess the client's acceptance of the amputation and knowledge base about care needs, any activity restrictions or special needs, and resources for home care. Discuss home management—who is responsible for household activities such as cleaning and cooking. Inquire about arrangements that have been made for home care activities and ADLs. Evaluate the client's use of prescription and nonprescription medications, paying particular attention to possible interactions and drugs that may affect the client's balance, mental alertness, or appetite. Ask about social habits, such as cigarette smoking, alcohol use, or other drug use, that may affect healing or the client's ability to provide self-care.

Assess the client's home environment for possible safety hazards or barriers to ambulation, such as:

- Scatter rugs
- Stairs between living areas of the house
- Presence of grab bars to facilitate toileting and bathing
- Access to clean water and other needs for wound care.

TEACHING FOR HOME CARE

The new amputee needs a great deal of teaching to learn to adapt to loss of a limb, whether it is an upper or lower extremity that has been lost. Because the client must be ready to learn before teaching can be effective, use therapeutic communication techniques to encourage the client to verbalize feelings about the amputation and its effects. Use active listening and teach the client ways to reduce anxiety and deal with feelings of helplessness and loss. Encourage the client to participate in care of the stump to build self-esteem and reinforce teaching. Include the following in teaching for home care:

- Teach the client to wrap the stump appropriately in preparation for fitting the prosthesis.
- Discuss positioning of the stump. Contractures are a particular problem for clients with an above-knee amputation, and can interfere with ability to effectively use a prosthesis.
- Teach the client how to perform stump exercises to maintain joint mobility and muscle tone of the affected limb.
- Encourage the client to resume physical activities as soon as possible. This improves the client's health and well-being, as well as the client's self-esteem.
- Discuss household modifications to promote independence, such as grab bars in the bathroom, faucets with single-handle controls for water flow and temperature, and handheld shower heads and shower chairs for bathing.

renal and liver function; hence, medications have longer half-lives. Altered circulation prolongs wound healing, and slowing of reflexes and alterations in gait may disrupt balance. A walker may be more appropriate than crutches, because older clients have less strength in the upper extremities. Safety issues, such as decreasing the risk for recurrent falls, must be addressed. The nurse should also assess the client's need for in-home assistance and make appropriate referrals to visiting nurses and home health aides.

In addition, suggest the following resources:

- The Amputee Coalition of America
- Amputee Resource Foundation of America.

THE CLIENT WITH A REPETITIVE USE INJURY

Repeatedly twisting and turning the wrist, pronating and supinating the forearm, kneeling, or raising arms over the head can result in repetitive use injuries. Clients with repetitive use injuries pose a challenge to the healthcare team. Often these clients appear puzzled as they relate a history of manifestations that have worsened over time. They deny abrupt trauma and often worry about the ability to return to work. Repetitive use injuries are common. The number of worker's compensation claims for repetitive use injuries is steadily growing. The increase is believed to be a result of technology advances in the workplace.

Pathophysiology

Common repetitive use injuries include carpal tunnel syndrome, bursitis, and epicondylitis.

Carpal Tunnel Syndrome

The carpal tunnel is a canal through which flexor tendons and the median nerve pass from the wrist to the hand. The syndrome develops from narrowing of the tunnel and irritation of the median nerve. Carpal tunnel syndrome involves compression of the median nerve as a result of inflammation and swelling of the synovial lining of the tendon sheaths. The client complains of numbness and tingling of the thumb, index finger,

and lateral ventral surface of the middle finger. The client may also complain of pain in this area that interferes with sleep and is alleviated by shaking or massaging the hand and fingers. The affected hand may become weak and the client may be unable to hold utensils or perform activities that require precision.

Carpal tunnel syndrome is one of the three most common work-related injuries. The incidence is believed to be related directly to the number of people using computers. The incidence of carpal tunnel syndrome is higher in women, especially postmenopausal women.

Bursitis

Bursitis is an inflammation of a bursa. A bursa is an enclosed sac found between muscles, tendons, and bony prominences. The bursae that commonly become inflamed are in the shoulder, hip, knee, and elbow. Constant friction between the bursa and the musculoskeletal tissue around it causes irritation, edema, and inflammation. Manifestations develop as the sac becomes engorged. The area around the sac is tender, and extension and flexion of the joint near the bursa produce pain. The inflamed bursa is hot, red, and edematous. The client guards the joint to decrease pain and may point to the area of the bursa when identifying joint tenderness.

Epicondylitis

Epicondylitis is the inflammation of the tendon at its point of origin into the bone. Epicondylitis is also referred to as *tennis elbow* or *golfer's elbow.* The exact pathophysiology of epicondylitis is unknown. Current theories attribute inflammation of the tendon to microvascular trauma. Tears, bleeding, and edema are thought to cause avascularization and calcification of the tendon. Manifestations of epicondylitis include point tenderness, pain radiating down the dorsal surface of the forearm, and a history of repetitive use.

INTERDISCIPLINARY CARE

Medical management of repetitive use disorders focuses on relieving pain and increasing mobility. Once the diagnosis is made, treatment can range from conservative measures, such as rest and pharmacologic agents, to aggressive measures such as surgery.

Diagnosis

Carpal tunnel syndrome is diagnosed by the client's history and physical examination. The history may reveal an occupation that involves areas such as computer work, jackhammer operation, mechanical work, or gymnastics. History of a radial bone fracture or rheumatoid arthritis also increases the risk of carpal tunnel syndrome. Tests specific for carpal tunnel include the Phalen test (see Chapter 40). Bursitis and epicondylitis are diagnosed by history and physical examination.

Medications

The client with a repetitive use injury usually receives NSAIDs. Narcotics also may be administered for acute flare-ups and severe pain. For the client who has epicondylitis or carpal tunnel syndrome, corticosteroids may be injected into the joint.

Treatments

Treatment of repetitive use injuries is performed first by conservative management, followed, if necessary, by surgery.

CONSERVATIVE MANAGEMENT The first steps in the care of all repetitive use injuries are to immobilize and rest the involved joint. The joint may be splinted, and ice may be applied (as described in Table 41–1) in the first 24 to 48 hours to decrease pain and inflammation. Ice application may be followed by heat application every 4 hours.

SURGERY Surgery is usually reserved for the client who does not obtain relief with conservative treatment. Surgery for carpal tunnel syndrome includes resection of the carpal ligament to enlarge the tunnel. In epicondylitis and bursitis, calcified deposits may be removed from the area surrounding the tendon or bursa.

NURSING CARE

The nursing care of a client with a repetitive use injury focuses on relieving pain, teaching about the disease process and treatment, and improving physical mobility.

Nursing Diagnoses and Interventions

Acute Pain

Swelling and nerve inflammation cause pain in the client with a repetitive use injury.

- Ask the client to rate the pain on a scale of 0 to 10 (with 10 being the most severe pain) before and after any intervention. *This facilitates objective assessment of the effectiveness of the chosen pain relief strategy.*
- Encourage the use of immobilizers. *Splinting maintains joint alignment and prevents pain due to movement of inflamed tissues.*
- Teach the client to apply ice and/or heat as prescribed. *Ice causes vasoconstriction and decreases the pooling of blood in the inflamed area. Ice may also numb the tender area. Heat decreases swelling by increasing venous return.*
- Encourage use of NSAIDs as prescribed. *NSAIDs decrease swelling by inhibiting prostaglandins.*
- Explain why treatment should not be abruptly discontinued. *Abrupt discontinuation of treatment may cause reinflammation of the injured area.*

Impaired Physical Mobility

Joint pain and swelling can impair mobility.

- Suggest interventions to alleviate pain (such as using an immobilizer and taking pain medications). *If the joint is pain free, the client will be more likely to take an active role in therapy.*
- Refer to a physical therapist for exercises. *The physical therapist can assist the client with exercise to prevent joint stiffness.*
- Suggest consultation with an occupational therapist. *Occupational therapy can help the client learn new ways to perform tasks to prevent recurring symptoms.*

Community-Based Care

Address the following topics for home care:

- Causes of and treatments for repetitive use injury.
- Rehabilitation to allow the client to return to a state of independence.
- Ways to avoid unnecessary exposure to the activities that increase risk of redeveloping the injury. Suggest evaluation of the client's work environment by an environmental risk manager who can prescribe measures to reduce the risk of repetitive use injuries. Wrist supports or an ergonomic keyboard may be useful for the client who uses a computer extensively. Appropriate desk and chair height also are important in maintaining the correct anatomic position while working.
- Information about sources for braces or other assistive devices.

EXPLORE MEDIALINK

Prentice Hall Nursing MediaLink DVD-ROM

Audio Glossary
NCLEX-RN® Review

Animation/Video

Bone Healing
Crutch Instruction

COMPANION WEBSITE www.prenhall.com/lemone

Audio Glossary
NCLEX-RN® Review
Care Plan Activity: Below-the-Knee Amputation
Case Study: A Client with Fractures
MediaLink Applications
Compartment Syndrome
Preventing Musculoskeletal Injuries
Links to Resources

CHAPTER HIGHLIGHTS

- The most commonly reported musculoskeletal injuries are contusions, strains, and sprains. Immediate treatment includes RICE (rest, ice, compression, elevation) therapy.
- Dislocations may be congenital, traumatic, or pathologic. Nursing assessments include monitoring neurovascular status by assessing for increased pain, decreased or absent pulses, pale skin, inability to move a body part or extremity, and changes in sensation.
- Any of the 206 bones of the body may sustain a fracture. Fractures are closed or simple (skin is intact) or open or compound (skin integrity is interrupted); open fractures are at risk for infection. Other fracture descriptors include oblique or spiral, avulsed, comminuted, compressed, impacted, or depressed.
- Fractures heal through three phases: inflammatory, reparative, and remodeling. Healing is influenced by the age and physical condition of the client and by the type of fracture.
- Fracture complications include compartment syndrome, fat embolism syndrome, deep venous thrombosis, infection, delayed union and nonunion, and reflex sympathetic dystrophy.
- Fractures are treated with surgery, traction, and/or casts to stabilize the fractured bone, maintain bone immobilization, prevent complications, and restore function.
- Fractures of the hip are most often sustained by older adult women, and are usually the result of a fall. They are the most common injury in the older population, resulting in the greatest number of deaths and most serious health problems of all fractures for people age 65 years and older.
- Nursing care for the client with a fracture focuses on interventions for acute pain, risk for peripheral vascular dysfunction, risk for infection, impaired physical mobility, and risk for disturbed tactile sensory perception.
- An amputation is the partial or total removal of an extremity. This loss has a significant physical and psychosocial effect on the client and on the family. The most common cause for amputation of a lower extremity is peripheral vascular disease. Trauma is the most common cause for upper extremity amputation.
- Complications that may follow an amputation include infection, delayed healing, chronic stump pain, phantom pain, and

contractures. Stump care is necessary to prevent complications and to prepare the stump for a prosthesis.

- Nursing care for the client with an amputation is provided as part of the interdisciplinary team, and is focused on a return to functional health, with interventions to meet needs for acute pain, impaired skin integrity, grieving, disturbed body image, and impaired physical mobility.
- Repetitive use injuries, especially common in the workplace, include carpal tunnel syndrome, bursitis, and epicondylitis.

TEST YOURSELF NCLEX-RN® REVIEW

1 You are teaching a young adult how to provide self-care for a sprained ankle. You explain that the reason for applying ice immediately after the injury is based on the principle that ice:
   1. increases the diameter of blood vessels.
   2. decreases the diameter of blood vessels.
   3. is helpful in increasing white blood cells.
   4. lowers the blood pressure and pulse.

2 A client with a compound, open fracture has been admitted to the emergency department and is scheduled for immediate surgery. Which of the following nursing diagnoses would be most appropriate in the immediate postoperative period?
   1. *Risk for Post-Trauma Syndrome*
   2. *Impaired Transfer Ability*
   3. *Risk for Infection*
   4. *Risk for Falls*

3 While providing care to an older woman with a cast on her left lower arm (from below the elbow to above the fingers), you perform a neurovascular assessment. Which of the following assessments indicates a possible complication?
   1. slightly edematous fingers
   2. warm, pink skin above the cast
   3. pale, cold fingers
   4. pain rating of 2 on a 1 to 10 scale

4 Which of the following minerals is essential to bone healing?
   1. potassium
   2. magnesium
   3. sodium
   4. calcium

5 You are assessing a young man with a newly applied long-leg cast. He complains of extreme pain in his leg, and his toes are cyanotic and lack sensation. What is your priority intervention?
   1. Document the assessments carefully and accurately.
   2. Notify the healthcare provider who applied the cast.
   3. Elevate the leg on at least three pillows.
   4. Apply an ice bag over the painful area.

6 Your assigned client has been diagnosed with DVT of the left lower extremity. What body system would require very careful monitoring?
   1. hematologic
   2. respiratory
   3. digestive
   4. renal

7 Although nursing diagnoses are always individualized, what is one nursing diagnosis common to all musculoskeletal injuries?
   1. *Disturbed Body Image*
   2. *Acute Pain*
   3. *Chronic Pain*
   4. *Risk for Infection*

8 At what position would you place the remaining extremity following a below-the-knee amputation during the first 24 hours after surgery?
   1. elevated above the level of the heart
   2. lower than the rest of the body
   3. crossed over the intact extremity
   4. level with the rest of the body

9 The day following a below-the-knee amputation, your client tells you that he feels as though his toes are cramping in the amputated foot. What is this experience called?
   1. chronic stump pain
   2. contractures
   3. attention-seeking
   4. phantom limb pain

10 Your husband is cutting wood with a circular saw. He suddenly screams that he has cut off his finger. What would you do with the amputated finger?
   1. Don't worry about it; the important thing is to get him to the hospital.
   2. Put it in a storage bag filled with warm water.
   3. Tape it to his hand so the emergency personnel will know where it is.
   4. Wrap it in a towel, put it in a plastic bag, and lay it on ice.

See Test Yourself answers in Appendix C.

BIBLIOGRAPHY

Altizer, L. (2003a). Forearm and humeral fractures. *Orthopaedic Nursing, 22*(4), 266–273.

_____. (2003b). Hand and wrist fractures. *Orthopaedic Nursing, 22*(3), 232–239.

_____. (2004a). Casting for immobilization. *Orthopaedic Nursing, 23*(2), 1135–1141.

_____. (2004b). Compartment syndrome. *Orthopaedic Nursing, 23*(6), 391–396.

Assessment of a limb in a cast. (2003). *Nursing Times, 99*(31), 27.

Bergland, A., & Wyller, T. (2004). Risk factors for serious fall related injury in elderly women living at home. *Injury Prevention, 10*(5), 308–313.

Bongiovanni, M., Bradley, S., & Kelley, D. (2005). Orthopedic trauma: Critical care nursing issues. *Critical Care Nursing Quarterly, 28*(1), 60–71.

Brunner, L., Eshilian-Oates, L. , & Kuo, T. (2003). Hip fractures in adults. *American Family Physician, 67*(3). Retrieved from http://www.aafp.org/afp/wooeoeow/53l7.html

Burgess, B., & Sennett, B. (2003). Traumatic shoulder instability: Nonsurgical management versus surgical intervention. *Orthopaedic Nursing, 22*(5), 345–352.

Centers for Disease Control and Prevention. (2005). Bone health. Retrieved from http;//www.cdc.gov/nccdphp/dnpa/bonehealth/

Childs, S. (2003). Stimulators of bone healing: Biologic and biomechanical. *Orthopaedic Nursing, 22*(6), 421–428.

Cole, E. (2004). Assessment and management of the trauma patient. *Nursing Standard, 18*(41), 45–52, 54.

Clontz, A., Annonio, D., & Walker, L. (2004). Trauma nursing: Amputation. *RN, 67*(7), 38–44.

Davis, P. (2004). Venous thromboembolism prevention—an update. *Journal of Orthopaedic Nursing, 8*(1), 50–56.

Dochterman, J., & Bulechek, G. (2004). *Nursing interventions classification (NIC)* (4th ed.). St. Louis, MO: Mosby.

Feury, K. (2003). Injury prevention: Where are the resources? *Orthopaedic Nursing, 22*(2), 124–130.

Harris, H. (2004). Action stat. Fat embolism. *Nursing, 34*(6), 96.

Harvey, C. (2005). Wound healing. *Orthopaedic Nursing, 24*(2), 143–160.

Hip fracture. Information about a broken hip. (2004). Retrieved from http://orthopedics.about.com/cs/hipsurgery/a/brokenhip.htm

Holmes, S., & Brown, S. (2005). Skeletal pin site care. National Association of Orthopaedic Nurses guidelines for orthopaedic nursing. *Orthopaedic Nursing, 24*(2), 99–108.

Houghton, K., Peregrina, M., Gillies, D., & Herden, J. (2003). A small trial of the nursing care of patients immobilized with a Thomas splint. *Journal of Orthopaedic Nursing, 7*(4), 201–204.

Kasper, C., Talbot, L., & Gaines, J. (2002). Skeletal muscle damage and recovery. *AACN Clinical Issues: Advanced Practice in Acute and Critical Care, 13*(2), 237–241.

Kass-Wolff, J. (2004). Calcium in women: Healthy bones and much more. *Journal of Obstetrics, Gynecologic, and Neonatal Nursing, 33*(1), 21–33.

Little, D., & Alper, B. (2004). Ankle sprain. *Clinical Advisor, 7*(11), 56, 61–62.

Love, C. (2003). Carpal tunnel syndrome. *Journal of Orthopaedic Nursing, 7*(1), 33–42.

Mayo Clinic. (2006). *Dislocation; first aid.* Retrieved from http://health/first-aid-dislocation/FA0009www.mayoclinic.com

McConnel, E. (2002). Assessing neurovascular status in a casted limb. *Nursing, 32*(9), 20.

Miller, R. L. S. (2003). Reflex sympathetic dystrophy. *Orthopaedic Nursing, 22*(2), 91–101.

Moorhead, S., Johnson, M., & Maas, M. (2003). *Nursing outcomes classification (NOC)* (3rd ed.). St. Louis, Mo: Mosby.

Moss Rehab Resource Net. (2005). *Amputation fact sheet.* Retrieved from http://www.mossresourcenet.org/amputa.htm

_____. (2004). *Falls and hip fractures among older adults.* Retrieved from http://www.cdc.gov/ncipc/factsheets/falls.htm

National Center for Injury Prevention and Control. (2006). *Falls and hip fractures among older adults.* Retrieved from http://www.cdc.gov/ncipc/factsheets/falls.htm

National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2004). *Questions and answers about sprains and strains*. Retrieved from http://www.niams.nih.gov/hi/topics/strain_sprain/strain_sprain.htm

NANDA International. (2005). *Nursing diagnoses: Definitions & classification 2005–2006.* Philadelphia: Author.

Porth, C. M. (2005). *Pathophysiology: Concepts of altered health states* (7th ed.). Philadelphia: Lippincott.

Proehl, J. (2004). Emergency. Accidental amputation: A frightening injury requiring quick action. *American Journal of Nursing, 104*(2), 50–53.

Reed, D. (2004). Understanding and meeting the needs of farmers with amputations. *Orthopaedic Nursing, 23*(6), 397–405.

Ruddick, S., & Scollen, C. (2003). Fracture prevention in the frail elderly. *Practice Nurse, 14*(8), 361–366.

Shannon, M., Wilson, B., & Stang, C. (2005). *Nurse's drug guide 2005.* Upper Saddle River, NJ: Prentice Hall.

Siddle, L. (2004). The challenge and management of phantom limb pain after amputation. *British Journal of Nursing, 13*(11), 664–667.

Taggart, H., Mincer, A., & Thompson, A. (2004). Caring for the orthopaedic patient who is obese. *Orthopaedic Nursing, 23*(3), 204–210.

Tierney, L., McPhee, S., & Papadakis, M. (Eds.). (2004). *Current medical diagnosis & treatment* (43rd ed.). Stamford, CT: Appleton & Lange.

Vestergaard, P., Emborg, C., Stoving, R., Hagen, C., Mosekilde, L., & Briken, K. (2003). Patients with eating disorders: A high-risk group for fractures. *Orthopaedic Nursing, 22*(5), 325–331.

Walls, M. (2002). Orthopedic trauma. *RN, 65*(7), 53–56.

Wilkinson, J. (2005). *Prentice Hall nursing diagnosis handbook with NIC interventions and NOC outcomes* (8th ed.). Upper Saddle River, NJ: Prentice Hall.

Wilson, B., Shannon, M., & Stang, C. (2005). *Prentice Hall nurse's drug guide 2005.* Upper Saddle River, NJ: Prentice Hall.

Young, T. (2004). The healing of amputation wounds. *Nursing Standard, 18*(45), 74, 76, 78.