Skeletal System

LECT FOUR

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Bones:

The bones are the primary organs of the skeletal system; they are composed of approximately 25% water and 75% solid matter. The solid matter in bone is a calcified, rigid substance known as osseous tissue. This tissue is a relatively hard and lightweight composite material, formed mostly of calcium phosphate.

Table 6.1 Skeletal System at-a-Glance

Organ/Structure	Primary Functions/Description
Bones	• Primary organs of the skeletal system, which are composed of water and solid matter • Provide shape, support, and the framework of the body • Provide protection for internal organs • Serve as a storage place for mineral salts, calcium, and phosphorus • Play an important role in the formation of blood cells (**hematopoiesis**) • Provide areas for the attachment of skeletal muscles • Help make movement possible through **articulation**
Cartilage	• Specialized type of fibrous connective tissue found at the ends of bones; forms the major portion of the embryonic skeleton and part of the skeleton in adults
Tendons	• Attach muscles to bones; consist of connective tissue
Ligaments	• Bands of fibrous connective tissue that connect bones, cartilages, and other structures; also serve as places for the attachment of fascia

Classification of Bones

Bones are classified according to their shapes. See Figure 6.2. Table 6.2 classifies the bones

Table 6.2 Classifications of Bone

Bone	Example
Flat	Ribs, scapula (shoulder blade), parts of the pelvic girdle, bones of the skull
Long	Tibia (shin bone), femur (thigh bone), humerus, radius
Short	Carpals, tarsals
Irregular	Vertebrae, ossicles of the ear
Sesamoid	Patella (kneecap)
Sutural or wormian	Between the flat bones of the skull

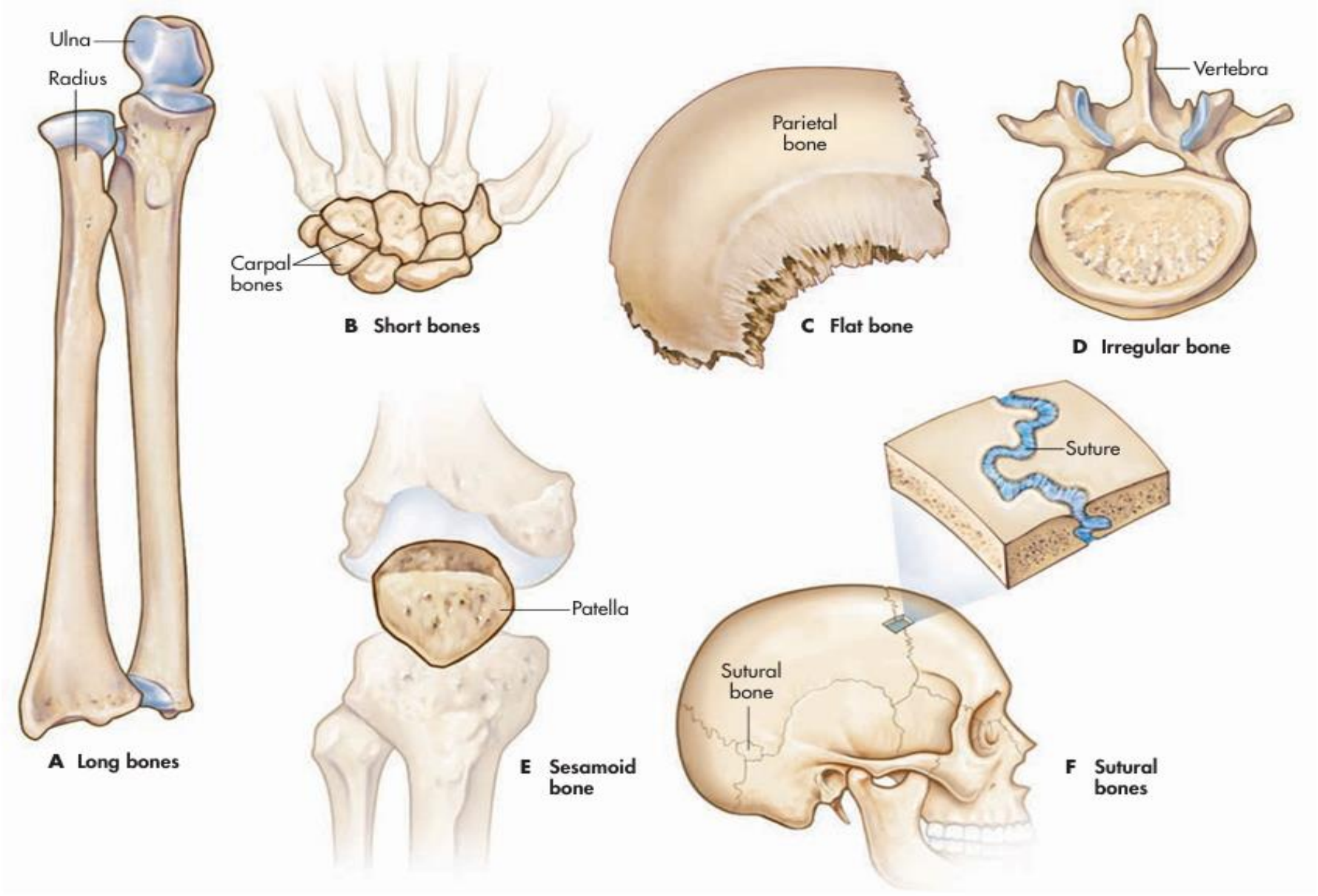


Figure 6.2 Classification of bones by shape.

Structure of a Long Bone

Long bones, such as the tibia, femur, humerus, or radius, have most of the features found in all bones. These features are listed here and shown in Figure 6.3.

- **Epiphysis. The ends of a developing bone.**
- **Diaphysis. The shaft of a long bone.**
- **Periosteum. A fibrous vascular membrane that forms the covering of bones except at their articular (joint) surfaces. • Compact bone. The dense, hard layer of bone tissue.**
- **Medullary canal. A narrow space or cavity throughout the length of the diaphysis.**
- **Endosteum. A tough, connective tissue membrane lining the medullary canal and containing the bone marrow.**
- **Cancellous or spongy bone. The reticular network that makes up most of the volume of bone**

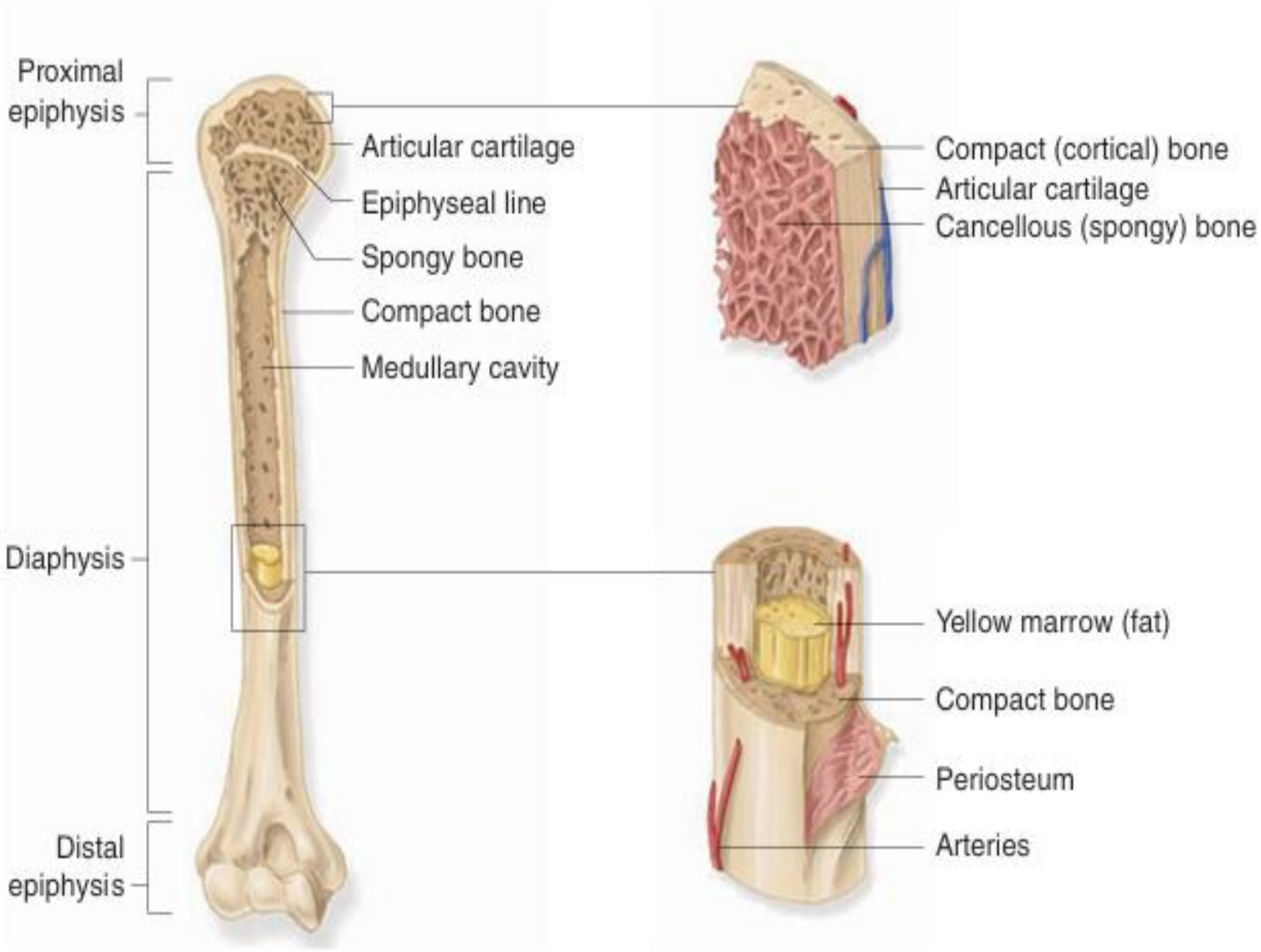


Figure 6.3 Features found in a long bone.

Joints and movements

A joint (jt) is an articulation, a place where two or more bones connect. The manner in which bones connect determines the type of movement possible at the joint.

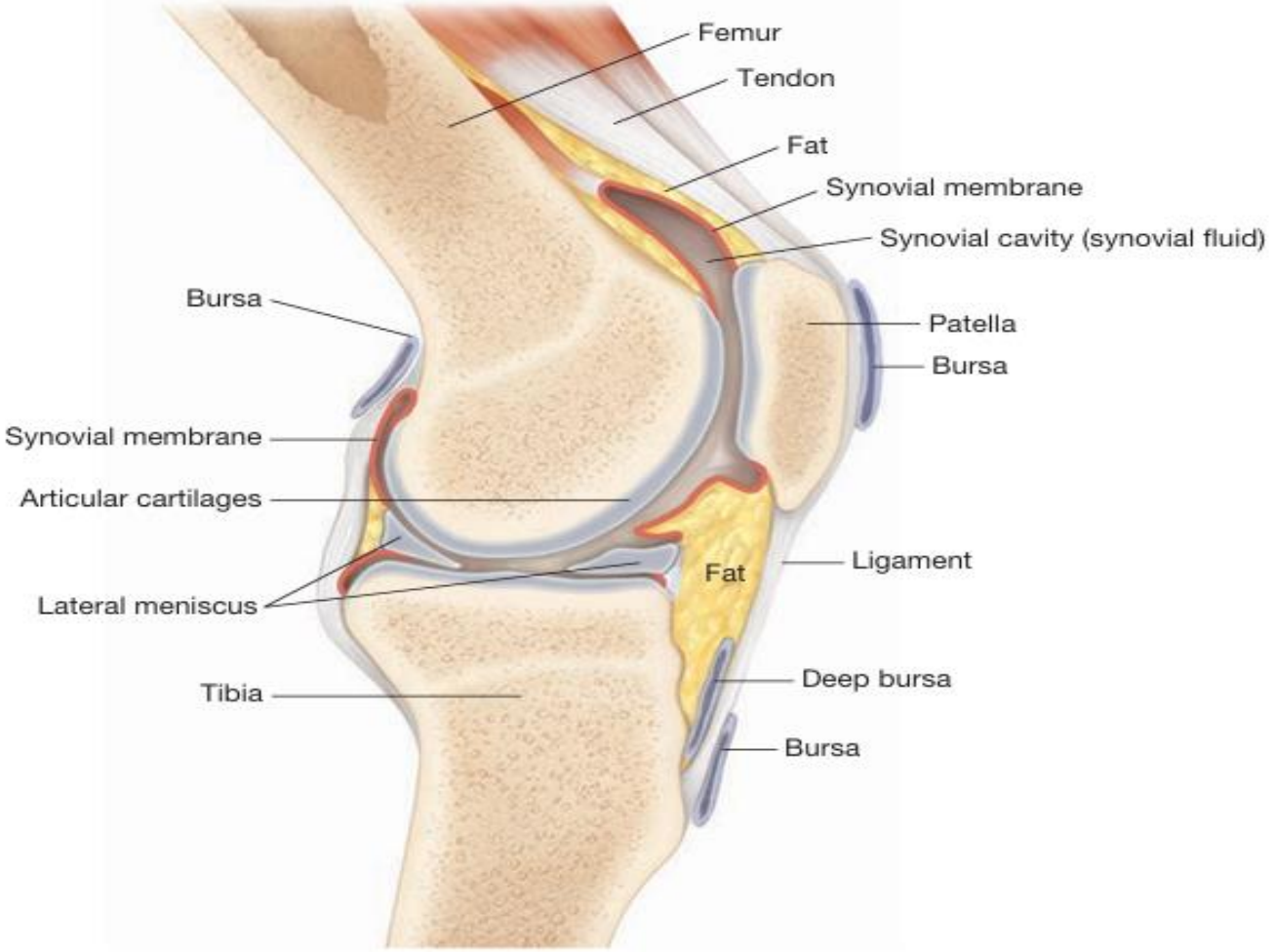


Figure 6.4 Knee joint.

Classification of Joints

Joints are classified as follows:

- **Synarthrosis (Fibrous). Does not permit movement. The bones are in close contact with each other, but there is no joint cavity. An example is a cranial suture.**
- **Amphiarthrosis (Cartilaginous). Permits very slight movement. An example of this type of joint is a vertebra.**
- **Diarthrosis (Synovial). Allows free movement in a variety of directions. A synovial membrane lines the joint and produces synovial fluid, which lubricates the joint. Examples of this type of joint are the knee, hip, elbow, wrist, and foot.**

Joint Movements

The following terms describe types of body movement that occur at the freely movable joints. See Figure 6.5.

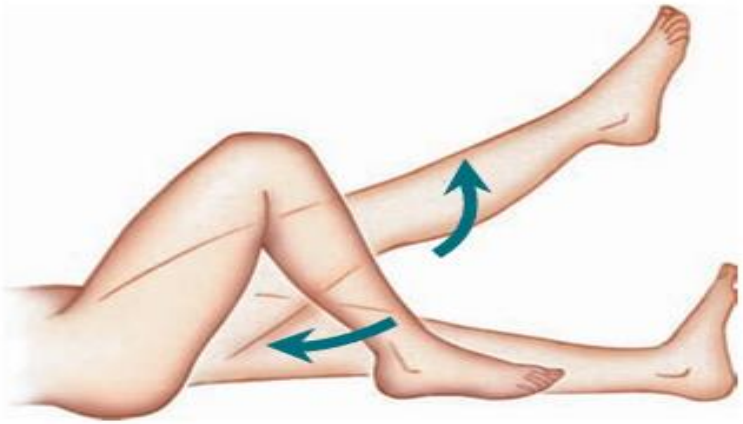


Figure 6.5A Flexion and extension
Flexion–Bending a limb.
Extension–Straightening a flexed limb.

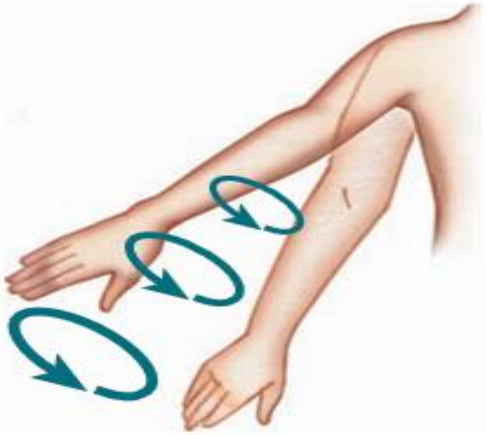


Figure 6.5B Circumduction
Circumduction–Moving a body part in a circular motion.

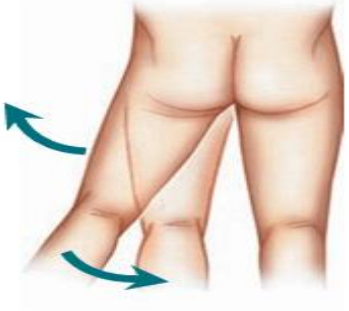


Figure 6.5C Abduction and adduction
Abduction–Moving a body part away from the middle.
Adduction–Moving a body part toward the middle.

Figure 6.5E Rotation
Rotation–Moving a body part around a central axis.

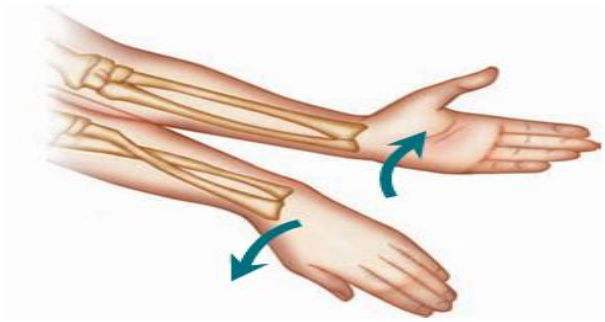


Figure 6.5G Pronation and supination
Pronation–Lying prone (face downward); also turning the palm downward.
Supination–Lying supine (face upward); also turning the palm or foot upward.

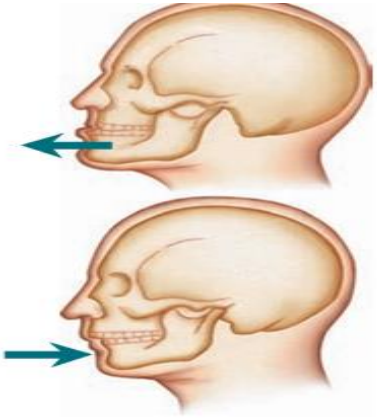


Figure 6.5D Protraction and retraction
Protraction–Moving a body part forward.
Retraction–Moving a body part backward.

Figure 6.5F Dorsiflexion
Dorsiflexion–Bending a body part backward.

Figure 6.5H Eversion and inversion
Eversion–Turning outward.
Inversion–Turning inward.

The vertebral column

The vertebral column is composed of a series of separate bones (vertebrae) connected in such a way as to form four spinal curves. These curves have been identified as the cervical, thoracic, lumbar, and sacral.

1. The cervical curve consists of the first seven vertebrae,

2. the thoracic curve consists of the next 12 vertebrae,

3. the lumbar curve consists of the next five vertebrae,

4. and the sacral curve consists of the sacrum and coccyx (tailbone).

It is known that a curved structure has more strength than a straight structure.

The spinal curves of the human body are most important because they help support the weight of the body and provide the balance that is necessary to walk on two feet.

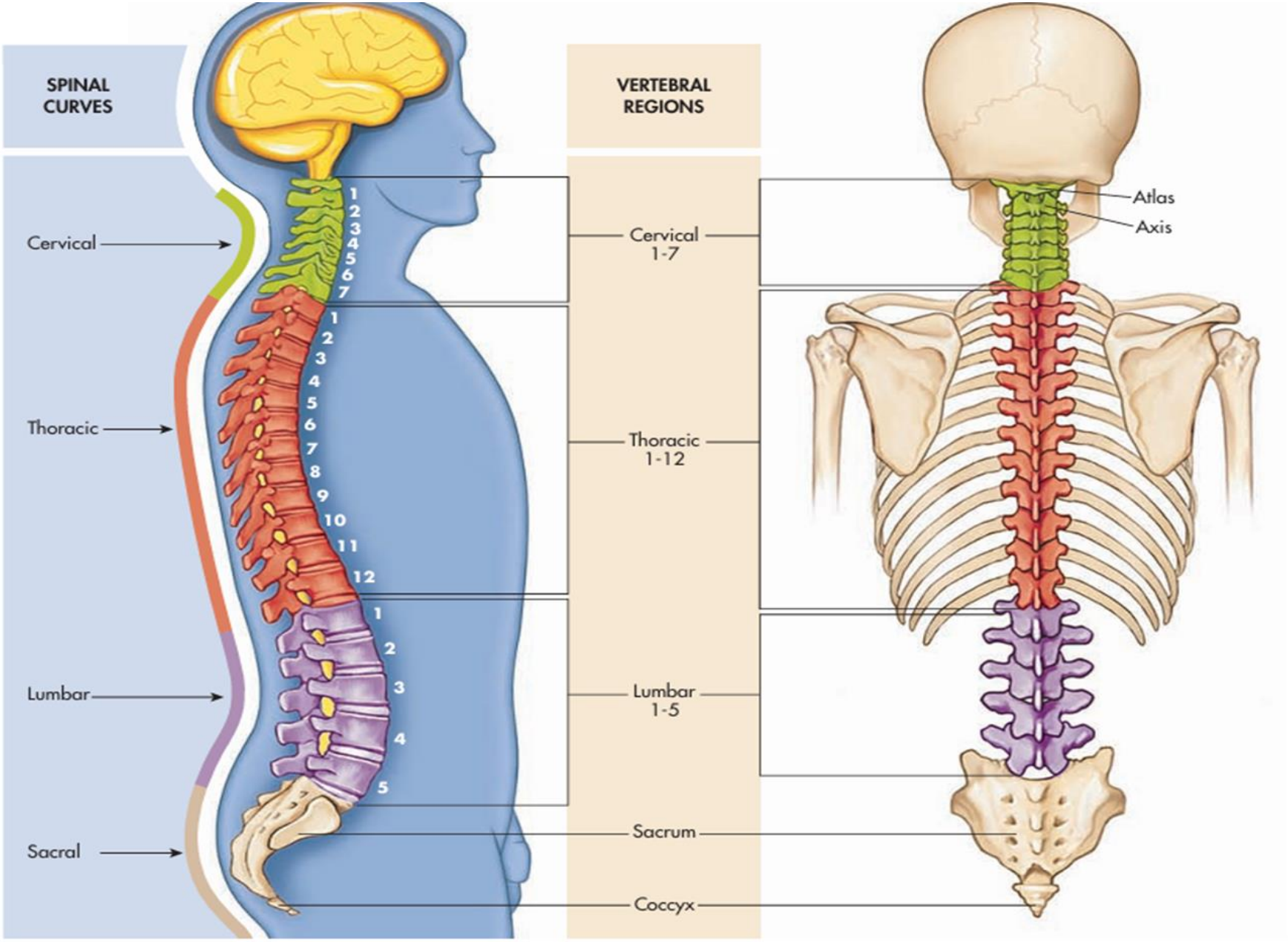
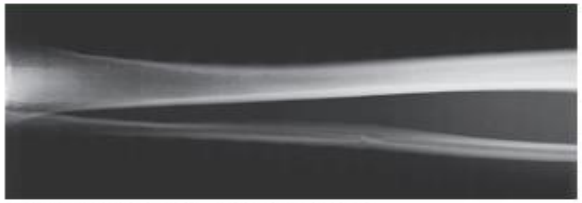
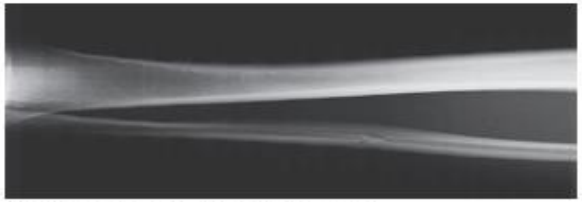


Figure 6.6 Vertebral (spinal) column.

Fractures

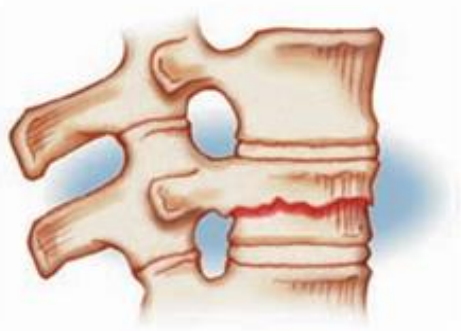
A crack or break in the bone is called a fracture (Fx). A fracture is classified according to its external appearance, the site of the fracture, and the nature of the crack or break in the bone. Many fractures fall into more than one category. For example, Colles fracture is a transverse fracture, but depending on the injury, it can also be a comminuted fracture that can be either open or closed.

Table 6.4 Types of Fractures

Type of Fracture	Description	Figure 6.9A–L
Closed, or **simple**	A completely internal break that does not involve a break in the skin (x-ray of the tibia and fibula). Note the break in the fibula (smaller bone).	A  Source: Pearson Education, Inc.
Open, or **compound**	The fracture projects through the skin and there is a possibility of infection or hemorrhage; more serious than a closed fracture	B  Source: Pearson Education, Inc.
Transverse	Breaks the shaft of a bone across its longitudinal axis; the break is in the fibula, the smaller bone (note that images A and C are the same)	C  Source: Pearson Education, Inc.

Comminuted	Shatters the affected part into a multitude of bony fragments (x-ray of the femur bone)	 D Source: Pearson Education, Inc.
Greenstick	Only one side of the shaft is broken, and the other is bent (like a green stick); usually occurs in children whose long bones have not fully ossified	 E
Spiral	Produced by twisting stresses that are spread along the length of a bone (note the break in the humerus)	 F Source: Pearson Education, Inc.
Colles	A break in the distal portion of the radius; often the result of reaching out to cushion a fall	 G

Table 6.4 Types of Fractures (*continued*)

Type of Fracture	Description	Figure 6.9A–L
Pott	Occurs at the ankle and affects both bones of the lower leg (fibula and tibia)	 H
Compression	Due to the collapse of a vertebra. It may be caused by trauma or due to a weakening of the vertebra due to osteoporosis, tumors, or infection.	 I
Vertebral compression	Fractures of the spine (vertebra) can cause severe "band-like" pain that radiates from the back to the sides of the body; often occur in patients with osteoporosis. Over the years, repeated spinal fractures can lead to chronic lower back pain as well as loss of height or curving of the spine due to collapse of the vertebrae. The collapse gives individuals a hunched-back appearance of the upper back, often called a "dowager's hump" because it is commonly seen in elderly women.	 J Source: Pearson Education, Inc.

Epiphyseal	Usually occurs through the growth plate where the matrix is undergoing calcification and chondrocytes (cartilage cells) are dying; this type of fracture is seen in children	 K
Stress	Usually occurs during the course of normal activity; some patients with osteoporosis develop stress fractures of the feet while walking or stepping off a curb	
Hip	Typically occurs as a result of a fall; with osteoporosis, hip fractures can occur as a result of the degenerative process	 L Source: Muratart/Shutterstock

Achondroplasia: Defect in the formation of cartilage at the epiphyses of long bones.

Acroarthritis: Inflammation of the joints of the hands or feet (the extremities).

Ankylosis: Abnormal condition of stiffening of a joint.

Arthralgia:Joint pain.

Arthritis: Inflammation of a joint that can result from various disease processes, such as injury to a joint (including fracture), an attack on the joints by the body itself (caused by an autoimmune disease, such as rheumatoid arthritis), or general wear and tear on joints (osteoarthritis).

Arthrocentesis: Surgical procedure to remove joint fluid; may be used as a diagnostic tool or as part of a treatment regimen.

Arthroplasty: Surgical procedure used to repair a joint.

Arthroscope: Surgical instrument used to examine the interior of a Joint.

Bone marrow transplant: Surgical procedure used to transfer bone marrow from a donor to a patient.

Calcium (Ca): Mineral that is essential for bone growth, teeth development, blood coagulation, and many other functions

calcium (Ca) blood test: Calcium level of the blood can be increased in metastatic bone cancer, acute osteoporosis, prolonged immobilization, and during fracture healing; can be decreased in osteomalacia and rickets.

Cast: Type of material made of plaster of Paris, fiberglass, sodium silicate, starch, or dextrin used to immobilize a fractured bone, a dislocation, a deformity, or a sprain.

collagen: Fibrous insoluble protein found in the connective tissue, skin, ligaments, and cartilage.

connective: Literally means the nature of connecting or binding together.

craniectomy:Surgical excision of a portion of the skull.

Craniotomy: Surgical incision made into the skull.

dislocation: Displacement of a bone from a joint.

fixation: Process of holding or fastening in a fixed position; making rigid, immobilizing.

osteopenia: Deficiency of bone tissue, regardless of the cause.

osteoporosis: Abnormal condition characterized by a decrease in the density of bones, decreasing their strength and causing fragile bones, which can result in fractures. It is most common in women after menopause, when it is called postmenopausal osteoporosis, but may also develop in men.

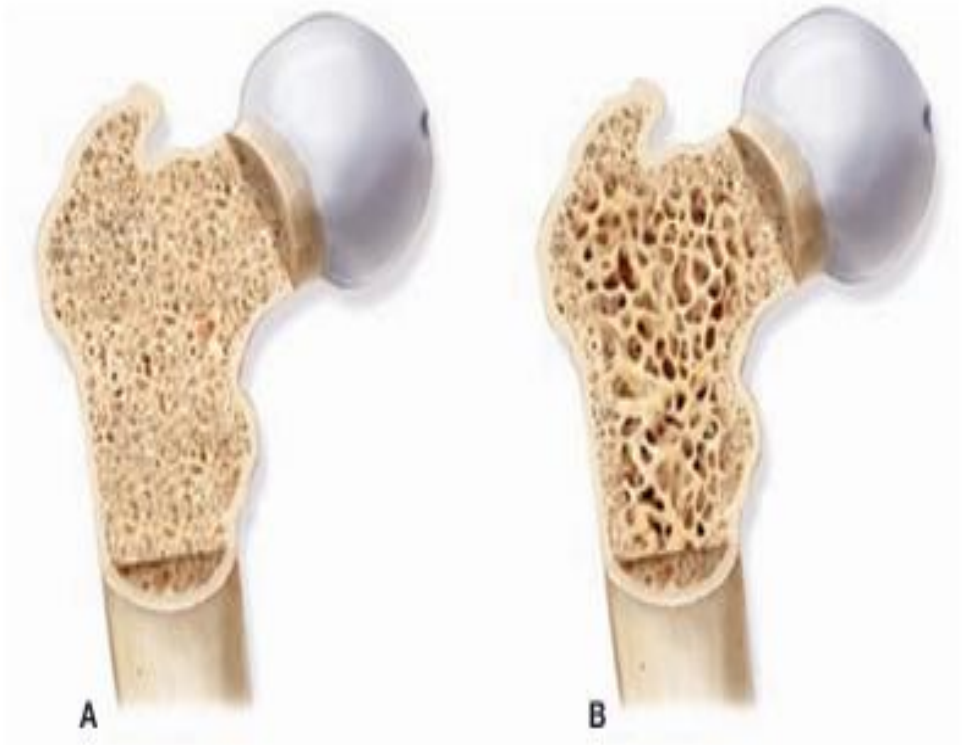


Figure 6.16 (A) Normal spongy bone. (B) Spongy bone with osteoporosis, which is characterized by a loss of bone density.

genu valgum: Medical term for knock-knee.
genu varum: Medical term for bow leg.

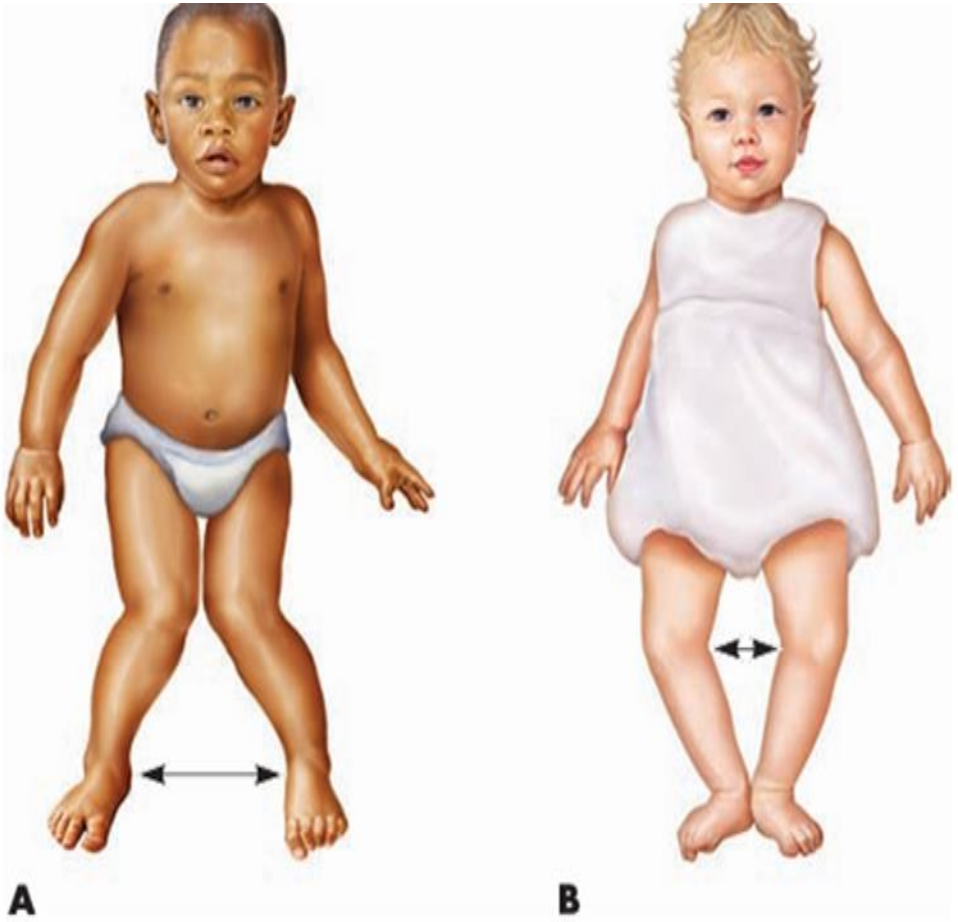


Figure 6.12 (A) Genu valgum, or knock-knee. Note that the ankles are far apart when the knees are together. (B) Genu varum, or bowleg. The legs are bowed so that the knees are far apart as the child stands.

osteoarthritis (OA): Inflammation of the bone and joint; the most common type of arthritis in the United States in people over 50 years of age. It is often called wear-and-tear disease because the cartilage that cushions a joint wears away as one ages, so that bone rubs against bone.

osteoblast: Bone-forming cell.

osteochondritis: Inflammation of bone and cartilage.

osteogenesis: Formation of bone.

osteomalacia: Softening of bones.

osteomyelitis: Inflammation of bone, especially the marrow, caused by a pathogenic organism.

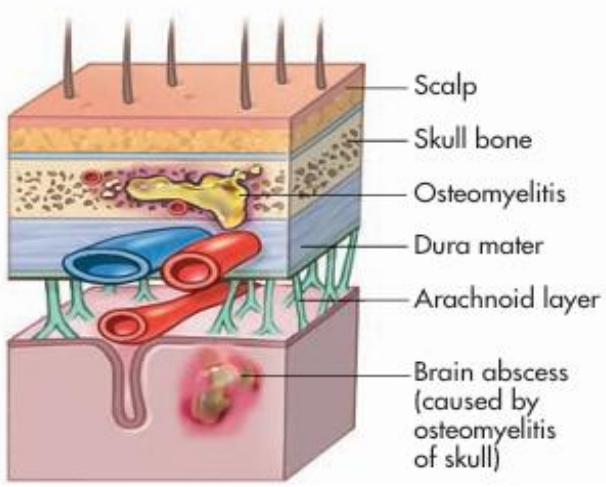
Radiograph: Film or record on which an x-ray image is produced.

Osteosarcoma: Malignant tumor of the bone; cancer growing from cells of "fleshy" connective tissue such as bone or muscle.

Osteotome: Surgical instrument used for cutting bone.

phosphorus (P): Mineral that is essential in bone formation, muscle contraction, and many other functions.

phosphorus (P) blood test: Phosphorus level of the blood can be increased in osteoporosis and fracture healing.



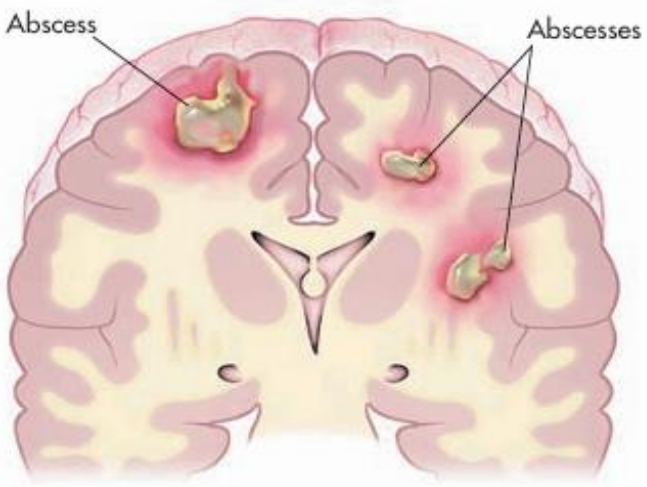


Figure 6.15
Abscess of the brain due to osteomyelitis.

rheumatoid arthritis (RA):Chronic autoimmune disease characterized by inflammation of the joints, stiffness, pain, and swelling, which results in crippling deformities.

Rickets: Abnormal condition that can occur in children; caused by a lack of vitamin D.

symphysis: Literally means growing together; a joint in which adjacent bony surfaces are firmly united by fibrocartilage. An example is the symphysis pubis, where the bones of the pelvis have grown together.

Submaxilla:Below the jaw or mandible.

Traction (Tx): Process of drawing or pulling on bones or muscles to relieve displacement and facilitate healing.

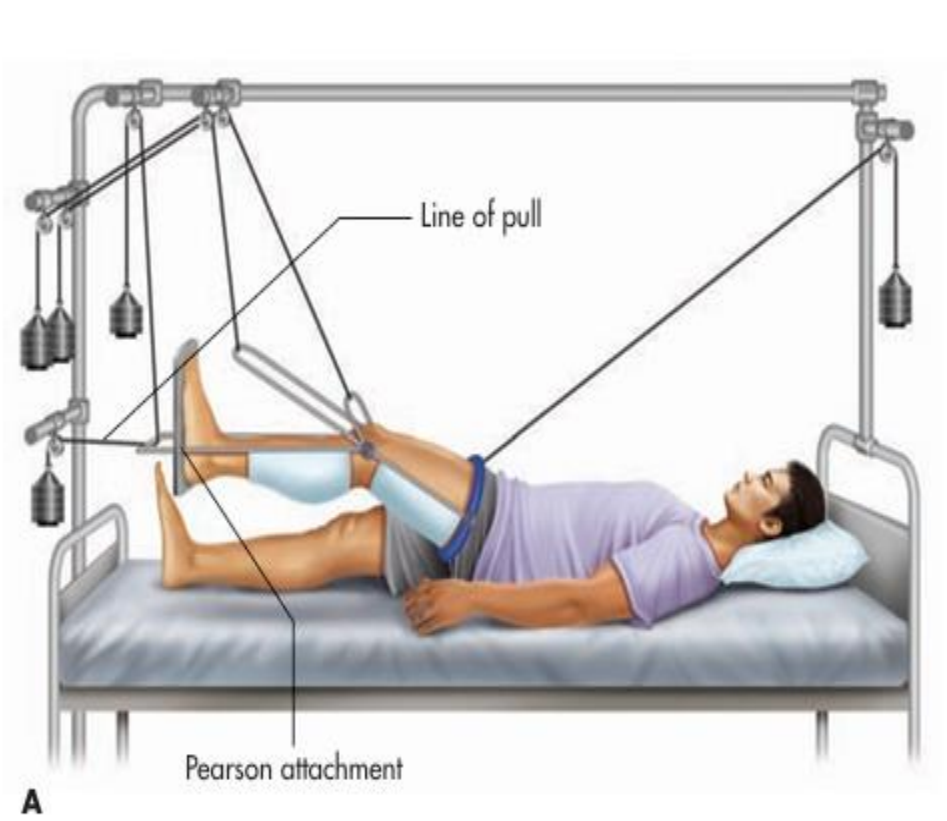


Figure 6.20 Traction is the application of a pulling force to maintain bone alignment during fracture healing. Different fractures require different types of traction. (A) Balanced suspension traction is commonly used for fractures of the femur. (B) Skeletal traction, in which the pulling force is applied directly to the bone, may be used to treat fractures of the humerus.

Arthrography: Diagnostic examination of a joint (usually the knee) in which air and then a radiopaque contrast medium are injected into the joint space, x-rays are taken, and internal injuries of the meniscus, cartilage, and ligaments can be seen if present.

Arthroscopy: Process of examining and inspecting the internal structures of a joint using an arthroscope; usually done after an arthrography and before joint surgery.

Figure 6.21 Arthroscopic surgery involves the surgery of a joint with the use of a flexible arthroscope and other surgical tools. In this example, the surgeon inserts the arthroscope to evaluate the damage to the knee joint and then uses instruments to perform the necessary procedure.

computed tomography (CT): Advanced x-ray scanning system with a minicomputer that provides cross section imaging. CT scans reveal both bone and soft tissue, including organs, muscles, and tumors.

magnetic resonance imaging (MRI): Noninvasive imaging technique used to view organs, bone, and other internal body structures. The imaged body part is exposed to radio waves while in a magnetic field. The picture is produced by energy emitted from hydrogen atoms in the human body.

x-ray: Examination of bones using an electromagnetic wave of high energy produced by the collision of a beam of electrons with a target in a vacuum tube; used to identify fractures and pathological conditions of the bones and joints such as rheumatoid arthritis, spondylitis, and tumors.

Figure 20.3 Technician preparing patient for CT scan in hospital.
(Tyler Olson/Fotolia)

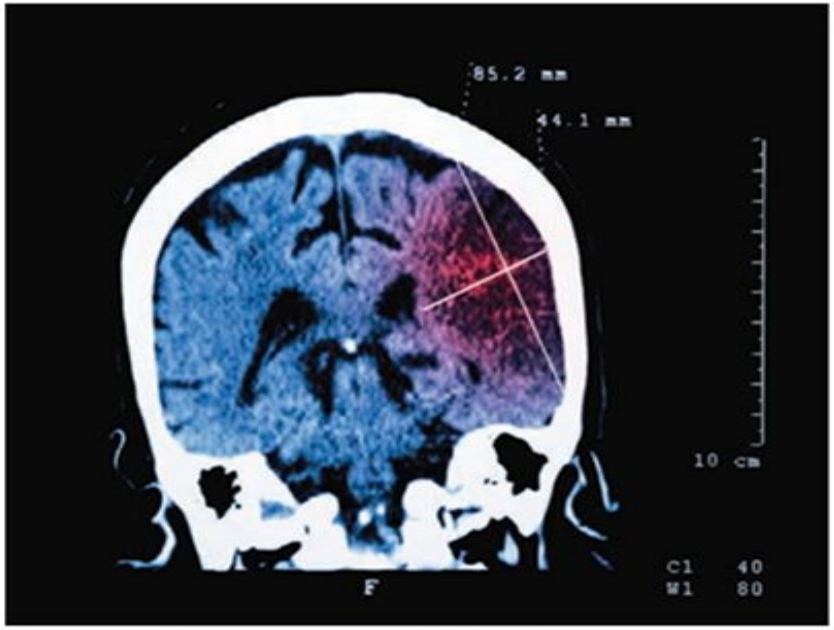


Figure 20.4 CT scan of the brain showing cerebral infarction (ischemic stroke). (stockdevil/Fotolia)

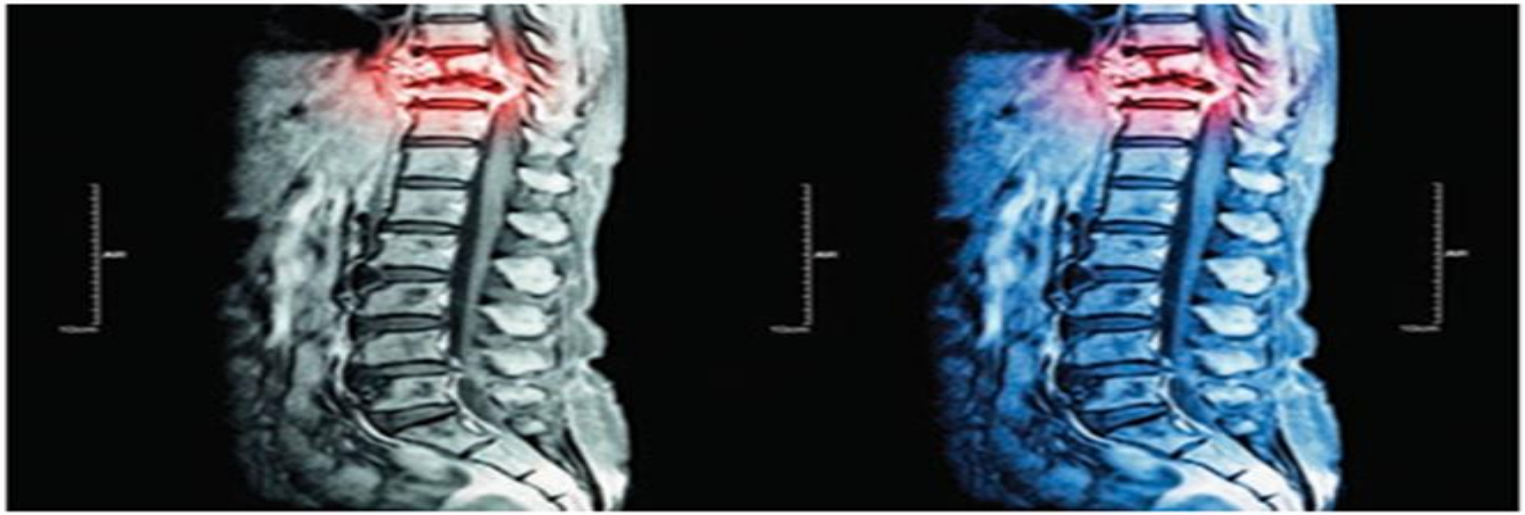


Figure 20.5 Spinal metastasis. MRI of the thoracic and lumbar spine showing cancer in the thoracic region with spinal compression. (stockdevil/Fotolia)

Figure 20.6 X-ray technician in a lead apron prepares to take an x-ray of a patient. This apron is a protective shield of lead and rubber worn by a patient or those taking x-rays to protect the genitals and other vital organs from excessive exposure to x-rays.

Source: Pearson Education, Inc.

Figure 20.8 Radiologist examines an x-ray of the chest.

(adam121/Fotolia)


thank
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