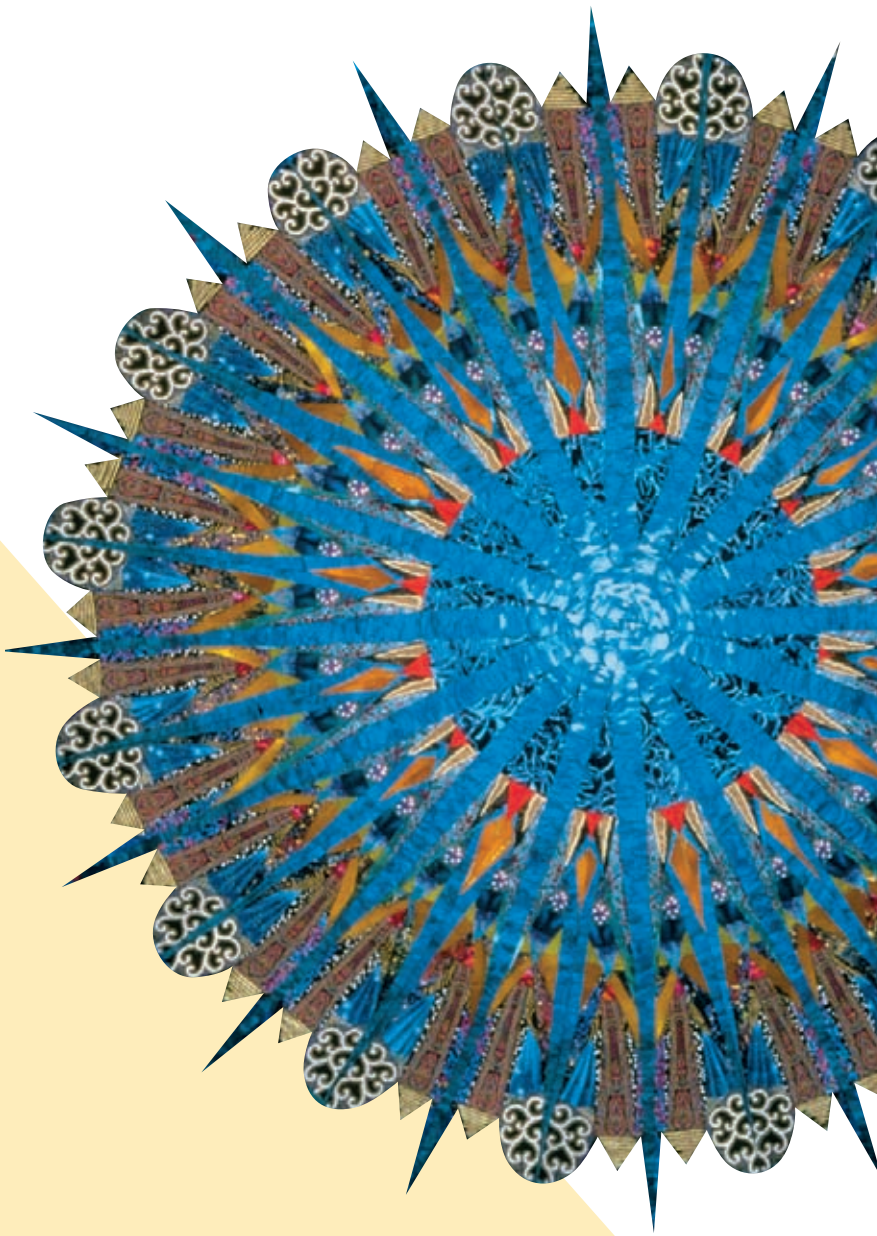
UNIT 12 Responses to Altered Musculoskeletal Function



CHAPTER 40
Assessing Clients with Musculoskeletal Disorders

CHAPTER 41
Nursing Care of Clients with Musculoskeletal Trauma

CHAPTER 42
Nursing Care of Clients with Musculoskeletal Disorders

CHAPTER 40 Assessing Clients with Musculoskeletal Disorders

LEARNING OUTCOMES

- Describe the anatomy, physiology, and functions of the musculoskeletal system.
- Explain the normal movements allowed by synovial joints.
- Identify specific topics for consideration during a health history interview of the client with health problems involving the musculoskeletal system.
- Describe normal variations in assessment findings for the older adult.
- Identify manifestations of impairment of the musculoskeletal system.

CLINICAL COMPETENCIES

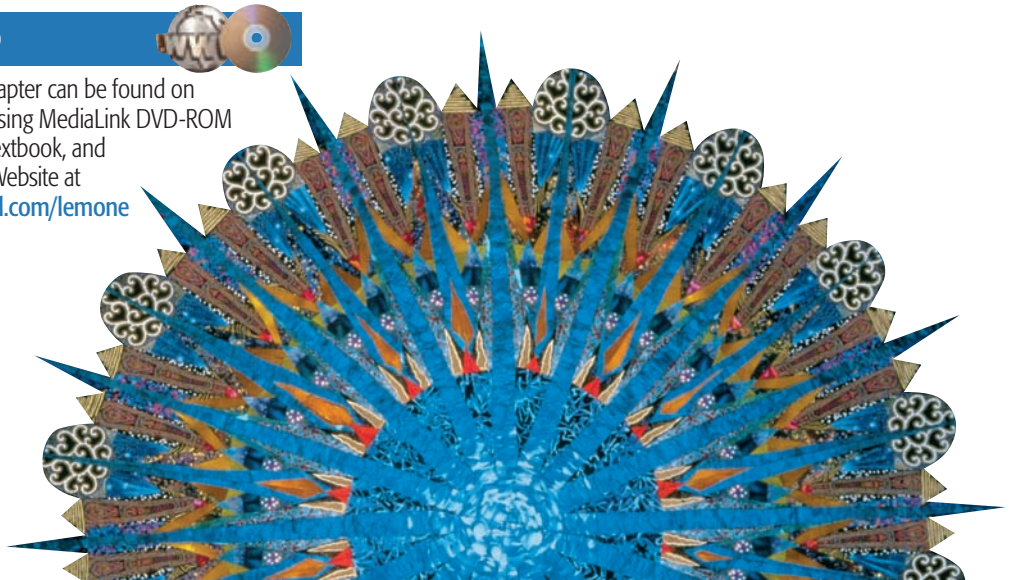
- Conduct and document a health history for clients having or at risk for alterations in the musculoskeletal system.
- Conduct and document a physical assessment of musculoskeletal structures and functions.
- Monitor the results of diagnostic tests and report abnormal findings.

EQUIPMENT NEEDED

- Tape measure
- Goniometer

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

bursitis, *1394*
crepitation, *1392*
hematopoiesis, *1380*
kyphosis, *1391*
lordosis, *1391*
ossification, *1381*
scoliosis, *1391*
synovitis, *1394*
tendonitis, *1394*

The tissues and structures of the musculoskeletal system perform many functions, including support, protection, and movement. The musculoskeletal system has two subsystems: the bones and joints of the skeleton, and the skeletal muscles. These subsystems work together to allow the body to perform both gross, simple movements such as closing a door, and fine, complex movements such as repairing a watch.

ANATOMY, PHYSIOLOGY, AND FUNCTIONS OF THE MUSCULOSKELETAL SYSTEM

The musculoskletal system is composed of bones of the skeletal system; ligaments, tendons, and muscles of the muscular system; and joints. The bones serve as the framework for the body and for the attachment of muscles, tendons, and ligaments. Innervated by the nervous system, contraction and relaxation of muscles permit movement at joints.

The Skeleton

Bones form the body's structure and provide support for soft tissues. They also protect vital organs from injury and serve to move body parts by providing points of attachment for muscles. Bones also store minerals and serve as a site for **hematopoiesis** (blood cell formation).

The human skeleton is made up of 206 bones (Figure 40–1 ■). Bones of the skeletal system are divided into the axial skeleton and the appendicular skeleton. The axial skeleton includes the bones of the skull, the ribs and sternum, and the vertebral column. The appendicular skeleton consists of all the bones of the limbs, the shoulder girdles, and the pelvic girdle.

Bone Structure

Bone cells include osteoblasts (cells that form bone), osteocytes (cells that maintain bone matrix), and osteoclasts (cells that resorb bone). Bone matrix is the extracellular element of bone tissue; it consists of collagen fibers, minerals (primarily calcium and phosphate), proteins, carbohydrates, and ground substance. Ground substance is a gelatinous material that facilitates diffusion of nutrients, wastes, and gases between the blood vessels and bone tissue. Bones are covered with periosteum, a double-layered connective tissue. The outer layer of the periosteum contains blood vessels and nerves; the inner layer is anchored to the bone.

Bones consist of a rigid connective tissue called osseous tissue, of which there are two types: Compact bone is smooth and dense; spongy bone contains spaces between meshworks of bone. Both types contain the same elements and are found in almost all bones of the body.

The basic structural unit of compact bone is the Haversian system (also called an osteon). The Haversian system consists of a central canal, called the Haversian canal; concentric layers of bone matrix, called lamellae; spaces between the lamellae, called lacunae; osteocytes within the lacunae; and small channels, called canaliculi (Figure 40–2 ■).

Spongy bone has no Haversian systems. Instead, the lamellae are arranged in concentric layers called trabeculae that branch and join to form meshworks. The spongy sections of long bones and flat bones contain tissue for hematopoiesis. In the adult, these sections, called red marrow cavities, are present in the spongy center of flat bones (especially the sternum) and in only two long bones: the humerus and the head of the femur. This red marrow is active in hematopoiesis in adults.

Bone Shapes

Bones are classified by shape (Figure 40–3 ■):

- *Long bones* are longer than they are wide. They have a midportion, or shaft, called a diaphysis and two broad ends, called epiphyses (Figure 40–4 ■). The diaphysis is compact bone and contains the marrow cavity, which is lined with endosteum. Each epiphysis is spongy bone covered by a thin layer of compact bone. Long bones include the bones of the arms, legs, fingers, and toes.
- *Short bones*, also called cuboid bones, are spongy bone covered by compact bone. They include the bones of the wrist and ankle.
- *Flat bones* are thin and flat, and most are curved. Their disklike structure consists of a layer of spongy bone between two thin layers of compact bone. Flat bones include most bones of the skull, the sternum, and the ribs.
- *Irregular bones* are of various shapes and sizes and, like flat bones, are plates of compact bone with spongy bone between. Irregular bones include the vertebrae, the scapulae, and the bones of the pelvic girdle.

Bone Remodeling in Adults

Although the bones of adults do not normally increase in length and size, constant remodeling of bones, as well as repair of damaged bone tissue, occurs throughout life. In the bone remodeling process, bone resorption and bone deposit occur at all periosteal and endosteal surfaces. Hormones and forces that

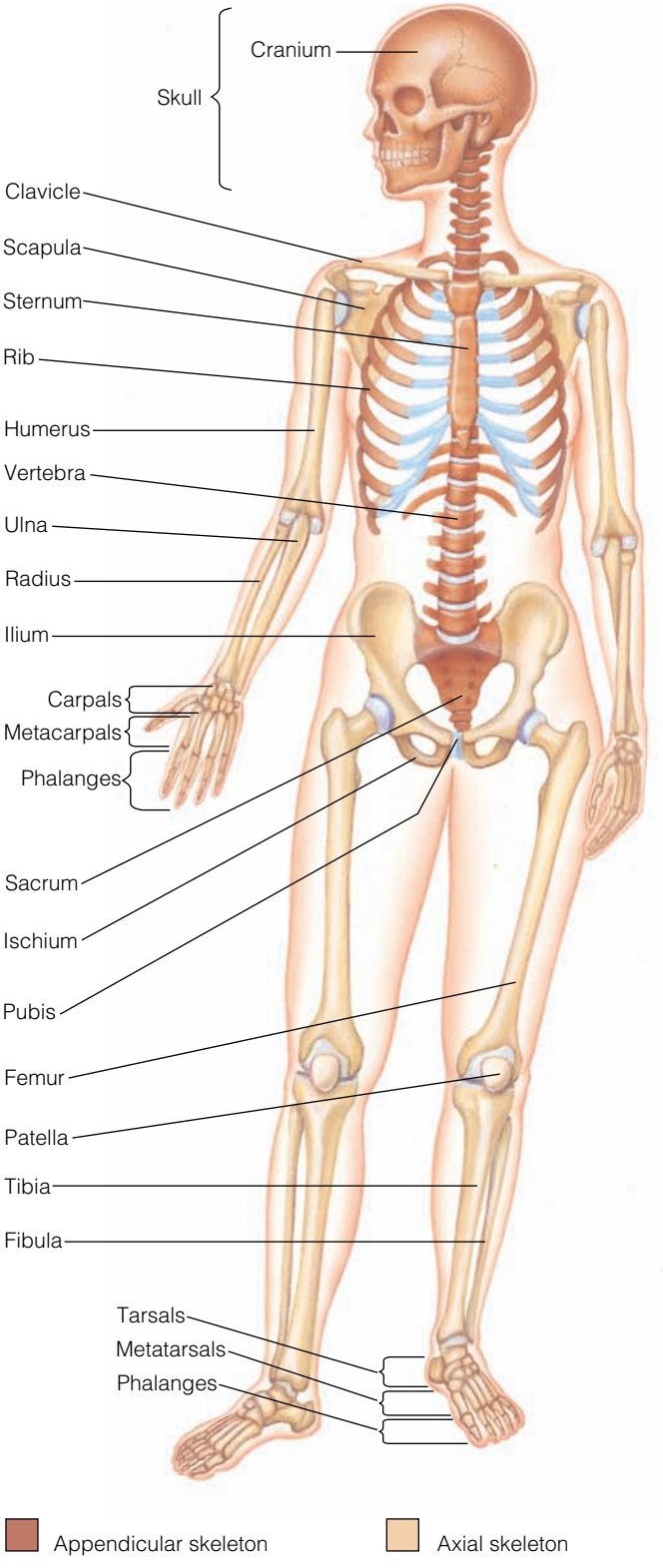


Figure 40–1 ■ Bones of the human skeleton.

put stress on the bones regulate this process, which involves a combined action of the osteocytes, osteoclasts, and osteoblasts. Bones that are in use, and are therefore subjected to stress, increase their osteoblastic activity to increase **ossification** (the development of bone). Bones that are inactive undergo increased osteoclast activity and bone resorption.

The hormonal stimulus for bone remodeling is controlled by a negative feedback mechanism that regulates blood calcium levels. This stimulus involves the interaction of parathyroid hormone (PTH) from the parathyroid glands and calcitonin from the thyroid gland. When blood levels of calcium decrease, PTH is released; PTH then stimulates osteoclast activity and bone resorption so that calcium is released from the bone matrix. As a result, blood levels of calcium rise, and the stimulus for PTH release ends. Rising blood calcium levels stimulate the secretion of calcitonin, inhibit bone resorption, and cause the deposit of calcium salts in the bone matrix. Thus, bones are necessary to regulate blood calcium levels. Calcium ions are necessary for the transmission of nerve impulses, the release of neurotransmitters, muscle contraction, blood clotting, glandular secretion, and cell division. Of the body's 1200 to 1400 g of calcium, over 99% is present as bone minerals.

Bone remodeling is also regulated by the response of bones to gravitational pull and to mechanical stress from the pull of muscles. Although the exact mechanism is not fully understood, it is known that bones that undergo increased stress are heavier and larger. This finding supports Wolff's law, which states that bone develops and remodels itself to resist the stresses placed on it.

The process of bone repair following a fracture is discussed in Chapter 41.

Muscles

The three types of muscle tissue in the body are skeletal muscle, smooth muscle, and cardiac muscle (Table 40–1). This discussion focuses on skeletal muscle, the only muscle that allows musculoskeletal function. Skeletal muscles attach to and cover the bones of the skeleton. Skeletal muscles promote body movement, help maintain posture, and produce body heat. They may be moved by conscious, voluntary control or by reflex activity. The body has approximately 600 skeletal muscles (Figure 40–5 ■).

Skeletal muscles are thick bundles of parallel multinucleated contractile cells called fibers. Each single muscle fiber is itself a bundle of smaller structures called myofibrils. The myofibrils have alternating light and dark bands that give skeletal muscle its striated (striped) appearance under an electron microscope. Myofibrils are strands of smaller repeating units called sarcomeres, which consist of thick filaments of myosin and thin filaments of actin, proteins that contribute to muscle contraction.

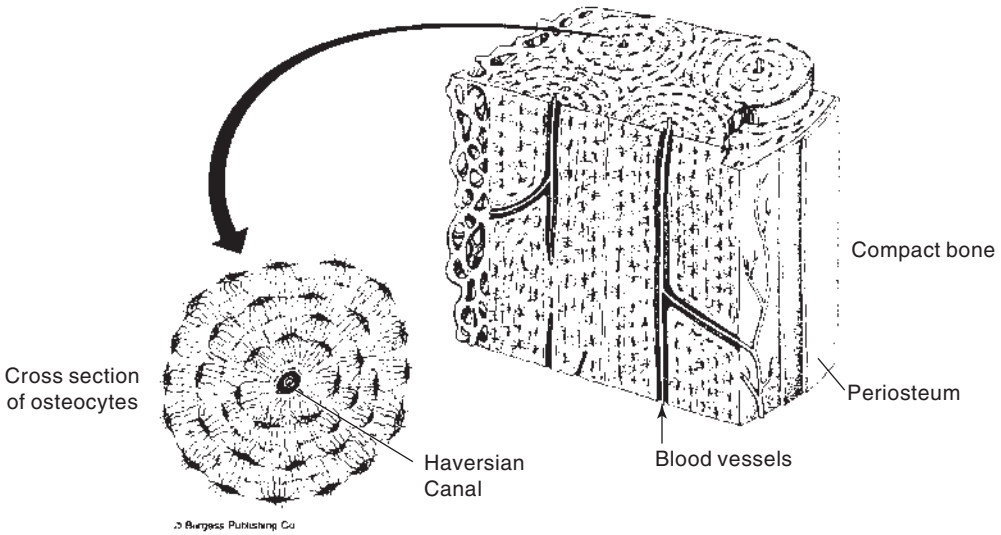


Figure 40–2 ■ The microscopic structure (Haversian system) of compact bone.

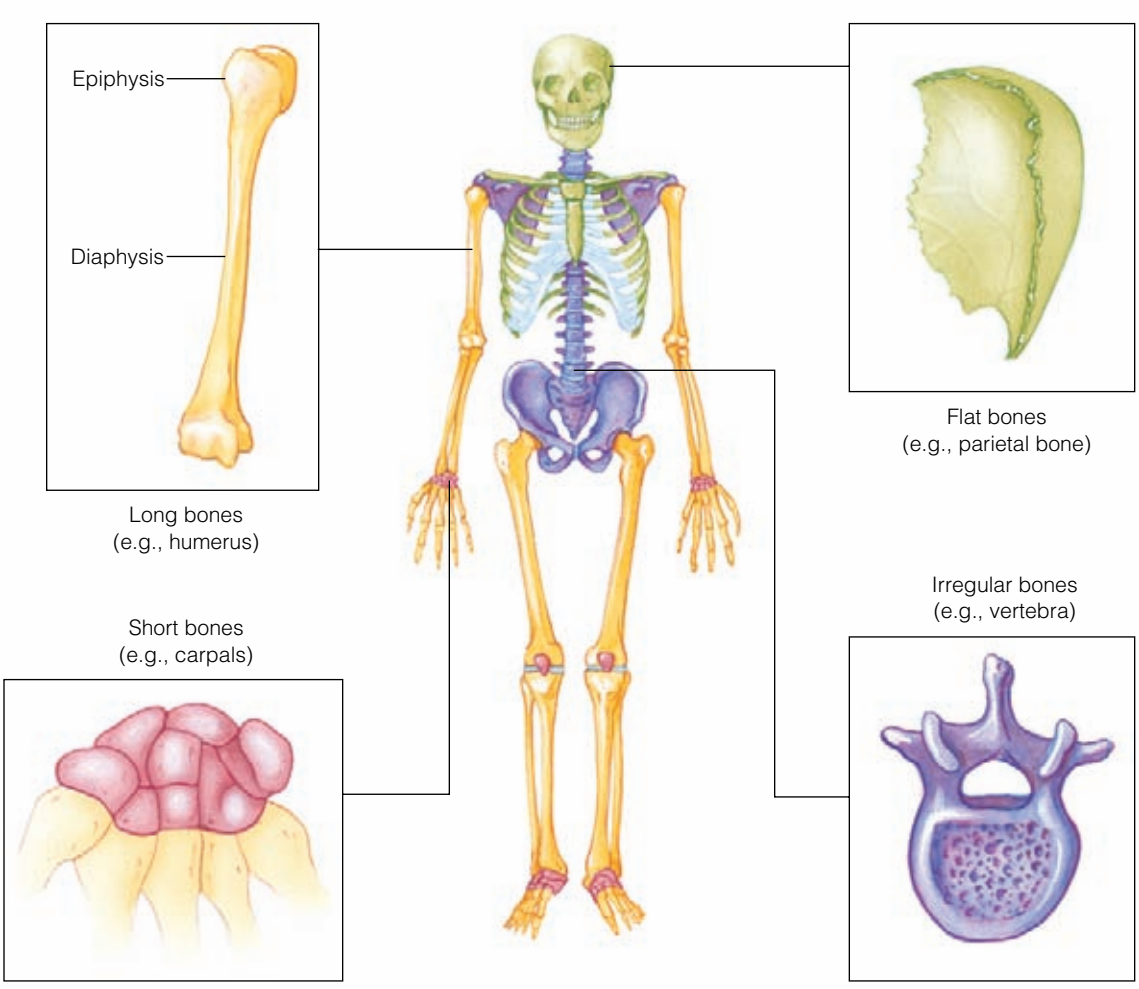


Figure 40–3 ■ Classification of bones according to shape.

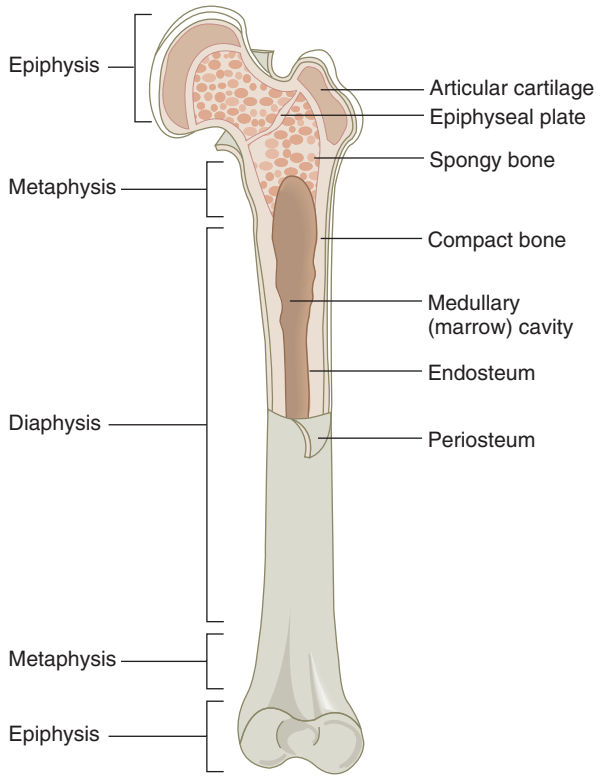


Figure 40–4 ■ Parts of a long bone.

Skeletal muscle cells have typical functional properties:

- *Excitability:* the ability to receive and respond to a stimulus. The stimulus is usually a neurotransmitter released by a neuron, and the response is the generation and transmission of an action potential along the plasma membrane of the muscle cell. (Chapter 41 ∞ discusses action potentials.)
- *Contractibility:* the ability to respond to a stimulus by forcibly shortening.
- *Extensibility:* the ability to respond to a stimulus by extending and relaxing; muscle fibers shorten when they contract and extend when they relax.
- *Elasticity:* the ability to resume its resting length after it has shortened or lengthened.

Skeletal muscle movement is triggered when motor neurons release acetylcholine, a neurotransmitter that crosses the neuromuscular junction and alters the permeability of the muscle fiber. Sodium ions enter the fiber, producing an action potential that causes muscle contraction. The more fibers that contract, the stronger the contraction of the entire muscle.

Prolonged strenuous activity causes continuous nerve impulses and eventually results in a buildup of lactic acid and reduced energy in the muscle, or muscle fatigue. However, continuous nerve impulses are also responsible for maintaining muscle tone. Lack of use results in muscle atrophy, whereas regular exercise increases the size and strength of muscles.

TABLE 40–1 **Types of Body Muscle**

TYPE	DESCRIPTION	EXAMPLES
Skeletal	Striated, voluntary muscle (can consciously move)	Biceps, triceps, deltoid, gluteus maximus
Smooth	Nonstriated, involuntary muscle (cannot consciously move)	Muscles in the walls of the bladder, stomach, and bronchi
Cardiac	Striated, involuntary muscle	Heart muscle

Joints, Ligaments, and Tendons

Joints, or articulations, are regions where two or more bones meet. Joints hold the bones of the skeleton together while allowing the body to move. Joints may be classified by function as synarthroses, amphiarthroses, or diarthroses. Table 40–2 describes each of these types. Joints are also classified by structure as fibrous, cartilaginous, or synovial.

Fibrous Joints

Fibrous joints permit little or no movement, because the articulating bones are joined either by short connective tissue fibers that bind the bones together, as with the sutures of the skull, or by short cords of fibrous tissue called ligaments, which permit slight give but no true movement.

Cartilaginous Joints

Some cartilaginous joints, such as the sternocostal joints of the rib cage, are composed of hyaline cartilage growths that fuse together the articulating bone ends. These joints are immobile. In other cartilaginous joints, such as the intervertebral disks, the hyaline cartilage fuses to an intervening plate of flexible fibrocartilage. This structural feature accounts for the flexibility of the vertebral column.

Synovial Joints

Bones in synovial joints are enclosed by a cavity that is filled with synovial fluid, a filtrate of blood plasma (Figure 40–6 ■). Synovial joints are freely movable, allowing many kinds of movements, as listed and described in Table 40–3. Synovial

MEDIALINK Joint Movement

TABLE 40–2 **Functional Classification of Joints**

TYPE	DESCRIPTION	EXAMPLES
Synarthrosis	Immovable joint	Skull sutures Epiphyseal plates Joint between first rib and manubrium of sternum
Amphiarthrosis	Slightly movable joint	Vertebral joints Joint of the public symphysis
Diarthrosis	Freely movable joint	Joints of the limbs Shoulder joints Hip joints

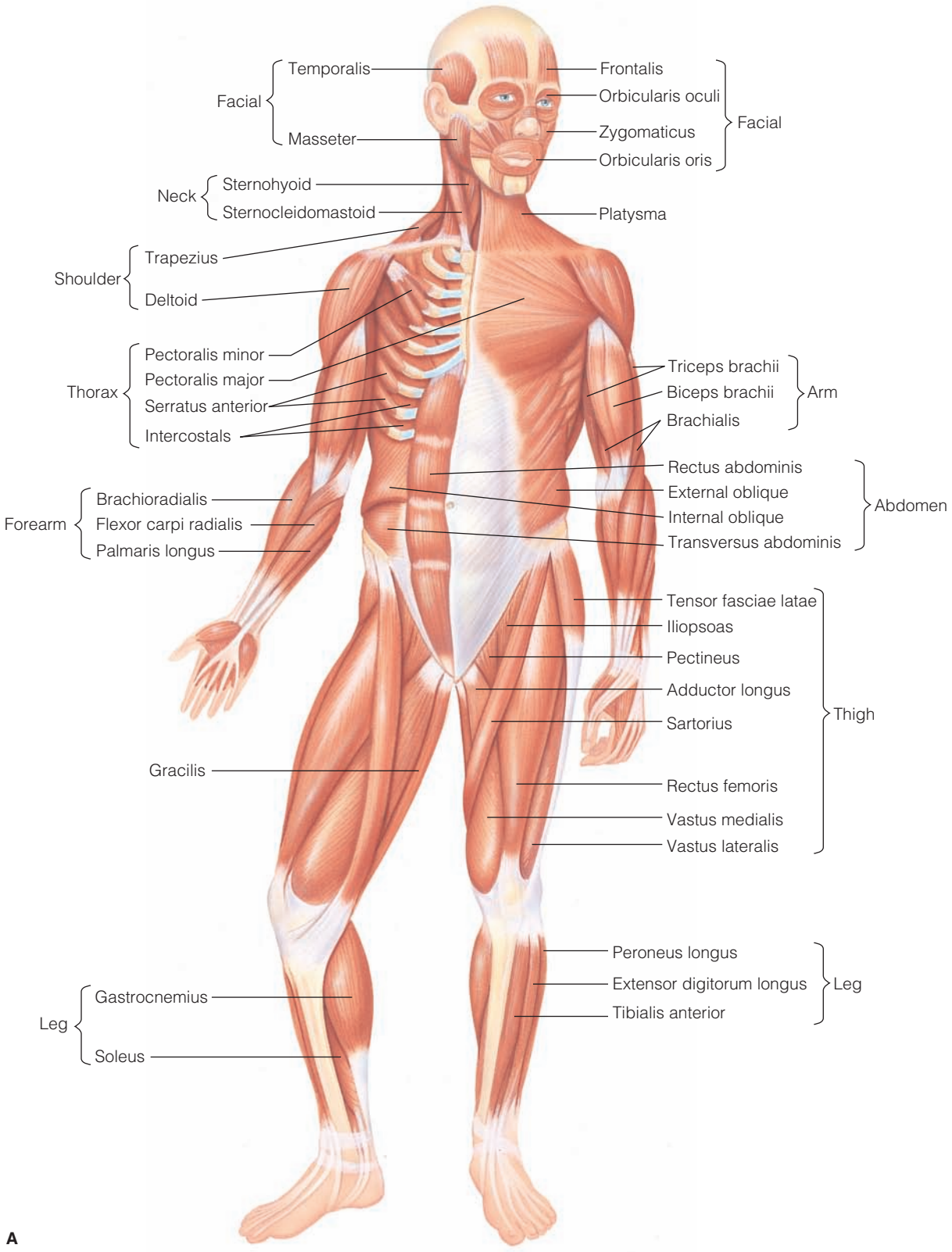


Figure 40–5 ■ *A,* Muscles of the anterior body. *B,* Muscles of the posterior body.

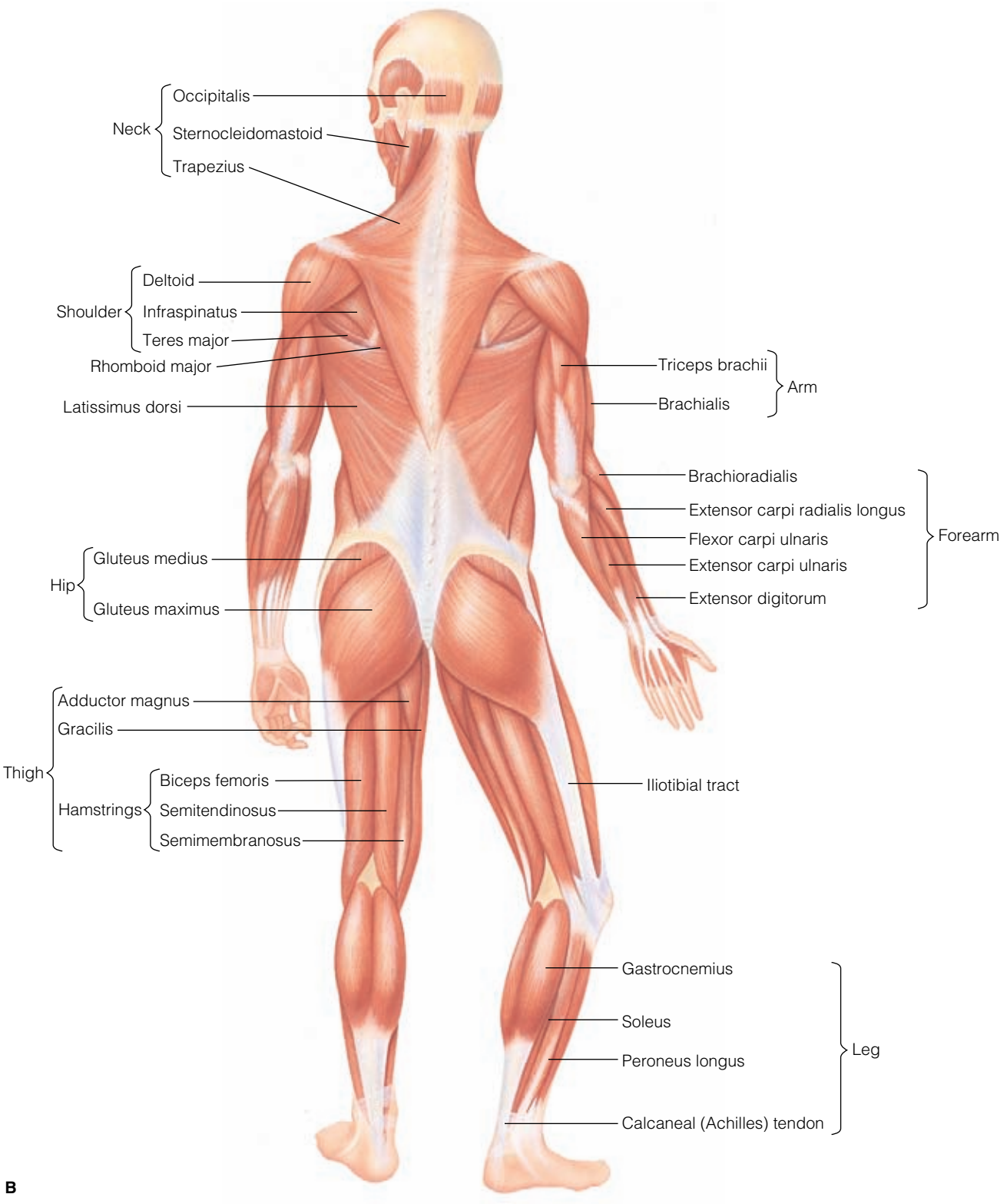


Figure 40–5 ■ Continued

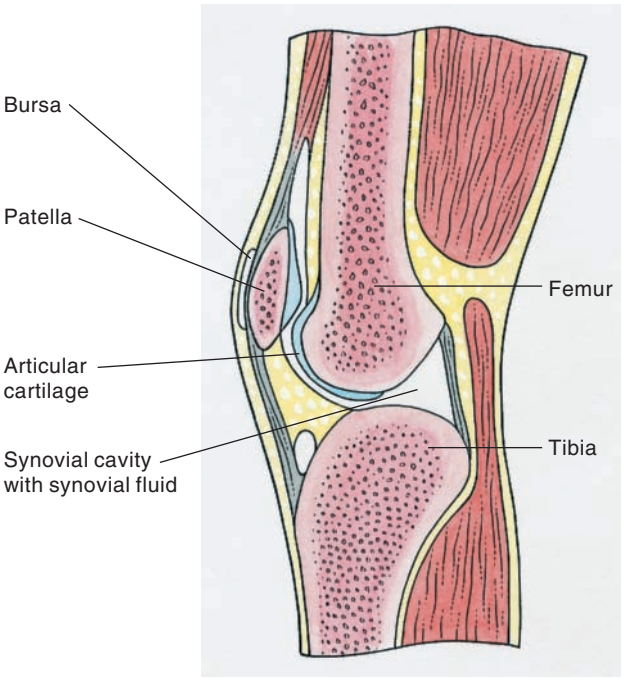


Figure 40–6 ■ Structure of a synovial joint (knee).

joints are found at all articulations of the limbs. They have several characteristics:

- The articular surfaces are covered with articular cartilage.
- The joint cavity is enclosed by a tough, fibrous, double-layered articular capsule; internally, the cavity is lined with a synovial membrane that covers all surfaces not covered by the articular cartilage.
- Synovial fluid fills the free spaces of the joint capsule, enhancing the smooth movement of the articulating bones.

Bursae are small sacs of synovial fluid that cushion and protect bony areas that are at high risk for friction, such as the knee and the shoulder. Tendon sheaths are a form of bursae, but they are wrapped around tendons in high-friction areas.

The fibrous capsules that surround synovial joints are supported by ligaments, dense bands of connective tissue that connect bones to bones. Ligaments limit or enhance movement, provide joint stability, and enhance joint strength. Tendons are fibrous connective tissue bands that connect muscles to the periosteum of bones and enable the bones to move when skeletal muscles contract. When muscles contract, increased pressure causes the tendon to pull, push, or rotate the bone to which it is connected.

TABLE 40–3 Movements Allowed by Synovial Joints

MOVEMENT	DESCRIPTION
Abduction	Move limb away from body midline
Adduction	Move limb toward body midline
Extension	Straighten limbs at joint
Flexion	Bend limbs at joint
Dorsiflexion	Bend ankle to bring top of foot toward shin
Plantar flexion	Straighten ankle to point toes down
Pronation	Turn forearm to place palm down
Supination	Turn forearm to place palm up
Eversion	Turn out
Inversion	Turn in
Circumduction	Move in circle
Internal rotation	Move inward on a central axis
External rotation	Move outward on a central axis
Protraction	Move forward and parallel to ground
Retraction	Move backward and parallel to ground

ASSESSING MUSCULOSKELETAL FUNCTION

Structures and functions of the musculoskeletal system are assessed by findings from diagnostic tests, a health assessment interview to collect subjective data, and a physical assessment to collect objective data. Sample documentation of an assessment of the musculoskeletal system is given in the accompanying box.

Diagnostic Tests

The results of diagnostic tests of musculoskeletal structure and function are used to support the diagnosis of a specific injury or disease, to provide information to identify or modify the appropriate medications or therapy used to treat the disease, and to help nurses monitor the client's responses to treatment and nursing care interventions. Diagnostic tests to assess the structures and functions of the musculoskeletal system are described in the table on the next page and summarized in the bulleted list that follows. More information is included in the discussion of specific injuries or diseases in Chapter 41 and 42 ∞.

- Blood tests are used to monitor levels of alkaline phosphatase, calcium, uric acid, and creatine kinase, commonly increased in bone and joint diseases and muscle trauma (Table 40–4).
- Radiologic examinations, including x-rays, CT scans, MRIs, and bone scans, are done to identify and evaluate bone density and structure in conditions such as arthritis, interverte-

SAMPLE DOCUMENTATION

Assessment of the Musculoskeletal System

58-year-old Hispanic male, employed as a roofer, comes to the orthopedic clinic for evaluation of chronic knee pain. Client states "The pain in my knees is worse when I get up in the morning and when I carry something heavy at work." Posture erect, gait even without obvious limp. Bones of lower extremities appear equal in size and shape bilaterally. No swelling noted, bulge test negative for fluid around knee. Crepitus heard in both knees during flexion and extension. ROM in both knees slightly decreased. No obvious decrease in muscle mass. Client states knee pain during ROM is a 3 on a 1 to 10 scale. Referred to clinic physician for further evaluation, including x-rays of both knees.

DIAGNOSTIC TESTS of the Musculoskeletal System

NAME OF TEST Blood chemistry

PURPOSE AND DESCRIPTION See Table 40–4

RELATED NURSING CARE No special preparation is needed.

NAME OF TEST X-ray

PURPOSE AND DESCRIPTION X-rays are done to identify and evaluate bone density and structure. Injection of contrast medium with an accompanying x-ray may be done to visualize joint structures, intervertebral disks, and wounds deep in muscle.

RELATED NURSING CARE No special preparation needed for standard x-rays. If contrast medium is used, assess for allergy to shellfish, iodine, or contrast medium used in previous tests. If allergy is present, test will not be performed.

NAME OF TEST Computed tomography (CT) scan

PURPOSE AND DESCRIPTION Provides a three-dimensional picture used to evaluate musculoskeletal trauma and bony abnormalities.

RELATED NURSING CARE No special preparation is needed.

NAME OF TEST Magnetic resonance imaging (MRI)

PURPOSE AND DESCRIPTION Used in diagnosis and evaluation of avascular necrosis, osteomyelitis, tumors, disk abnormalities, and tears in ligament or cartilage. Uses radio waves and magnetic fields; gadolinium may be injected to increase visualization of bony or muscular structures.

RELATED NURSING CARE Assess for metallic implants or metal on clothing (metallic implants, such as clips on aneurysms, pacemakers, or shrapnel, will prohibit having an MRI).

NAME OF TEST Bone scan

PURPOSE AND DESCRIPTION Degree of uptake of a radioisotope (based on blood supply to bone) is measured with a Geiger counter and recorded on paper. Uptake is increased in osteomyelitis, osteoporosis, cancers of the bone, and in some fractures. Uptake is decreased in avascular necrosis.

RELATED NURSING CARE No special preparation is needed; tell client to increase oral fluids after the test to aid in excretion of the radioisotope.

NAME OF TEST Bone density (BD)

- Dual energy x-ray absorptiometry (DEXA)
- Quantitative ultrasound (QUS)
- Bone mineral density (BMD)
- Bone absorptiometry

PURPOSE AND DESCRIPTION Bone density examinations are done to evaluate bone mineral density and to evaluate degree of osteoporosis. DEXA can calculate the size and thickness of bone. Osteoporosis is diagnosed if the peak bone mass level is below >2.5 standard deviations.

Normal Value: 1 standard deviation below peak bone mass.

RELATED NURSING CARE No special preparation is needed. Assess for previous fractures, which may increase bone density.

NAME OF TEST Arthroscopy

PURPOSE AND DESCRIPTION An endoscopic examination of the interior surfaces of a joint, used to perform surgery and diagnose diseases of the patella, meniscus, and synovial and extrasynovial membranes. In addition, fluid may be drained from the joint and tissue removed for biopsy. A fiber-optic endoscope is inserted into the joint, either with local anesthesia or general anesthesia.

RELATED NURSING CARE If general anesthesia is used, client is NPO after midnight. Following the procedure, assess for bleeding and swelling, apply ice to the area if prescribed, and teach client to avoid excessive use of the joint for 2 to 3 days.

NAME OF TEST Arthrocentesis

PURPOSE AND DESCRIPTION Done to obtain synovial fluid from a joint for diagnosis (such as infections) or to remove excess fluid. A needle is inserted through the joint capsule and fluid is aspirated.

RELATED NURSING CARE
No special preparation is needed. Apply compression dressing and assess for bleeding and leakage of fluid following the procedure.

(continued)

DIAGNOSTIC TESTS of the Musculoskeletal System (continued)

NAME OF TEST Electromyogram (EMG)

PURPOSE AND DESCRIPTION Measures the electrical activity of skeletal muscles at rest and during contraction; useful in diagnosing neuromuscular diseases. Needle electrodes are inserted into skeletal muscle (as on the legs) and electrical activity can be heard, viewed on an oscilloscope, and recorded on graph paper. Normally, there is no electrical activity at rest.

RELATED NURSING CARE Tell client not to drink fluids containing caffeine or to smoke for 3 hours before the test, and not to take medications such as muscle relaxants, anticholinergics, or cholinergics.

NAME OF TEST Somatosensory evoked potential (SSEP)

PURPOSE AND DESCRIPTION Measures nerve conduction along pathways to evaluate evoked potential of muscle contractions. Used to identify dysfunction of lower motor neurons as well as muscle disease. Transcutaneous or percutaneous electrodes are applied to the skin and provide recordings.

RELATED NURSING CARE No special preparation is needed.

bral disk disease, musculoskeletal trauma, muscle tears, osteomyelitis, and bone tumors.

- Bone density examinations (dual energy x-ray absorptiomentry [DEXA], quantitative ultrasound [QUS], and bone mineral density [BMD]) are done to evaluate bone mineral density and evaluate the degree of osteoporosis.
- An arthroscopy uses a fiber-optic endoscope to examine the joint interior, to diagnose diseases, and to perform surgery. An arthrocentesis is done to withdraw fluid from a joint by needle aspiration.
- Both electromyogram (EMG) and somatosensory evoked potential (SSEP) are tests of the electrical activity of skeletal muscle.

Regardless of the type of diagnostic test, the nurse is responsible for explaining the procedure and any special preparation needed, for assessing for medication use that may affect the outcome of the tests, for supporting the client during the examination as necessary, for documenting the procedures as appropriate, and for monitoring the results of the tests.

Genetic Considerations

When conducting a health assessment interview and a physical assessment, it is important for the nurse to consider genetic influences on health of the adult. During the health assessment interview, ask about family members with health problems affecting musculoskeletal structure or function. In addition, ask about a family history of arthritis, abnormally long bones, children with muscular dystrophy, and amyotrophic lateral sclerosis (ALS). During the physical assessment, assess for any manifestations that might indicate a genetic disorder (see the box on the next page). If data are found to indicate genetic risk factors or alterations, ask about genetic testing and refer for appropriate genetic counseling and evaluation. Chapter 8 ∞ provides further information about genetics in medical-surgical nursing.

Health Assessment Interview

A health assessment interview to determine problems with musculoskeletal structure and/or function may be conducted

TABLE 40–4 **Blood Tests with Purposes Specific to the Musculoskeletal System**

NAME OF TEST	PURPOSE	NORMAL VALUE
Alkaline phosphatase (ALP)	To identify bone diseases. Increased in bone cancer, Paget's disease, healing fractures, rheumatoid arthritis, osteoporosis.	42–136 unit/L ALP[1] 20–130 unit/L ALP[2] (increases slightly with aging)
Calcium (Ca)	To monitor calcium levels and detect calcium imbalances. Decreased with lack of calcium and vitamin D intake, and malabsorption from the gastrointestinal tract. Increased in bone cancer and multiple fractures.	4.5–5.5 mEq/L or 9–11 mg/dL (serum)
Phosphorus (P), phosphate (PO_4)	To assess phosphorus levels. Increased with bone tumors and healing fractures.	1.7–2.6 mEq/L or 2.5–4.5 mg/dL
Rheumatoid factor (RF)	To diagnose rheumatoid arthritis (RA) (positive for RA at >1:80) Also increased in lupus erythematosus and scleroderma.	<1:20 titer
Uric acid	To diagnose and monitor the treatment of gout. Panic level considered >12 mg/dL.	Male: 3.5–8.0 mg/dL Female: 2.8–6.8 mg/dL
Human leukocyte antigen (HLA)	To diagnose diseases such as juvenile RA or ankylosing spondylitis.	Match or no match; no normal values
Creatine kinase (CK)	To diagnose muscle trauma or disease. Increased in muscular dystrophy and traumatic injuries (specifically, CPK-MM isoenzyme)	94%–100%

GENETIC CONSIDERATIONS
Musculoskeletal Disorders

- Myotonic dystrophy is an inherited disorder in which the muscles become weak, have a decreased ability to relax, and eventually waste away. Other parts of the body affected are mental deficiency, hair loss, and cataracts. Although rare, the disease does increase in severity with each successive generation.
- Marfan's syndrome, an autosomal dominant disorder of connective tissue, affects the bones, lungs, eyes, heart, and blood vessels. It is characterized by abnormally long extremities, and is believed to have affected Abraham Lincoln. The aspect of the disease that is most life threatening is the effect on the cardiovascular system. The average life span of a person with Marfan's syndrome is 30 to 40 years (Porth, 2005).
- Ellis-van Creveld syndrome is a rare genetic disorder characterized by a variety of physical alterations, including short-limb dwarfism, additional fingers or toes, malformed wrists, cardiac abnormalities, and partial tooth eruption.
- Duchenne muscular dystrophy, an X-linked disorder, affects primarily males. It is one of the most common muscular dystrophies, and is characterized by rapid muscle degeneration early in life.
- Amyotropic lateral sclerosis (ALS) is a neurologic disease that affects the motor neurons in the spinal cord and brain, eventually resulting in paralysis and death.
- Other musculoskeletal diseases believed to have a genetic component include rheumatoid arthritis, osteoarthritis, gout, muscular dystrophy, ankylosing spondylitis, lupus erythematosus, and scleroderma.

during a health screening, may focus on a chief complaint (such as joint pain), or may be part of a total health assessment. Health problems affecting the neurologic system may manifest as problems with musculoskeletal function and an assessment of both systems may be necessary. (See Chapter 43 ∞ for assessment of the neurologic system.) If the client has problems with musculoskeletal structure or function, analyze its onset, characteristics, course, severity, precipitating and relieving factors, and any associated symptoms, noting the timing and circumstances. For example, ask the client:

- Describe the pain you have had in your elbow. Does the pain increase with movement? Have you noticed any redness or swelling?
- Did you injure your ankle before you began to experience difficulty walking?
- Is your pain worse in the morning, or does it get worse throughout the day?

The primary manifestations of altered function of the musculoskeletal system are pain and limited mobility. Specific descriptors of the pain, its location, and its nature are important. Other significant information includes associated manifestations, such as fever, fatigue, changes in weight, rash, and/or swelling. Also collect information about the client's lifestyle: type of employment, ability to carry out activities of daily living (ADLs) and provide self-care, exercise or participation in sports, use of alcohol or drugs, and nutrition. Explore past injuries and measures to self-treat pain (such as over-the-counter [OTC] medications, prescribed medications, application of heat or cold, splinting, wrapping, or rest).

Interview questions categorized by functional health patterns are listed in the Functional Health Pattern Interview table on page 1390.

Physical Assessment

Physical assessment of the musculoskeletal system may be performed either as part of a total assessment, or alone for a client with known or suspected problems. The techniques used to assess the musculoskeletal system are inspection, palpation, and measurement of muscle mass and range of motion (ROM). The client should be comfortably dressed in clothing that lets you see the movement of all joints clearly. The client may be standing, sitting, or lying down; the sequence of the examination should be such that the client does not have frequent position changes. An assessment of the older adult, the client in pain, or the client who is weak may take extra time. Normal age-related findings for the older adult are summarized in Table 40–5.

TABLE 40–5 **Age-Related Changes in the Musculoskeletal System**

AGE-RELATED CHANGE	SIGNIFICANCE
Bones and Joints:	
■ ↓ bone mass and minerals. ■ ↓ calcium reabsorption, a slow resorption of the interior of long bones, and slower production of new bone on the outside surface of bones. ■ Vertebrae shorten and intervertebral disks thin, and kyphosis often occurs. ■ Cartilage on bone surfaces in joints deteriorates and bone spurs may occur.	Decreased bone mass as well as decreased calcium absorption contributes to bones that are often thinner and weaker, with an increased risk of fractures with trauma. As the spinal column shortens, height decreases. Loss of joint cartilage and formation of bone spurs makes movement more painful and may even limit mobility.
Muscles	
■ Muscle fibers atrophy and fibrous tissue slowly replaces muscle tissue. ■ ↓ muscle mass and strength. ■ ↓ muscle movements, especially in the arms and legs. ■ Range of motion decreases. ■ Tendons shrink and harden. ■ Muscle cramping is common.	Regular exercise is very important in decreasing the loss associated with aging in terms of maintaining muscle mass, strength, and agility.

FUNCTIONAL HEALTH PATTERN INTERVIEW — Musculoskeletal System

Functional Health Pattern	Interview Questions and Leading Statements
Health Perception-Health Management	■ Have you ever had any muscle or bone diseases or injuries? If so, describe them. ■ Describe any surgery, physical therapy, heat, or other treatments you have received for problems with your muscles or bones. ■ List any medications, such as muscle relaxants or prescribed or over-the-counter (OTC) medications and ointments you use for musculoskeletal problems. ■ Do you take any herbal or nutritional supplements for musculoskeletal problems? If so, what and how often?
Nutritional-Metabolic	■ Describe your dietary intake in a typical 24-hour period. Does your diet include milk, cheese, cottage cheese, and vegetables? If so, how often? ■ Do you take vitamins and/or additional calcium supplements? If so, what type and how often? ■ Have you had a recent weight gain or loss? What do you see as your ideal weight? ■ Have you had any redness or swelling in your joints?
Elimination	■ Does your musculoskeletal problem make it difficult for you to get to the bathroom?
Activity-Exercise	■ Describe your usual activities for a 24-hour period. ■ Describe any musculoskeletal problems (such as weakness, stiffness, pain) that limit your activities of daily living (ADLs), such as driving, gardening, dressing, bathing, walking, climbing stairs, cooking, or cleaning. ■ Has there been a change in your usual ability to move around? Describe. ■ Do you regularly exercise, or take part in strenuous activities such as heavy lifting? Describe. If you have to lift heavy objects at work, do you use any type of special equipment? Describe. ■ Do you use any assistive devices (such as a cane or walker) to help move around?
Sleep-Rest	■ Does having this problem with your musculoskeletal system interfere with your ability to rest and sleep? If so, how and what do you do?
Cognitive-Perceptual	■ Describe any muscle, bone, or joint pain that you have. What relieves it or makes it worse? ■ Describe any changes in the color, temperature, or sensations in your extremities. ■ Describe any muscle weakness you are experiencing. ■ Do you have stiffness in your joints when you wake up? Does it get better with movement? ■ Do you ever have muscle cramps?
Self-Perception-Self-Concept	■ How does having this condition make you feel about yourself?
Role-Relationships	■ How has having this condition affected your relationships with others? ■ Has having this condition interfered with your ability to work? Explain. ■ Has anyone in your family had problems with bone, joint, or muscle disease? Explain.
Sexuality-Reproductive	■ Has this condition interfered with your usual sexual activity?
Coping-Stress-	■ Has having this condition created stress for you? ■ Have you experienced any kind of stress that makes the condition worse? Explain. ■ Describe what you do when you feel stressed.
Value-Belief	■ Describe how specific relationships or activities help you cope with this problem. ■ Describe specific cultural beliefs or practices that affect how you care for and feel about this problem. ■ Are there any specific treatments that you would not use to treat this problem?

Prior to the examination, collect all equipment and explain the techniques to decrease the client's anxiety. The sequence for a musculoskeletal examination follows:

1. Begin the examination with an assessment of gait and posture. Observe how the client walks, sits, and/or moves about in bed.
2. Inspect and palpate the bones for any obvious deformity or changes in size or shape. Palpation also will elicit tenderness or pain.
3. Measure the extremities for length and circumference. Before taking measurements, make sure the client is lying in a comfortable position. Remember to compare limbs bilaterally.
4. Assess muscle mass by first inspecting for obvious increase or decrease in size. Assess and document muscle strength on a scale of 0 to 5 (Table 40–6). Box 40–1 provides instructions for testing the strength of various muscles.

BOX 40–1 Guidelines for Assessing Muscle Strength

In adults, muscles are usually strong and equally strong bilaterally. However, neuromuscular diseases, disuse, metabolic disorders, or infections can cause muscle weakness. Muscle strength is expected to be greater in the dominant arm and leg. In most instances (and especially when moving digits and extremities), the nurse provides resistance by pushing in the opposite direction.

The muscles listed below are routinely tested. Instructions for clients are also provided.

MUSCLE	CLIENT INSTRUCTIONS
Ocular muscles and lids	Close eyes tightly.
Finger muscles	Shake hands. Make a fist. Spread fingers.
Facial muscles	Blow out cheeks. Stick out tongue.
Hip muscles	Raise straight leg while supine.
Neck muscles	Bend head forward and backward.
Gluteal and leg muscles	Alternately cross legs while sitting.
Deltoid muscles	Hold arms up.
Biceps muscle	Bend the arm.
Quadriceps muscle	Straighten leg.
Triceps muscle	Straighten the arm.
Wrist muscles	Bend hand forward and backward.
Ankle and foot muscles	Bend foot up and down.

TABLE 40–6 Muscle Grading Scale

GRADING SCALE	ASSESSMENT DESCRIPTION
0	(No visible) contraction; paralysis
1	Can feel contraction of muscle but there is no movement of limb
2	Passive ROM
3	Full ROM against gravity
4	Full ROM against some resistance
5	Full ROM against full resistance

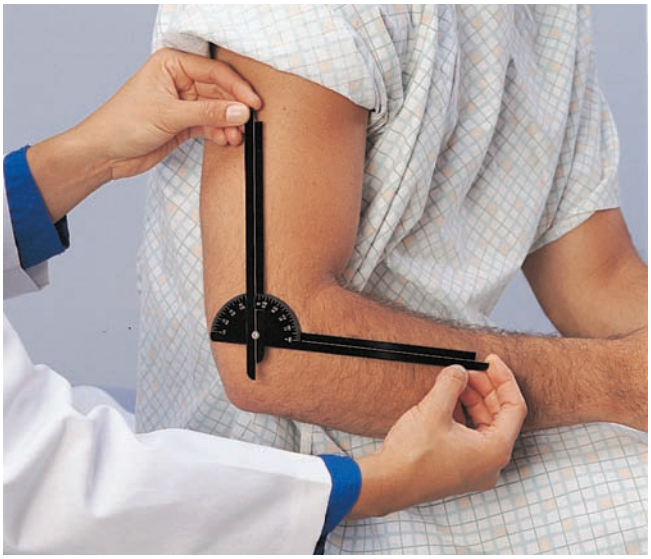


Figure 40–7 ■ Using a goniometer to measure joint ROM. This device has a pointer joined to a protractor at 0 degrees. These two arms are placed along articulating bones, and the angle of joint movement is recorded in degrees.

5. Assess joints for swelling, pain, redness, warmth, crepitus, and ROM. Only assess the ROM of every joint if the client has a specific musculoskeletal problem; however, assessing one or more joints is a common part of nursing care. Use a goniometer for precise measurements of joint ROM (Figure 40–7 ■).

MUSCULOSKELETAL ASSESSMENTS

Technique/Normal Findings	Abnormal Findings
Gait and Body Posture Assessment	
Inspect body posture and gait. *Body posture should be upright, gait should be smooth and steady.*	■ Joint stiffness, pain, deformities, and muscle weakness can cause changes in gait and posture.
Inspect the spine for curvature. Ask the client to stand and bend back slowly as far as possible, bend slowly to the right and then to the left as far as possible, turn slowly to the right and left in a circular motion, and bend forward slowly and try to touch fingers to toes. *When viewed from the back, the cervical and lumbar spine are concave, the thoracic spine is convex, and the spine is straight.*	■ With herniated lumbar disks, the lumbar curve flattens and spinal mobility is decreased. ■ An increased lumbar curve, called **lordosis**, may be seen in obesity or pregnancy. ■ A lateral, S-shaped curvature of the spine is called **scoliosis**. Functional scoliosis usually is a compensatory response to painful paravertebral muscles, herniated disks, or discrepancy in leg length. It disappears with forward flexion. Structural scoliosis is often congenital and tends to appear during adolescence. It is accentuated with forward bending. These disorders are discussed and illustrated in Chapter 42. ■ **Kyphosis** is an exaggerated thoracic curvature of the spine common in older adults.

Technique/Normal Findings	Abnormal Findings

Joint Assessment

Inspect the joints for deformity, swelling, and redness. *There should be no visible deformity, swelling, or redness of joints.*

- Diseases of the joints may be manifested by such deformities as tissue loss, tissue overgrowth, contractures, or irreversible shortenings of muscles and tendons.
- Edema in a joint may cause obvious bulging.
- Redness, swelling, and pain are evidence of an inflammation or infection in the joint.

Palpate the joints for tenderness, warmth, crepitation, consistency, and muscle mass. *Joints should be nontender and consistent bilaterally, and without visible or palpable excess warmth, crepitation, or masses.*

- Inflammation and injury cause joint pain.
- Arthritis, bursitis, tendonitis, and osteomyelitis (infection of a bone) result in painful, hot joints.
- **Crepitation** (a grating sound) is present in a joint when the articulating surfaces have lost their cartilage, such as in arthritis.

Range-of-Motion Assessment

Assess joint ROM by asking the client to perform activities specific to each joint, as follows: *All bilateral joints should move through full range of motion.*

***Temporomandibular joint*:** **"Open your mouth wide, and then close your mouth." (As the client opens and closes the mouth, palpate the temporomandibular joints with your index and middle fingers, as shown in Figure 40–8 ■.)**

- Clicking or popping noises, decreased ROM, pain, and swelling may indicate temporomandibular joint syndrome or, in rare cases, osteoarthritis.

Figure 40–8 ■ Palpating the temporomandibular joints.

Cervical spine:

45-degree flexion: "Touch your chin to your chest."
55-degree extension: "Look at the ceiling."
40-degree lateral bending: "Try to touch your right ear to your right shoulder." Repeat with the left side.
70-degree rotation: "Try to touch your chin to each shoulder."

- Neck pain and limited extension with lateral bending are seen with herniated cervical disks and in cervical spondylosis.
- An immobile neck with head and neck thrust forward is seen with ankylosing spondylitis.

Lumbar spine:

75- to 90-degree flexion: "Touch your toes with your fingers" (Figure 40–9A ■).
30-degree extension: "Bend backward slowly."
35-degree lateral bending: "Bend right and left" (Figure 40–9B).
30-degree rotation: "Twist your shoulders right and left" (Figure 40–9C).

- Decreased movement or pain with movement may indicate an abnormal spinal curvature, arthritis, herniated disk, or spasm of paravertebral muscles.

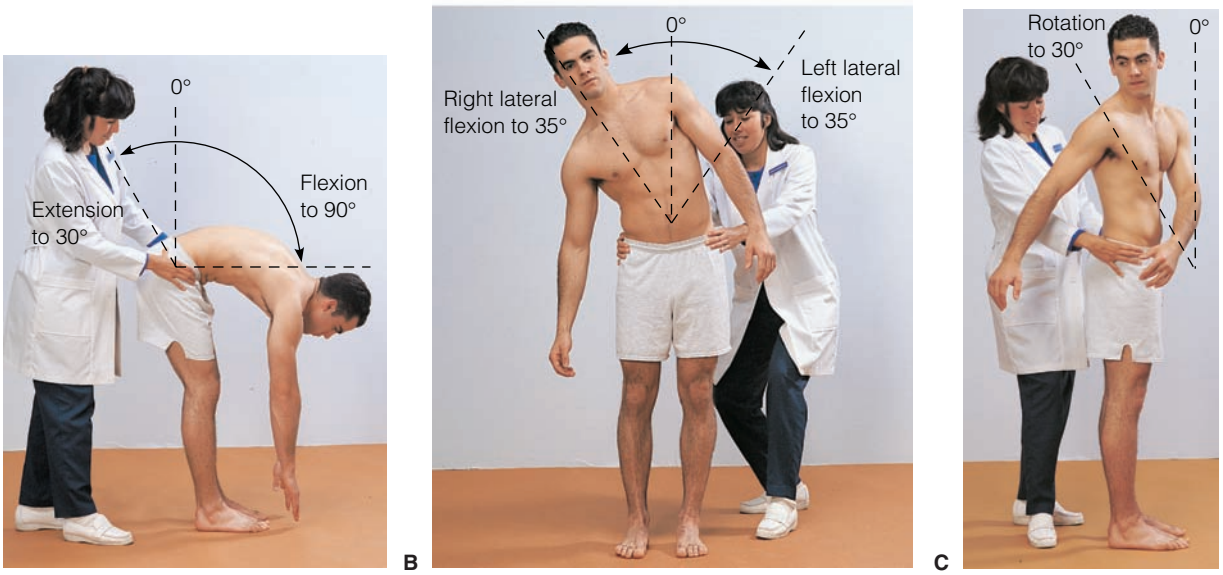


Figure 40–9 ■ *A,* Forward flexion of spine. *B,* Lateral flexion of spine. *C,* Rotation of spine.

Technique/Normal Findings	Abnormal Findings
Fingers: Flexion: "Make a fist." Extension: "Open your hand." Abduction: "Spread your fingers." Adduction: "Close your fingers."	■ Flexion and extension of fingers are decreased in arthritis. ■ Heberden's nodes and Bouchard's nodes are hard, nontender nodules on the dorsolateral parts of the distal and proximal interphalangeal joints, respectively. They are common in osteoarthritis. ■ Stiff, painful, swollen finger joints are seen in acute rheumatoid arthritis. ■ Boutonnière and swan-neck deformities are seen in chronic rheumatoid arthritis. ■ Swollen finger joints with a white chalky discharge may be seen in chronic gout.
Wrists: 90-degree flexion: "Bend wrist down." 70-degree extension: "Bend wrist up." 55-degree ulnar deviation: "Bend wrist toward little finger." 20-degree radial deviation: "Bend wrist toward thumb."	■ Bilateral chronic swelling in the wrist is seen in arthritis.
Elbows 160-degree flexion: "Touch your hands to your shoulders." 180-degree extension: "Straighten your elbows." 90-degree supination: "Bend your elbows 90 degrees, and turn hands palm up." 90-degree pronation: "Bend your elbows 90 degrees, and turn fists down."	■ Swollen, tender, inflamed elbows are apparent in gouty arthritis and rheumatoid arthritis. ■ Pain and tenderness at the lateral epicondyle occur in tennis elbow.

Technique/Normal Findings	Abnormal Findings
Shoulders: 180-degree flexion: "Hold your arms straight up and out." 50-degree hyperextension: "Put your straight arm behind your back." 90-degree internal rotation: "Put your forearm behind your lower back." 180-degree abduction: "Raise your straight arm up and out to your side." 50-degree adduction: "Put your straight arm across your chest."	■ Pain and tenderness over the biceps tendon occurs with **tendonitis** (inflammation of a tendon). ■ The arm cannot be abducted fully when the supraspinatus tendon of the shoulder is ruptured. ■ Pain and limited abduction is also seen with **bursitis** (inflammation of a bursa) and calcium deposits in this area.
Toes: 90-degree flexion: "Walk on your toes."	■ The great toe is excessively abducted in hallux valgus. ■ The joint above the great toe is swollen, inflamed, and painful in gouty arthritis. ■ There is hyperextension of the metatarsophalangeal joint and flexion of the proximal interphalangeal joint with hammer toes.
Ankles: 20-degree dorsiflexion: "Point your foot to the ceiling." 45-degree plantar flexion: "Point your foot to the floor." 30-degree inversion: "Walk on the outside of your feet." 20-degree eversion: "Walk on the inside of your feet."	■ Contractures of the Achilles tendon may occur in clients with rheumatoid arthritis or following prolonged bed rest.
Knees: 130-degree flexion: "Do a deep knee bend." 180-degree extension: "Sit down and hold your legs straight out in front of you."	■ Swelling over the suprapatellar pouch is seen with inflammation and fluid in the articular capsule of the knee. **Synovitis** is inflammation of the synovial membrane lining the articular capsule of a joint. It is common with knee trauma. ■ Swelling over the patella is seen in bursitis.
Hips: (The client is lying down.) 120-degree flexion: "Bring bent knee up to your chest." 30-degree hyperextension: "Lie on the abdomen, and lift up one leg at a time." 45-degree abduction: "Hold your leg straight, and move it out to the side." 40-degree internal rotation: "Bend your knee, and swing it toward your other leg." 45-degree external rotation: "Bend your knee, and swing it out to the side."	■ Movement of the hip is limited and/or painful in arthritis.

MEDIALINK Case Study: Knee Pain

Technique/Normal Findings	Abnormal Findings

Special Assessments

Perform Phalen's test. Ask the client to hold the wrist in acute flexion for 60 seconds (Figure 40–10 ■). *There should be no tingling, numbness, or pain.*

■ Numbness and burning in the fingers during Phalen's test may indicate carpal tunnel syndrome.

Figure 40–10 ■ Phalen's test.

Check for small amounts of fluid on the knee by conducting the bulge test. Milk upward on the medial side of the knee, and then tap the lateral side of the patella (Figure 40–11 ■). *No bulge of fluid should appear on the medial side of the knee.*

■ A fluid bulge indicates increased fluid in the knee joint rather than soft tissue swelling.

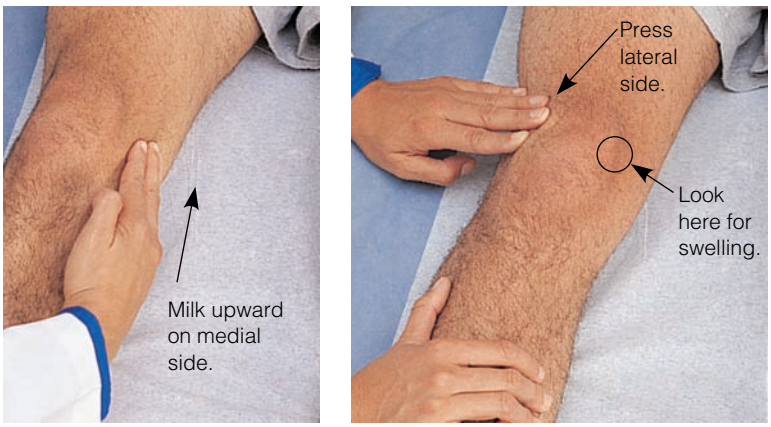


Figure 40–11 ■ Checking for the bulge sign.

Check for larger amounts of fluid by conducting the ballottement test, to detect large amounts of fluid in the knee. Apply downward pressure on the knee with one hand while pushing the patella backward against the femur with the other hand (Figure 40–12 ■). *There should be no movement of the patella. The patella should rest firmly over the femur.*

■ Increased fluid will cause a tapping sound as the patella displaces the fluid and hits the femur.

Figure 40–12 ■ Checking for ballottement.

Technique/Normal Findings	Abnormal Findings
Perform McMurray's test. While reclining, ask the client to turn the flexed knee toward the center of the body. Stabilize the knee with one hand, and apply pressure on the lower leg with the other hand (Figure 40–13 ■). *There should be no pain or clicking.*	■ Pain, locking (inability to fully extend the knee), or a popping sound may indicate an injury to a meniscus, a disk of cartilaginous tissue in the knee.

Figure 40–13 ■ McMurray's test.

Perform the Thomas test. Ask the client to lie down and extend one leg while bringing the knee of the opposite leg to the chest (Figure 40–14 ■). *The extended leg should not rise off the table.*	■ A hip flexion contracture will cause the extended leg to rise off the table.

Figure 40–14 ■ Thomas test for hip contracture.

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Links to Resources

TEST YOURSELF NCLEX-RN® REVIEW

1. Your client has an epiphyseal fracture. Based on this information, what classification of bone is involved?
   1. irregular
   2. flat
   3. long
   4. short
2. When asking a client to move an extremity away from the body midline, you are assessing:
   1. abduction.
   2. adduction.
   3. extension.
   4. flexion.
3. Your client asks you, "Why is blood being examined for uric acid?" What would be your most accurate response?
   1. "A uric acid test is done to see if your gout medication is effective."
   2. "A uric acid test is done to diagnose rheumatoid arthritis."
   3. "Do you have a family history of muscle or bone disease?"
   4. "Tell me how you got that big bruise on your hip."
4. What age woman would be most likely to have a bone density examination?
   1. teenager
   2. a woman in her 20s
   3. a woman in her 40s
   4. a woman in her 60s
5. With aging, bone mass and calcium absorption decrease. What risk is increased as a result?
   1. obesity
   2. weakness
   3. fractures
   4. deformity
6. What would you ask the client to do in order to assess facial muscle strength?
   1. "Close your eyes tightly."
   2. "Stick out your tongue."
   3. "Bend your head forward."
   4. "Open your eyes widely."
7. What term is used to document a grating sound when a joint is moved?
   1. crackles
   2. arthritis
   3. synovitis
   4. crepitation
8. While conducting the ballottement test, you note the patella rebounds against your fingers. What does this finding indicate?
   1. deformity of the elbow
   2. infection of the metatarsals
   3. fluid in the knee joint
   4. crepitus in the hip joint
9. During the physical assessment of a young adult, you note a lateral, S-shaped curve of the spine. What is the name of this condition?
   1. lordosis
   2. scoliosis
   3. kyphosis
   4. musclosis
10. What are the most common manifestations of musculoskeletal disorders?
    1. pain and limited mobility
    2. swelling and exaggerated reflexes
    3. cyanosis and decreased pulses
    4. pallor and decreased ROM

See Test Yourself answers in Appendix C.

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