

# Joints

## Outline

- 8.1 Joints are classified into three structural and three functional categories (p. 251; Table 8.1)
- A. Joints are classified by structure and by function: Structural classification focuses on the material binding the bones together and whether or not a joint cavity is present, while functional classification is based on the amount of movement allowed at the joint. (p. 251)
    - 1. Structurally, joints may be fibrous, cartilaginous, or synovial.
    - 2. Functionally, joints may be synarthroses (immovable joints), amphiarthroses (slightly movable joints), or diarthroses (freely movable joints).
- 8.2 In fibrous joints, the bones are connected by fibrous tissue (p. 252; Fig. 8.1; Tables 8.1–8.2)
- A. In fibrous joints, bones are joined together by fibrous tissue and lack a joint cavity, and provide little to no movement. (p. 252)
  - B. There are three types of fibrous joints: sutures, that use very short connective tissue fibers to hold the bones together; syndesmoses, in which the bones are connected by a ligament; and gomphoses, peg-in-socket fibrous joints. (p. 252; Fig. 8.1)
- 8.3 In cartilaginous joints, the bones are connected by cartilage (pp. 253; Fig. 8.2; Tables 8.1–8.2)
- A. In cartilaginous joints, the bones are joined together by cartilage, they lack a joint cavity, and have very little mobility. (p. 253)
  - B. There are two types of cartilaginous joints: synchondroses, that have a plate of hyaline cartilage connecting the bones, and symphyses, in which the articular surfaces are covered with articular cartilage that is then fused to a pad or plate of fibrocartilage. (p. 253; Fig. 8.2)
- 8.4 Synovial joints have a fluid-filled joint cavity (pp. 254–260; Figs. 8.3–8.13; Tables 8.1–8.2)
- A. Synovial joints have a fluid-filled joint cavity that allows free movement about the joint. (p. 254)
  - B. The general structure of a synovial joint contains six distinguishing features. (pp. 254–255; Fig. 8.3)
    - 1. Articular cartilage covers the ends of the articulating bones.
    - 2. The joint (synovial) cavity is a space that is filled with synovial fluid.
    - 3. The two-layered articular capsule, consisting of a fibrous layer and a synovial membrane, encloses the joint cavity.
    - 4. Synovial fluid is a viscous, slippery fluid that fills all free space within the joint cavity.
    - 5. Reinforcing ligaments cross synovial joints to strengthen the joint.
    - 6. There is a rich supply of nerves innervating the capsule that detect pain and stretch and blood vessels supplying the synovial membrane, giving rise to capillaries that provide filtrate that becomes synovial fluid.

- C. Bursae and tendon sheaths contain lubricant that reduces friction at synovial joints. (p. 255; Fig. 8.4)
- D. Factors Influencing the Stability of Synovial Joints (p. 257)
1. The shapes of the articular surfaces of bones found at a synovial joint determine the movements that occur at the joint, but play a minimal role in stabilizing the joint.
  2. Ligaments at a synovial joint prevent excessive or unwanted movements and help to stabilize the joint: the greater the number of ligaments at the joint, the greater the stability.
  3. The most important factor stabilizing joints is muscle tone, which keeps tendons crossing joints taut.
- E. Movements Allowed by Synovial Joints (pp. 258–260; Figs. 8.5–8.6; Table 8.2)
1. Skeletal muscles attach to bones or other connective structures at two points: the origin, attached to the immovable bone; and the insertion, attached to the movable bone.
  2. Gliding movements occur when one flat, or nearly flat, bone surface glides or slips over another.
  3. Angular movements increase or decrease the angle between two bones.
    - a. Flexion decreases the angle of the joint and brings the articulating bones closer together.
    - b. Extension increases the angle between the articulating bones.
    - c. Dorsiflexion decreases the angle between the top of the foot (dorsal surface) and the anterior surface of the tibia.
    - d. Plantar flexion decreases the angle between the sole of the foot (plantar surface) and the posterior side of the tibia.
    - e. Abduction is the movement of a limb (or fingers) away from the midline body (or of the hand).
    - f. Adduction is the movement of a limb (or fingers) toward the midline of the body (or the hand).
    - g. Circumduction is moving a limb so that it describes a cone in the air.
  4. Rotation is the turning of a bone along its own long axis.
  5. Special Movements
    - a. Supination is rotating the forearm laterally so that the palm faces anteriorly or superiorly.
    - b. Pronation is rotating the arm medially so that the palm faces posteriorly or inferiorly.
    - c. Inversion turns the sole of the foot so that it faces medially.
    - d. Eversion turns the sole of the foot so that it faces laterally.
    - e. Protraction moves the mandible anteriorly; it juts the jaw forward.
    - f. Retraction returns the mandible to its original position.
    - g. Elevation means lifting a body part superiorly.
    - h. Depression means to move an elevated body part inferiorly.
    - i. Opposition occurs when you touch your thumb to the fingers on the same hand.

8.5 Five examples illustrate the diversity of synovial joints ( pp. 260–271; Figs. 8.7–8.12; Focus Figure 8.1)

- A. Six types of synovial joint shapes determine the movements that can occur at a joint. (pp. 262–263; Focus Figure 8.1)
1. Plane joints have flat articular surfaces and allow gliding movements.
  2. Hinge joints consist of a cylinder that nests in a trough, and allow flexion and extension.
  3. Pivot joints consist of an axle that protrudes into a sleeve, and allow rotation of a bone around the long axis.
  4. Condylar joints consist of oval articular surfaces, and permit flexion, extension, abduction, and adduction.
  5. Saddle joints consist of a pair of articular surfaces, each bearing complementary concave and convex areas, and allow flexion, extension, adduction, and abduction.
  6. Ball-and-socket joints consist of a spherical head that articulates with a cup, and allow flexion, extension, adduction, abduction, and rotation.
- B. Knee Joint (pp. 264–266; Figs. 8.7–8.8; Table 8.2)
1. The single cavity of the knee joint consists of three joints in one: the femoropatellar joint, the lateral and medial joints between the femoral condyles, and the menisci of the tibia, known collectively as the tibiofemoral joint.
    - a. The tibiofemoral joint is a hinge joint, allowing mostly flexion and extension, although limited rotation is possible when the knee is bent.
    - b. The femoropatellar joint is a plane joint that allows the patella to glide across the knee when the knee is flexed.
  2. Three types of ligaments stabilize and strengthen the capsule of the knee joint: capsular and extracapsular ligaments prevent hyperextension and rotation when the knee is extended, and cruciate ligaments that keep the articulating bones of the knee aligned.
    - a. The knee capsule is reinforced by muscle tendons such as the strong tendons of the quadriceps muscles and the tendon of the semimembranosus.
- C. Shoulder (Glenohumeral) Joint (pp. 266–267; Fig. 8.9; Table 8.2)
- a. The shoulder joint is a ball-and-socket joint that is the most freely moving joint in the body, although it is not a very stable joint.
  - b. The joint capsule surrounding the shoulder joint is thin and loose, and supporting ligaments are located mostly on the anterior aspect, and are weak.
  - c. The tendons that cross the shoulder joint form the rotator cuff, encircling the joint, and providing the most stabilizing effect on the joint.
- D. Elbow Joint (p. 268; Fig. 8.10; Table 8.2)
- a. The joint between the ulna and humerus provides a stable and smoothly operating hinge joint that allows flexion and extension only.
  - b. The thin articular capsule of the elbow provides substantial flexion and extension, but side-to-side movements are restricted by strong capsular ligaments.
  - c. Tendons of several arm muscles, the biceps and the triceps, also provide additional stability by crossing the elbow joint.

- d. The radius is not involved in flexion or extension at the elbow, but rotates within the annular ligament to provide pronation and supination of the forearm.
  - E. Hip (Coxal) Joint (pp. 268–269; Fig. 8.11; Table 8.2)
    - a. The hip joint is a ball-and-socket joint that provides a wide range of motion.
    - b. Several strong ligaments reinforce the capsule of the hip joint.
    - c. The muscle tendons that cross the joint contribute to the stability and strength of the joint, but the majority of the stability of the hip joint is due to the deep socket of the acetabulum and the ligaments.
  - F. Temporomandibular Joint (pp. 270–271; Fig. 8.12; Table 8.2)
    - a. The temporomandibular joint allows both hinge-like movement and side-to-side lateral excursion.
    - b. The joint contains an articular disc that divides the synovial cavity into compartments that support each type of movement.
    - c. The lateral aspect of the articular capsule contains a lateral ligament that reinforces the joint.
- 8.6 Joints are easily damaged by injury, inflammation, and degeneration (pp. 271–274; Fig. 8.13–8.14)**
- A. Common Joint Injuries (pp. 271–272; Fig. 8.13)
    1. Cartilage tears occur when a meniscus is subjected to compression and shear stress at the same time.
    2. Sprains result from stretching or tearing of the ligaments and may repair themselves, although surgical repair may be necessary.
    3. Dislocations occur when the bones are forced out of alignment and are usually accompanied by sprains, inflammation, and immobility of the joint.
  - B. Inflammatory and Degenerative Conditions (pp. 272–274; Fig. 8.14)
    1. Bursitis, an inflammation of the bursa, is usually caused by a blow or friction, while tendonitis is inflammation of the tendons, and is usually caused by overuse.
    2. Arthritis describes many inflammatory or degenerative diseases that damage the joints, resulting in pain, stiffness, and swelling of the joint.
      - a. Osteoarthritis is the most common chronic arthritis. It is the result of breakdown of articular cartilage and subsequent thickening of bone tissue, which may restrict joint movement.
      - b. Rheumatoid arthritis is a chronic inflammatory disorder that is an autoimmune disease.
      - c. Gouty arthritis results when uric acid is deposited in the soft tissues of the joints.
    3. Lyme disease is an inflammatory condition caused by a type of spirochete bacteria transmitted by ticks living on deer and mice.
- Developmental Aspects of Joints (pp. 274–275)**
- A. In an embryo, joints develop at the same time as bones, and resemble adult joints by week 8. (p. 274)
  - B. During childhood, use defines the size, shape, and flexibility of joints. (p. 274)

C. At late middle age and beyond, ligaments and tendons shorten and weaken, intervertebral discs become more likely to herniate, and there is onset of osteoarthritis. (p. 274)