Chapter 8: Joints

Objectives:
1. Define joint or articulation.
2. Classify joints structurally and functionally.
3. Describe the general structure of fibrous joints. Name and give an example of each of the three common types of fibrous joints.
4. Describe the general structure of cartilaginous joints. Name and give an example of each of the two common types of cartilaginous joints.
5. Describe the structural characteristics of synovial joints.
7. Compare the structures and functions of bursae and tendon sheaths.
8. Name and describe (or perform) the common body movements.
9. Name and provide examples of the 6 types of synovial joints based on the movement(s) allowed.
10. Describe the elbow, knee, hip, jaw, and shoulder joints relative to articulating bones, anatomical characteristics of the joint movements allowed, and joint stability.
11. Name the most common joint injuries and discuss the symptoms and problems associated with each.
12. Compare and contrast the common types of arthritis.
13. Discuss factors that promote or disturb joint homeostasis.

I. Joints (Articulations)
   A. Weakest parts of the skeleton
   B. Articulation – site where two or more bones meet
   C. Functions of joints
      1. Give the skeleton mobility
      2. Hold the skeleton together

II. Classification of Joints: Structural
   A. Structural classification focuses on the material binding bones together and whether or not a joint cavity is present
   B. The three structural classifications are:
      1. Fibrous
      2. Cartilaginous
      3. Synovial
III. Classification of Joints: Functional
A. Functional classification is based on the amount of movement allowed by the joint
B. The three functional classes of joints are:
   1. Synarthroses – immovable
   2. Amphiarthroses – slightly movable
   3. Diarthroses – freely movable

IV. Fibrous Structural Joints
A. The bones are joined by fibrous tissues
B. There is no joint cavity
C. Most are immovable
D. There are three types
   1. sutures
   2. syndesmoses
   3. gomphoses
E. Sutures
   1. Occur between the bones of the skull
   2. Comprised of interlocking junctions completely filled with connective tissue fibers
   3. Bind bones tightly together, but allow for growth during youth
   4. In middle age, skull bones fuse and are called synostoses
F. Syndesmoses
   1. Bones are connected by a fibrous tissue ligament
   2. Movement varies from immovable to slightly variable
   3. Examples
      a. connection between tibia and fibula
      b. connection between radius and ulna
G. Gomphoses
1. The peg-in-socket fibrous joint between a tooth and its alveolar socket
2. The fibrous connection is the periodontal ligament

V. Cartilaginous Joints
A. Articulating bones are united by cartilage
B. Lack a joint cavity
C. Two types
   1. synchondroses
   2. symphyses
D. Synchondroses
   1. A bar or plate of hyaline cartilage unites the bones
   2. All synchondroses are synarthrotic
   3. Examples:
      a. Epiphyseal plates of children
      b. Joint between the costal cartilage of the first rib and the sternum
E. Symphyses
   1. Hyaline cartilage covers the articulating surface of the bone and is fused to an intervening pad of fibrocartilage
   2. Amphiarthrotic joints designed for strength and flexibility
   3. Examples
      1. intervertebral joints
      2. pubic symphysis of the pelvis

VI. Synovial Joints
A. Those joints in which the articulating bones are separated by a fluid-containing joint cavity
B. All are freely movable diarthroses
C. Examples
1. all limb joints  
2. most joints of the body  

D. General Structure  
1. Synovial joints all have the following  
   a. Articular cartilage  
   b. Joint (synovial) cavity  
   c. Articular capsule  
   d. Synovial fluid  
   e. Reinforcing ligaments  

E. Friction-Reducing Structures  
1. Bursae  
   a. flattened, fibrous sacs lined with synovial membranes and containing synovial fluid  
   b. Common where ligaments, muscles, skin, tendons, or bones rub together  
2. Tendon sheath  
   a. elongated bursa that wraps completely around a tendon  

F. Stability  
1. Stability is determined by:  
   a. Articular surfaces – shape determines what movements are possible  
   b. Ligaments – unite bones and prevent excessive or undesirable motion  
2. Muscle tone is accomplished by:  
   a. Muscle tendons across joints acting as stabilizing factors  
   b. Tendons that are kept tight at all times by muscle tone  

G. Movement  
1. Two muscle attachments across a joint  
   a. Origin – attachment to the immovable bone  
   b. Insertion – attachment to the movable bone  
1. Described as movement along transverse, frontal, or sagittal planes  

H. Range of Motion  
a. Nonaxial – slipping movements only  
b. Uniaxial – movement in one plane  
  c. Biaxial – movement in two planes  
  d. Multiaxial – movement in or around all three planes  

I. Gliding Movements  
   a. One flat bone surface glides or slips over another similar surface  
   b. Examples
1. intercarpal and intertarsal joints
2. between the flat articular processes of the vertebrae

J. Angular Movement
1. Flexion — bending movement that decreases the angle of the joint
2. Extension — reverse of flexion; joint angle is increased
3. Dorsiflexion and plantar flexion — up and down movement of the foot
4. Abduction — movement away from the midline
5. Adduction — movement toward the midline
6. Circumduction — movement describes a cone in space
7. Rotation — turning of a bone around its own long axis
   a. Examples
      1. Between first two vertebrae
      2. Hip and shoulder joints

K. Special Movements
1. Supination and pronation — movement of radius and ulna
   a. supination – palm up
   b. pronation – palm down
2. Inversion and eversion — movement of foot
   a. inversion – sole inward
   b. eversion – sole out
3. Protraction and retraction
   a. protraction – moving forward
   b. retraction – moving backward
4. Elevation and depression
   a. elevation – moving up
   b. depression – moving down
5. Opposition – moving in opposite directions
6. Hyperextension — movement above 180°

VII. Types of Synovial Joints
A. Plane Joint
1. Articular surfaces are essentially flat
2. Allow only slipping or gliding movements
3. Only examples of nonaxial joints

B. Hinge joints
1. Cylindrical projections of one bone fits into a trough-shaped surface on another
2. Motion is along a single plane
3. Uniaxial joints permit flexion and extension only
4. Examples
   a. elbow
   b. interphalangeal joints
C. Pivot Joints
   1. Rounded end of one bone protrudes into a “sleeve,” or ring, composed of bone (and possibly ligaments) of another
   2. Only uniaxial movement allowed
   3. Examples
      1. joint between the axis and the dens
      2. proximal radioulnar joint
D. Condyloid or Ellipsoidal Joints
   1. Oval articular surface of one bone fits into a complementary depression in another
   2. Both articular surfaces are oval
   3. Biaxial joints permit all angular motions
   4. Examples
      a. radiocarpal (wrist) joints
      b. metacarpophalangeal (knuckle) joints
E. Saddle Joints
   1. Similar to condyloid joints but allow greater movement
   2. Each articular surface has both a concave and a convex surface
   3. Example
      a. carpometacarpal joint of the thumb
F. Ball-and-Socket Joints
   1. A spherical or hemispherical head of one bone articulates with a cuplike socket of another
   2. Multiaxial joints permit the most freely moving synovial joints
   3. Examples
      a. shoulder
      b. hip joints

VII. Selected Synovial Joints
   A. Knee
      1. Largest and most complex joint of the body
      2. Allows flexion, extension
      3. Three joints in one surrounded by a single joint cavity
         a. Femoropatellar joint
         b. Lateral and medial tibiofemoral joints
   B. Shoulder (Glenohumeral)
1. Ball-and-socket joint in which stability is sacrificed to obtain greater freedom of movement
2. Head of humerus articulates with the glenoid fossa of the scapula
3. Shoulder Stability  
   a. Weak stability is maintained by:  
      1) Thin, loose joint capsule  
      2) Four ligaments – coracohumeral, and three glenohumeral  
      3) Tendon of the long head of biceps, which travels through the intertubercular groove and secures the humerus to the glenoid cavity  
      4) Rotator cuff (four tendons) that encircles the shoulder joint and blends with the articular capsule
C. Elbow  
   1. Hinge joint that allows flexion and extension only  
   2. Radius and ulna articulate with the humerus
D. Hip (Coxal) Joint  
   1. Ball-and-socket joint  
   2. Head of the femur articulates with the acetabulum  
   3. Good range of motion, but limited by the deep socket and strong ligaments
E. Temporomandibular Joint (TMJ)  
   1. Mandibular condyle articulate with the temporal bone  
   2. Two types of movement  
      a. Hinge – depression and elevation of mandible  
      b. Side to side – (lateral excursion) grinding of teeth
IX. Common Joint Injuries
A. Sprains  
   1. The ligaments reinforcing a joint are stretched or torn  
   2. Partially torn ligaments slowly repair themselves  
   3. Completely torn ligaments require prompt surgical repair
B. Cartilage Injuries  
   1. The snap and pop of overstressed cartilage  
   2. Common aerobics injury  
   3. Repaired with arthroscopic surgery
C. Dislocations  
   1. Occur when bones are forced out of alignment  
   2. Usually accompanied by sprains, inflammation, and joint immobilization
3. Caused by serious falls and are common sports injuries
4. Subluxation – partial dislocation of a joint

X. Inflammatory and Degenerative Condition
A. Tendonitis
   1. Inflammation of tendon sheaths typically caused by overuse
   2. Symptoms and treatment are similar to bursitis
B. Arthritis
   1. More than 100 different types of inflammatory or degenerative diseases that damage the joints
   2. Most widespread crippling disease in the U.S.
   3. Symptoms
      a. pain
      b. stiffness
      c. swelling of a joint
   4. Acute forms are caused by bacteria and are treated with antibiotics
   5. Chronic forms include osteoarthritis, rheumatoid arthritis, and gouty arthritis
6. Osteoarthritis (OA)
   a. Most common chronic arthritis; often called “wear-and-tear” arthritis
   b. Affects women more than men
   c. 85% of all Americans develop OA
   d. More prevalent in the aged, and is probably related to the normal aging process
7. Rheumatoid Arthritis (RA)
   a. Chronic, inflammatory, autoimmune disease of unknown cause, with an insidious onset
   b. Usually arises between the ages of 40 to 50, but may occur at any age
   c. Signs and symptoms
      1) joint tenderness
      2) anemia
      3) osteoporosis
      4) muscle atrophy
      5) cardiovascular problems
8. Gouty Arthritis
   a. Deposition of uric acid crystals in joints and soft tissues, followed by an inflammation response
b. Typically, gouty arthritis affects the joint at the base of the great toe
c. In untreated gouty arthritis, the bone ends fuse and immobilize the joint

XII. Developmental Aspects of Joints
   A. By embryonic week 8, synovial joints resemble adult joints
   B. Few problems occur until late middle age
   C. Advancing years take their toll on joints:
   D. Ligaments and tendons shorten and weaken
   E. Intervertebral discs become more likely to herniate
   F. Most people in their 70s have some degree of OA
   G. Prudent exercise (especially swimming) that coaxes joints through their full range of motion is key to postponing joint problems