

CHAPTER 9

LECTURE OUTLINE

INTRODUCTION

I. A joint (articulation or arthrosis) is a point of contact between two or more bones, between cartilage and bones, or between teeth and bones.

- A. The scientific study of joints is called arthrology.
- B. The scientific study of motion is called kinesiology.

II. JOINT CLASSIFICATION

- A. Structural classification is based on the presence or absence of a synovial (joint) cavity and type of connecting tissue. Structurally, joints are classified as fibrous, cartilaginous, or synovial.
- B. Functional classification of joints is based on the degree of movement permitted. Joints may be synarthroses (immovable), amphiarthroses (partially movable), or diarthroses (freely movable).

III. FIBROUS JOINTS

- A. Fibrous joints lack a synovial cavity, have the articulating bones held together by fibrous connective tissue, and permit little or no movement.
- B. Types of fibrous joints include sutures, syndesmoses, and interosseous membranes.
 - 1. A suture is a fibrous joint composed of a thin layer of dense fibrous connective tissue that unites skull bones (Figure 9.1a).
 - 2. A synostosis is a suture joint that has ossified. An example of a synostosis is the frontal suture between the left and right sides of the frontal bone.
 - a. A synostosis is functionally classified as a synarthrosis.
 - 3. A syndesmosis is a fibrous joint in which there is more fibrous connective tissue than in a suture (Figure 9.1b).
 - a. A gomphosis is a fibrous syndesmoses joint in which a cone-shaped peg fits into a socket, allowing no movement. An example is the root of a tooth in its socket (Figure 9.1b).
 - b. Another example of a syndesmoses is the distal tibiofibular ligament which permits some movement.

4. An interosseous ligament is a fibrous joint made of a broad sheet of ligament that allows some movement between adjacent bones. An example is between the radius and ulna. (Figure 9.1c)

IV. CARTILAGINOUS JOINTS

- A. A cartilaginous joint lacks a synovial cavity, has the articulating bones connected by either fibrocartilage or hyaline cartilage, and allows little or no movement.
- B. The two types of cartilaginous joints are synchondroses and symphyses.
 1. A synchondrosis is a cartilaginous joint in which the connecting material is hyaline cartilage, allowing no movement (Figure 9.2a).
 2. A symphysis is a cartilaginous joint in which the connecting material is a disc of fibrocartilage, allowing some movement. Examples are the intervertebral discs and the pubic symphysis (Figure 9.2b).

V. SYNOVIAL JOINTS

- A. Synovial joints have a synovial (joint) cavity between the articulating bones (Figure 9.3) and are freely movable (diarthrotic).
- B. Structure of Synovial Joints
 1. Articular cartilage
 - a. The articular cartilage covers the bones at synovial joints.
 - b. The articular cartilage reduces friction at the joint with movement and helps absorb shock
 2. Articular Capsule
 - a. The articular capsule surrounds a diarthrosis, encloses the synovial cavity, and unites the articulating bones.
 - b. The articular capsule is composed of two layers - the outer fibrous capsule (which may contain ligaments) and the inner synovial membrane (which secretes a lubricating and joint-nourishing synovial fluid) (Figure 9.3).
 - c. The flexibility of the fibrous capsule permits considerable movement at a joint, whereas its great tensile strength helps prevent bones from dislocating.
 - d. Other capsule features include ligaments and articular fat pads (Figure 9.15c).
 - e. **Clinical Connection:** Autologous Chondrocyte Implantation

3. Synovial fluid, secreted by the synovial membrane, lubricates and reduces friction in the joint and supplies nutrients to and removes metabolic wastes from the joint.
- C. Accessory Ligaments and Articular Discs
1. Many diarthroses also contain accessory ligaments and articular discs (menisci) (Figure 9.15d).
 2. Ligaments help hold bone to bone.
 3. Articular discs modify the shape of the joint surfaces of the articulating bones, help maintain the stability of the joint, and direct the flow of synovial fluid to areas of greatest friction (see Figure 9.15d).
 4. The labrum is an important structure for ball and socket type joints (Figure 9.14c)
 5. **Clinical Connection:** Torn cartilage, occurring frequently in the knees of athletes, is damage to the articular discs that lie between the ends of some bones. Removal, to prevent erosion and arthritis, is usually accomplished by arthroscopy.

VI. Nerve and Blood Supply

- A. Nerves that supply a joint are the same as those that supply the skeletal muscles that move the joint.
- B. Numerous arteries and veins supply the joints and surrounding structures.

VII. Bursae and Tendon Sheaths

- A. Bursae are synovial fluid filled saclike structures that cushion the movement of one body part over another (Figures 9.12 and 9.15c). They are found where one part of the body moves over another.
- B. Tendon sheaths are tubelike bursae that wrap around tendons where there is considerable friction, such as the tendon of the biceps brachii at the shoulder joint (Figure 9.12c).
 1. **Clinical Connection:** Bursitis is a chronic inflammation of a burse.
 2. **Clinical Connection:** Tenosynovitis
- C. Table 9.2 summarizes the structural and functional categories of joints.

VIII. TYPES OF MOVEMENTS AT SYNOVIAL JOINTS

- A. Gliding movements occur when relatively flat bone surfaces move back and forth and from side to side with respect to one another (Figure 9.4).
 1. In gliding joints there is no significant alteration of the angle between the bones.
 2. Gliding movements occur at plantar joints.

B. Angular Movements

1. In angular movements there is an increase or a decrease in the angle between articulating bones.
2. The principal angular movements are flexion, extension and hyperextension (Figure 9.5)
 - a. Flexion results in a decrease in the angle between articulating bones.
 - b. Extension results in an increase in the angle between articulating bones.
 - c. Lateral flexion involves the movement of the trunk sideways to the right or left at the waist. The movement occurs in the frontal plane and involves the intervertebral joints
 - d. Hyperextension is a continuation of extension beyond the anatomical position and is usually prevented by the arrangement of ligaments and the anatomical alignment of bones .

C. Abduction, Adduction, and Circumduction

1. Abduction refers to the movement of a bone away from the midline (Figure 9.6-c).
2. Adduction refers to the movement of a bone toward the midline (Figure 9.6a-c).
3. Circumduction refers to movement of the distal end of a part of the body in a circle (Figure 9.7).
 - a. Circumduction occurs as a result of a continuous sequence of flexion, abduction, extension, and adduction.
 - b. Condylloid, saddle, and ball-and-socket joints allow circumduction.
4. In rotation, a bone revolves around its own longitudinal axis (Figure 9.8a).
 - 1) Pivot and ball-and-socket joints permit rotation.
 - i. If the anterior surface of a bone of the limb is turned toward the midline, medial rotation occurs. If the anterior surface of a bone of the limb is turned away from the midline, lateral rotation occurs (Figure 9.8 b&c).

D. Special Movements

1. Elevation is an upward movement of a part of the body (Figure 9.9a).
2. Depression is a downward movement of a part of the body (Figure 9.9b).
3. Protraction is a movement of a part of the body anteriorly in the transverse plane (Figure 9.9c).
4. Retraction is a movement of a protracted part back to the anatomical position (Figure 9.9d).

5. Inversion is movement of the soles medially at the intertarsal joints so that they face away from each other (Figure 9.9e).
6. Eversion is a movement of the soles laterally at the intertarsal joints so that they face away from each other (Figure 9.9f).
7. Dorsiflexion refers to bending of the foot at the ankle in the direction of the superior surface (Figure 9.9g).
8. Plantar flexion involves bending of the foot at the ankle joint in the direction of the plantar surface (Figure 9.9g).
9. Supination is a movement of the forearm at the proximal and distal radioulnar joints in which the palm is turned anteriorly or superiorly (Figure 9.9h).
10. Pronation is a movement of the forearm at the proximal and distal radioulnar joints in which the distal end of the radius crosses over the distal end of the ulna and the palm is turned posteriorly or inferiorly (Figure 9.9h).
11. Opposition is the movement of the thumb at the carpometacarpal joint in which the thumb moves across the palm to touch the tips of the finger on the same hand (see Figure 9.9i).
 - a. A summary of the movements that occur at synovial joints is presented in Table 9.1.

IX. TYPES OF SYNOVIAL JOINTS

- A. Plain joints (Plantar joint) permit mainly side-to-side and back-and-forth gliding movements (Figure 9.10a). These joints are nonaxial and include the intercarpal, intertarsal, sternoclavicular, acromioclavicular, sternocostal, and vertebrocostal joints.
- B. A hinge joint contains the convex surface of one bone fitting into a concave surface of another bone (Figure 9.10b). Movement is primarily flexion or extension in a single plane. Examples include the elbow, knee, ankle, and interphalangeal joints.
- C. In a pivot joint, a round or pointed surface of one bone fits into a ring formed by another bone and a ligament (Figure 9.10c). Movement is rotational and monaxial. An example is the atlas rotating about the axis (see Figure 9.9a).
- D. In an condyloid joint, an oval-shaped condyle of one bone fits into an elliptical cavity of another bone (Figure 9.10d). Movements are flexion-extension, abduction-adduction, and circumduction; an example is the joint between the carpals and the radius.

- E. A saddle joint contains one bone whose articular surface is saddle-shaped and another bone whose articular surface is shaped like a rider sitting in the saddle. Movements are flexion-extension, abduction-adduction, and circumduction (Figure 9.10e).
- F. In a ball-and-socket joint, the ball-shaped surface of one bone fits into the cuplike depression of another (Figure 9.10f). Movements are flexion-extension, abduction-adduction, rotation, and circumduction; the only examples are the shoulder joint and hip joint.

X. FACTORS AFFECTING CONTACT AND RANGE OF MOTION AT SYNOVIAL JOINTS

- A. Structure and shape of the articulating bone
- B. Strength and tautness of the joint ligaments
- C. Arrangement and tension of the muscles
- D. Contact of soft parts
- E. Hormones
- F. Disuse

XI. SELECTED JOINTS OF THE BODY

A. Temporomandibular joint (Exhibit 9.1 and Figure 9.11)

1. Anatomical components
 - a. Articular disc (meniscus).
 - b. Articular capsule.
 - c. Lateral ligament.
 - d. Sphenomandibular ligament
 - e. Stylomandibular ligament
2. This is a combined hinge and planar joint formed by the condylar process of the mandible and the mandibular fossa of the temporal bone.
3. Movements at the joint include elevation, depression, protraction, retraction and lateral displacement.

B. Shoulder Joint (Exhibit 9.2 and Figure 9.12).

1. This is a ball-and-socket joint formed by the head of the humerus and the glenoid cavity of the scapula.
2. Anatomical Components
 - a. Articular capsule.
 - b. Coracohumeral ligament
 - c. Glenohumeral ligaments

- d. Transverse humeral ligament
 - e. Glenoid labrum
 - f. Bursae
3. Movements at the joint include flexion, extension, abduction, adduction, medial and lateral rotation, and circumduction of the arm.
 4. **Clinical Connection:** This joint shows extreme freedom of movement at the expense of stability with the result of dislocation, separation and rotator cuff injuries .

C. Elbow Joint (Exhibit 9.3 and Figure 9.13)

1. This is a hinge joint formed by the trochlea of the humerus, the trochlear notch of the ulna, and the head of the radius.
2. Anatomical Components
 - a. Articular capsule
 - b. Ulnar collateral ligament
 - c. Radial collateral ligament
 - d. Anular ligament of the radius.
3. Movements at this joint are flexion and extension of the forearm.
4. **Clinical Connection:** Elbow injuries like tennis elbow and little-league elbow may result from incorrect usage.

D. Hip Joint (Exhibit 9.4 and Figure 9.14)

1. This ball-and-socket joint is formed by the head of the femur and the acetabulum of the hipbone.
2. Anatomical Components
 - a. Articular capsule
 - b. Iliofemoral ligament
 - c. Pubofemoral ligament
 - d. Ischiofemoral ligament
 - e. Ligament of the head of the femur
 - f. Acetabular labrum
 - g. Transverse ligament of the acetabulum
3. Movements at this joint include flexion, extension, abduction, adduction, circumduction, and medial and lateral rotation of the thigh.
4. This is an extremely stable joint due to the bones making up the joint and the accessory ligaments and muscles.

E. Knee Joints (Exhibit 9.5 and Figure 9.15)

1. This is the largest and most complex joint of the body and consists of three joints within a single synovial cavity
2. Anatomical Components
 - a. Articular capsule
 - b. Medial and lateral patellar retinacula
 - c. Patellar ligament.
 - d. Oblique popliteal ligament
 - e. Arcuate popliteal ligament.
 - f. Tibial collateral ligament.
 - g. Fibular collateral ligament
 - h. Intracapsular ligaments
 - i. Anterior cruciate ligament (ACL)
 - j. Articular discs (menisci)
 - k. The more important bursae of the knee include the following
 - 1) Prepatellar bursa between the patella and skin (Figure 9.15c, d).
 - 2) Infrapatellar bursa between superior part of tibia and patellar ligament (Figure 9.15c–e).
 - 3) Suprapatellar bursa between inferior part of femur and deep surface of quadriceps femoris muscle (Figure 9.15c–e).
3. at this joint include flexion, extension, slight medial rotation, and lateral rotation of the leg in a flexed position.
4. **Clinical Connection:** A common type of knee injury involves damage to the ligaments and meniscus
5. Refer to Tables 9.3 and 9.4 to integrate bones, joint classifications, and movements in selected joints of the axial and appendicular division, respectively.

XII. AGING AND JOINTS

- A. Various aging effects on joints include decreased production of synovial fluid, a thinning of the articular cartilage, and loss of ligament length and flexibility.
- B. The effects of aging on joints are due to genetic factors as well as wear and tear on joints.

XIII. DISORDERS: HOMEOSTATIC IMBALANCES

- A. Common injuries to joints include: rotator cuff injuries, separated shoulder, tennis elbow, dislocation of the radial head and knee injuries.

B. Rheumatism and Arthritis

1. Rheumatism refers to any painful state of the supporting structures of the body - bones, ligaments, joints, tendons, or muscles.
 - a. Rheumatoid arthritis is an autoimmune disease in which the body's immune system attacks its own cartilage and joint linings resulting in loss of joint function (Figure 9.15).
2. Arthritis is a form of rheumatism in which the joints become inflamed.
3. Osteoarthritis is a degenerative joint disease commonly known as “wear-and-tear” arthritis. It is characterized by deterioration of articular cartilage and bone spur formation. It is noninflammatory and primarily affects weight-bearing joints.
4. Gouty arthritis is a condition in which sodium urate crystals are deposited in soft tissues of joints, causing inflammation, swelling, and pain. If not treated, bones at affected joints will eventually fuse, rendering the joints immobile.

C. **MEDICAL TERMINOLOGY** - Students should be alerted to the glossary of medical terminology associated with joints.