Chapter 9
Joints

An Introduction to Joints

- **Articulations**
  - Body movement occurs at joints (articulations) where two bones connect
- Joint Structure
  - Determines direction and distance of movement (*range of motion* or *ROM*)
  - Joint strength decreases as mobility increases

9-1 Classification of Joints

- Two Methods of Classification
  1. Functional classification is based on range of motion of the joint
  2. Structural classification relies on the anatomical organization of the joint

9-1 Classification of Joints

- Functional Classifications
  - **Synarthrosis** (*immovable joint*)
  - **Amphiarthrosis** (slightly movable joint)
  - **Diarthrosis** (freely movable joint)

9-1 Classification of Joints

- Structural Classifications
  - *Bony*
  - *Fibrous*
  - *Cartilaginous*
  - *Synovial*

9-1 Classification of Joints

- **Synarthroses** (*Immovable Joints*)
  - Are very strong
  - Edges of bones may touch or interlock
  - Four types of synarthrotic joints
    1. **Suture**
    2. **Gomphosis**
    3. **Synchondrosis**
    4. **Synostosis**

9-1 Classification of Joints

- **Suture**

- Bones interlocked
- Are bound by dense fibrous connective tissue
- Are found only in skull

- **Gomphosis**
  - Fibrous connection (*periodontal ligament*)
  - Binds teeth to sockets

9-1 Classification of Joints

- **Synchondrosis**
  - Is a rigid cartilaginous bridge between two bones
    - Epiphyseal cartilage of long bones
    - Between vertebrosternal ribs and sternum
- **Synostosis**
  - Fused bones, immovable
    - Metopic suture of skull
    - Epiphyseal lines of long bones

9-1 Classification of Joints

- **Amphiarthroses**
  - More movable than synarthrosis
  - Stronger than freely movable joint
  - Two types of amphiarthroses
    1. Syndesmosis
       - Bones connected by ligaments
    2. **Symphysis**
       - Bones separated by fibrocartilage

9-1 Classification of Joints

- **Synovial Joints (Diarthroses)**
  - Also called *movable joints*
  - At ends of long bones
  - Within **articular capsules**
  - Lined with *synovial membrane*

9-2 Synovial Joints

- **Articular Cartilages**
  - Pad articulating surfaces within **articular capsules**
    - Prevent bones from touching
  - Smooth surfaces lubricated by **synovial fluid**
    - Reduce friction

9-2 Synovial Joints

- **Synovial Fluid**
  - Contains slippery proteoglycans secreted by fibroblasts
  - Functions of synovial fluid
    1. *Lubrication*
    2. *Nutrient distribution*
    3. *Shock absorption*

9-2 Synovial Joints

- Accessory Structures
  - **Cartilages**
  - **Fat pads**
  - **Ligaments**
  - Tendons
  - **Bursae**

9-2 Synovial Joints

- **Cartilages**
  - Cushion the joint
    - Fibrocartilage pad called a **meniscus** (or *articular disc*; plural, *menisci*)
- **Fat Pads**
  - Superficial to the joint capsule
  - Protect articular cartilages
- **Ligaments**
  - Support, strengthen joints
  - **Sprain** – ligaments with torn collagen fibers

9-2 Synovial Joints

- Tendons
  - Attach to muscles around joint
  - Help support joint
- **Bursae**
  - Singular, *bursa*, a pouch
  - Pockets of synovial fluid
  - Cushion areas where tendons or ligaments rub

9-2 Synovial Joints

- Factors That Stabilize Synovial Joints
  - Prevent injury by limiting range of motion
    - Collagen fibers (joint capsule, ligaments)
    - Articulating surfaces and menisci
    - Other bones, muscles, or fat pads
    - Tendons of articulating bones

9-2 Synovial Joints

- Injuries
  - **Dislocation (luxation)**
    - Articulating surfaces forced out of position
    - Damages articular cartilage, ligaments, joint capsule
  - **Subluxation**
    - A partial dislocation

9-3 Movements

- Three Types of Dynamic Motion
  1. **Linear movement (gliding)**
  2. Angular **movement**
  3. **Rotation**
- Planes (Axes) of Dynamic Motion
  - **Monaxial** (1 axis)
  - **Biaxial** (2 axes)
  - **Triaxial** (3 axes)

9-3 Movements

- Types of Movement at Synovial Joints
  - Terms describe:
    - Plane or direction of motion
    - Relationship between structures
-

9-3 Movements

- Types of Movement at Synovial Joints
  - **Gliding movement**
    - Two surfaces slide past each other
      - Between carpal or tarsal bones

9-3 Movements

- Angular Movement
  - **Flexion**
    - Angular motion
    - Anterior–posterior plane
    - *Reduces* angle between elements
  - **Extension**
    - Angular motion
    - Anterior–posterior plane
    - *Increases* angle between elements

9-3 Movements

- Angular Movement
  - **Hyperextension**
    - Angular motion
    - Extension past anatomical position

9-3 Movements

- Angular Movement
  - **Abduction**
    - Angular motion
    - Frontal plane
    - Moves *away from* longitudinal axis
  - **Adduction**
    - Angular motion
    - Frontal plane
    - Moves *toward* longitudinal axis

9-3 Movements

- Angular Movement
  - **Circumduction**
    - Circular motion without rotation
    - Angular motion

9-3 Movements

- Types of Movement at Synovial Joints
  - **Rotation**
    - Direction of rotation from anatomical position
    - Relative to longitudinal axis of body
    - **Left** or **right** rotation
    - Medial rotation (*inward rotation*)
      - Rotates toward axis
    - **Lateral rotation** (*outward rotation*)
      - Rotates away from axis

9-3 Movements

- Types of Movements at Synovial Joints
  - Rotation
    - **Pronation**
      - Rotates forearm, radius over ulna
    - **Supination**
      - Forearm in anatomical position

Figure 9-4b Rotational Movements.

9-3 Movements

- Special Movements
  - **Inversion**
    - Twists sole of foot medially
  - **Eversion**
    - Twists sole of foot laterally
  - **Dorsiflexion**
    - Flexion at ankle (lifting toes)
  - **Plantar flexion**
    - Extension at ankle (pointing toes)

9-3 Movements

- Special Movements
  - **Opposition**
    - Thumb movement toward fingers or palm (grasping)
  - **Reposition**
    - Opposite of opposition
  - **Protraction**
    - Moves anteriorly
    - In the horizontal plane (pushing forward)
  - **Retraction**
    - Opposite of protraction
    - Moving anteriorly (pulling back)

9-3 Movements

- Special Movements
  - **Elevation**
    - Moves in superior direction (up)
  - **Depression**
    - Moves in inferior direction (down)
  - **Lateral flexion**
    - Bends vertebral column from side to side

9-3 Movements

- Functional Classification of Synovial Joints
  - **Gliding**
  - **Hinge**
  - **Pivot**
  - **Condylar**
  - **Saddle**
  - **Ball-and-socket**

9-3 Movements

- **Gliding Joints**
  - Flattened or slightly curved faces
  - Limited motion (nonaxial)
- **Hinge Joints**
  - Angular motion in a single plane (monaxial)
- **Condylar Joints**
  - Oval articular face within a depression
  - Motion in two planes (biaxial)

9-3 Movements

- **Saddle Joints**
  - Two concave, straddled (biaxial)
- **Pivot Joints**
  - Rotation only (monaxial)
- **Ball-and-Socket Joints**
  - Round articular face in a depression (triaxial)

9-3 Movements

- Joints
  - A joint cannot be both mobile and strong
  - The greater the mobility, the weaker the joint
  - Mobile joints are supported by muscles and ligaments, not bone-to-bone connections

9-4 Intervertebral Joints

- *Intervertebral Joints*
  - C_2 to L_5 spinal vertebrae articulate:
    - At inferior and superior articular processes (gliding joints)
    - Between adjacent vertebral bodies (symphyseal joints)

9-4 Intervertebral Joints

- Intervertebral Discs
  - Pads of fibrocartilage
  - Separate vertebral bodies
  - **Anulus fibrosus**
    - Tough outer layer
    - Attaches disc to vertebrae
  - **Nucleus pulposus**
    - Elastic, gelatinous core
    - Absorbs shocks

9-4 Intervertebral Joints

- Vertebral Joints
  - Also called symphyseal joints
  - As vertebral column moves:
    - **Nucleus pulposus** shifts
    - Disc shape conforms to motion
- Intervertebral Ligaments
  - Bind vertebrae together
  - Stabilize the vertebral column

9-4 Intervertebral Joints

- Six Intervertebral Ligaments
  1. *Anterior longitudinal ligament*
     - Connects anterior bodies
  2. *Posterior longitudinal ligament*
     - Connects posterior bodies
  3. *Ligamentum flavum*
     - Connects laminae

9-4 Intervertebral Joints

- Six Intervertebral Ligaments
  4. *Interspinous ligament*
     - Connects spinous processes
  5. *Supraspinous ligament*
     - Connects tips of spinous processes (C_7 to sacrum)
  6. *Ligamentum nuchae*
     - Continues supraspinous ligament (C_7 to skull)

9-4 Intervertebral Joints

- Damage to Intervertebral Discs
  - **Slipped disc**
    - Bulge in anulus fibrosus
    - Invades vertebral canal
  - **Herniated disc**
    - Nucleus pulposus breaks through anulus fibrosus
    - Presses on spinal cord or nerves

9-4 Intervertebral Joints

- Movements of the Vertebral Column
  1. Flexion
  2. Extension
  3. Lateral flexion
  4. Rotation

9-5 The Shoulder Joint

- The **Shoulder Joint**
  - Also called the *glenohumeral joint*
  - Allows more motion than any other joint
  - Is the least stable
  - Supported by skeletal muscles, tendons, ligaments
  - Ball-and-socket diarthrosis
  - Between head of *humerus* and *glenoid cavity* of scapula

9-5 The Shoulder Joint

- Socket of the Shoulder Joint
  - **Glenoid labrum**
    - Deepens socket of glenoid cavity
    - Fibrocartilage lining
    - Extends past the bone

9-5 The Shoulder Joint

- Processes of the Shoulder Joint
  - Acromion (clavicle) and coracoid process (scapula)
    - Project laterally, superior to the humerus
    - Help stabilize the joint

9-5 The Shoulder Joint

- Shoulder Ligaments
  - *Glenohumeral*
  - *Coracohumeral*
  - *Coracoacromial*
  - *Coracoclavicular*
  - *Acromioclavicular*
- **Shoulder Separation**
  - Dislocation of the shoulder joint

9-5 The Shoulder Joint

- Shoulder Muscles (*Rotator* Cuff)
  - *Supraspinatus*
  - *Infraspinatus*
  - *Subscapularis*
  - *Teres minor*

9-5 The Shoulder Joint

- Shoulder Bursae
  - *Subacromial*

- *Subcoracoid*
- *Subdeltoid*
- *Subscapular*

9-5 The Elbow Joint

- The Elbow Joint
  - A stable hinge joint
  - With articulations involving humerus, radius, and ulna

9-5 The Elbow Joint

- Joints of the Elbow
  - *Humeroulnar joint*
    - Largest joint
    - Trochlea of humerus and trochlear notch of ulna
    - Limited movement

9-5 The Elbow Joint

- Joints of the Elbow
  - *Humeroradial joint*
    - Smaller joint
    - Capitulum of humerus and head of radius

9-5 The Elbow Joint

- Supporting Structures of the Elbow
  - *Biceps brachii muscle*
    - Attached to radial tuberosity
    - Controls elbow motion
  - Elbow ligaments
    - *Radial collateral*
    - *Annular*
    - *Ulnar collateral*

9-6 The Hip Joint

- The Hip Joint
  - Also called *coxal joint*
  - Strong ball-and-socket diarthrosis
  - Wide range of motion

9-6 The Hip Joint

- Structures of the Hip Joint
  - Head of femur fits into it

- Socket of acetabulum
- Which is extended by fibrocartilaginous *acetabular labrum*

9-6 The Hip Joint

- Ligaments of the Hip Joint
  - *Iliofemoral*
  - *Pubofemoral*
  - *Ischiofemoral*
  - *Transverse acetabular*
  - *Ligamentum teres*

9-6 The Knee Joint

- The Knee Joint
  - A complicated hinge joint
  - Transfers weight from femur to tibia
  - Articulations of the knee joint
    - Two femur–tibia articulations
      - At medial and lateral condyles
    - One between patella and patellar surface of femur

9-6 The Knee Joint

- The Articular Capsule and Joint Cavity
  - Medial and lateral menisci
    - Fibrocartilage pads
    - At femur–tibia articulations
    - Cushion and stabilize joint
    - Give lateral support

9-6 The Knee Joint

- Seven Major Supporting Ligaments
  1. *Patellar ligament* (anterior)
  2. & 3. Two *popliteal ligaments* (posterior)
  4. & 5. *Anterior* and *posterior cruciate ligaments* (inside joint capsule)
  6. *Tibial collateral ligament* (medial)
  7. *Fibular collateral ligament* (lateral)

9-7 Effects of Aging on Joints

- Degenerative Changes
  - **Rheumatism**
    - A pain and stiffness of skeletal and muscular systems
  - **Arthritis**
    - All forms of rheumatism that damage articular cartilages of synovial

joints
  - *Osteoarthritis*
    - Caused by wear and tear of joint surfaces, or genetic factors affecting collagen formation
    - Generally in people over age 60

9-7 Effects of Aging on Joints

- *Rheumatoid Arthritis*
  - An inflammatory condition
  - Caused by infection, allergy, or *autoimmune disease*
  - Involves the immune system
- *Gouty Arthritis*
  - Occurs when crystals (uric acid or calcium salts)
    - Form within synovial fluid
    - Due to metabolic disorders

9-7 Effects of Aging on Joints

- Joint Immobilization
  - Reduces flow of synovial fluid
  - Can cause arthritis symptoms
  - Treated by **continuous passive motion** or **CPM** (therapy)
- Bones and Aging
  - Bone mass decreases
  - Bones weaken
  - Increases risk of hip fracture, hip dislocation, or pelvic fracture

9-8 Integration with Other Systems

- Bone Recycling
  - Living bones maintain equilibrium between:
    - Bone building (osteoblasts)
    - And breakdown (osteoclasts)

9-8 Integration with Other Systems

- Factors Affecting Bone Strength
  1. Age
  2. Physical stress
  3. Hormone levels
  4. Calcium and phosphorus uptake and excretion
  5. Genetic and environmental factors

9-8 Integration with Other Systems

- Bones Support Body Systems

- Support and protect other systems
- Store fat, calcium, and phosphorus
- Manufacture cells for immune system

9-8 Integration with Other Systems

- Bones Support Body Systems
  - Disorders in other body systems can cause:
    - Bone tumors
    - Osteoporosis
    - Arthritis
    - Rickets (vitamin D deficiency)