

## CHAPTER 8: JOINTS OF THE SKELETAL SYSTEM

### OBJECTIVES:

1. Define the term *articulation*.
2. Distinguish between the functional and structural classification of joints, and relate the terms that are essentially synonymous.
3. Compare and contrast the terms synarthrosis, amphiarthrosis and diarthrosis and give examples of each.
4. Name the three types of fibrous joints and give an example of each.
5. Identify the difference between the epiphyseal plate and an intervertebral disc.
6. Sketch a typical synovial joint labeling all structures. Then in text form, discuss the function of each of the labeled structures.
7. Name the components and functions of synovial fluid.
8. Define the terms *fatty pads*, *articular discs*, and *bursa*, and name a key location for each.
9. List and discuss three factors that influence the stability of a synovial joint.
10. Distinguish between the origin and insertion of a muscle.
11. Name the three general types of movements allowed by joints.
12. List the angular movements allowed by synovial joints and give examples of each.
13. Identify the special movements allowed by the joints of the radius and ulna, foot, and shoulders.
14. Name the six types of synovial joints and give an example of each.
15. Explain how an intervertebral disc can be all of the following: an amphiarthrosis, cartilaginous joint, symphysis, gliding joint, and plane joint.
16. Discuss some important joint disorders.

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Definition: **Joint (articulation)** = site where two bones come together.

### CLASSIFICATION OF JOINTS

#### I. **Functional Classification** of Joints:

- A. Based on the amount of movement allowed.
- B. 3 types:
  - 1. **Synarthroses** = immovable joints.
    - a. Example = sutures of skull.
  - 2. **Amphiarthroses** = slightly movable joints.
    - a. Example = intervertebral discs between vertebrae.
  - 3. **Diarthroses** = freely movable joints.
    - a. Examples = joints of appendicular skeleton.

#### II. **Structural Classification** of Joints:

- A. Based on material, which joins bones (between bones).
- B. 3 types: Fibrous, Cartilaginous, Synovial
  - 1. **Fibrous Joints** = joints composed of fibrous tissue; no joint cavity is present; 3 types:
    - a. **Sutures** = short fibrous CT fibers;
      - synarthroses.
      - Only found in skull
    - b. **Syndesmosis** = cord of fibrous tissue called a ligament;
      - amphiarthroses with "give" but no true movement;
      - Example = distal tibiofibular joint.
    - c. **Gomphosis** = tooth within its bony socket; (alveolar fossa)
      - short periodontal ligament.

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### II. Structural Classification of Joints:

- B. 3 types: Fibrous, Cartilaginous, Synovial
2. **Cartilaginous Joints** = joints composed of cartilage; no joint cavity; 2 types:
    - a. **Synchondrosis** = a plate of hyaline cartilage;
      - sites of bone growth during youth;
      - eventually ossify = synarthrotic;
      - Examples
        1. joint between the first rib and manubrium
        2. the epiphyseal plate.
    - b. **Symphysis** = pad or plate of fibrocartilage;
      - compressible "shock absorber";
      - limited movement = amphiarthroses;
      - Examples
        1. intervertebral discs and
        2. symphysis pubis.
  3. **Synovial Joints** = fluid-filled joint cavity; free movement = diarthrosis;

### III. GENERAL STRUCTURE OF A SYNOVIAL JOINT = 5 distinct features:

- A. **Articular cartilage** = hyaline cartilage covers the surface of each bone;
- B. **Joint cavity** = a potential space between the two bones, filled with synovial fluid;
- C. **Articular capsule** = double layered capsule surrounding cavity:
  1. External, tough flexible **fibrous capsule** (continuous with periosteum of the bones);
  2. **Synovial membrane** = loose CT lining of fibrous capsule, that also covers all internal joint surfaces excluding hyaline cartilage;
- D. **Synovial fluid** = viscous lubricating fluid within cavity.
  1. reduces friction between cartilages of 2 bones;
  2. provide "weeping lubrication";
  3. nourish cartilage;
  4. contain phagocytes.
- E. **Reinforcing ligaments** = ligaments that strengthen joint.
  1. Definition: A ligament joins a bone to another bone across a synovial joint.
  2. usually thickened portions of fibrous capsule (intrinsic or capsular);

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### III. GENERAL STRUCTURE OF A SYNOVIAL JOINT

- F. Other joint features:
1. **fatty pads** (hip & knee);
  2. **menisci or articular discs** or that separate cavity into 2 compartments (knee, jaw, sternoclavicular).
  3. **bursa** = flattened fibrous sacs with a synovial membrane and fluid that act as "ball bearings" to prevent friction on adjacent structures during joint activity;
    - a. cushion the movement of one body part over another;
    - b. located between skin and bone (where skin rubs over bone), and between muscle, tendons, ligaments and bone.

### IV. TYPES OF SYNOVIAL JOINTS

- A. **Ball-and-socket joints** = most freely movable joints; all angular movement;
  1. The head of one bone fits into the socket of another;
  2. Examples = hip and shoulder.
- B. **Condylloid joints** = permit all angular motion, except rotation.  
Examples = wrists and knuckles,
- C. **Gliding joints** = cartilaginous joints;  
Example = intervertebral discs.
- D. **Hinge joints** = permit flexion & extension only;  
Examples = elbow and knee.
- E. **Pivot joints** = permit rotation;  
Example = first intervertebral joint (atlantoaxial joint)
- F. **Saddle joints** = thumb;

### V. TYPES OF JOINT MOVEMENTS:

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### A. Definitions:

1. **Origin** = part of muscle attached to the immovable bone;
2. **Insertion** = part of a muscle attached to the movable bone;

\* When a muscle contracts across a joint, its insertion is pulled toward its origin.

### B. Three general types of movement:

1. **Gliding movements** = when flat bone surfaces glide or slide over one another.
  - a. occur at cartilaginous joints;
  - b. Examples = intervertebral discs and sternoclavicular joints.
2. **Angular movements** = changes in angles between bones; occur only at synovial joints.
  - a. **Flexion** = decreasing the angle between 2 bones.
    - Example = head toward chest.
      1. **Dorsiflexion** = bringing foot closer to shin.
      2. **Plantar flexion** = pointing one's toe (flexion toward the sole).
  - b. **Extension** = increasing the angle between 2 bones.
    - Example = straightening a flexed neck.
      1. **Hyperextension** = increasing the angle greater than 180°;

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### V. TYPES OF JOINT MOVEMENTS:

#### B. Three general types of movement: (continued)

##### 2. Angular Movements of Synovial Joints (continued)

c. **Abduction** = moving a limb away from the midline.

- Example = raising arm or thigh laterally;

d. **Adduction** = moving a limb toward the midline.

e. **Circumduction** = moving a limb in a circular (cone-shaped) manner.

f. **Rotation** = turning movement of a bone along its long axis.

- Example = atlas over axis (i.e. “just say no”).
- Example = shoulder and hip joint.

##### 3. **Special Movements** = those at specific joints

a. **supination/pronation** = movements between the radius and ulna at the proximal radioulnar joint

- thumb up = supination;
- thumb down = pronation;

b. **inversion/eversion** = movement of foot;

- sole inward = inversion;
- sole out = eversion;

c. **elevation/depression:**

- shoulder shrug = elevation;
- mandible in opening mouth = depression.

d. **protraction/retraction:**

- thrust forward = protraction
- pull back = retraction

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### VII. EXAMPLES OF SYNOVIAL JOINTS

#### A. **Shoulder joint** (2 joints)

1. Ball and socket is the **glenohumeral joint**
  - joins Glenoid cavity and head of humerus
2. Syndesmosis is called the **acromioclavicular joint**
  - acromial end of clavicle and the acromion process of the scapula
3. Ball and socket is surrounded by many reinforcing ligaments and tendons collectively called the **rotator cuff**
4. Many bursa also lubricate the shoulder
5. Movement can occur in any angular plane

#### B. **Elbow joint** (2 joints)

1. **Hinge** is between trochlea of humerus and trochlear notch of ulna
2. **Gliding joint** is between capitulum of humerus and head of radius
3. Very stable joint with many reinforcing ligaments
4. Only allows **flexion and extension**

#### C. **Hip joint (coxal joint)**

1. Ball and socket between head of femur and acetabulum of coxa
2. Contains many large reinforcing ligaments
3. Allows same movements as shoulder, but with less range due to bony limitations

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### VII. EXAMPLES OF SYNOVIAL JOINTS

#### D. **Knee** (3 joints)

1. Largest, most complex joint
2. Functions as a **hinge** even though 3 joints work together
3. Medial condyles of femur and tibia make one **condyloid joint**
4. Lateral condyles of femur and tibia make another **condyloid joint**
5. Patellar surface of femur and patella make a **gliding joint**
6. **Flexion and extension** with some slight rotation
7. Contains many reinforcing structures
  - a. **Extracapsular ligaments** – found outside joint capsule
    - patellar ligament
    - tibial (medial) collateral ligament; **MCL**
    - fibular (lateral) collateral ligament; **LCL**
  - b. **Intracapsular ligaments** – found inside joint capsule
    - anterior cruciate ligament; **ACL**
    - posterior cruciate ligament; **PCL**
    - prevent hyperextension
  - c. **Menisci**
    - medial meniscus
    - lateral meniscus
    - C-shaped fibrocartilage pads
    - Reshape the tibial condyles for a better fit
    - Absorb shock
  - d. Many **bursae**

### VIII. LIFE SPAN CHANGES

- A. Fontanelles of skull harden in first 2 years
- B. Epiphyseal plates harden from ages 14-20 years.
- C. Fibrocartilage loses water, decreasing flexibility of intervertebral joints and knees
- D. Collagen changes causing stiffening beginning at age 30.
- E. Exercise decreases onset of joint stiffening.

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### **IX Homeostatic Imbalances of Joints**

- A. Gout.
- B. Benign joint hypermobility syndrome.
- C. Dislocation.
- D. Joint Replacement.
- E. Joint Disorders.
- F. Different Types of Arthritis

### **X. Clinical Terms Related to the Joints**

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### XI. JOINT SUMMARY TABLE: (Examples keyed at the end of this outline)

<b>NAME OF JOINT</b>			
<b>STRUCTURAL CLASSIFICATION OF JOINT</b>			
<b>FUNCTIONAL CLASSIFICATION OF JOINT</b>			
<b>BONES INVOLVED IN ARTICULATION</b>			
<b>SPECIFIC MOVEMENTS ALLOWED BY JOINT</b>			
<b>CLASSIFICATION OF JOINT BASED ON MOVEMENTS ALLOWED</b>			

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### XI. JOINT SUMMARY TABLE: (Examples keyed at the end of this outline)

<b>NAME OF JOINT</b>	<b>HIP</b>	<b>SUTURE</b>	<b>SYMPHYSIS PUBIS</b>
<b>STRUCTURAL CLASSIFICATION OF JOINT</b>	SYNOVIAL	FIBROUS	CARTILAGINOUS (SYMPYSIS OF FIBRO-CARTILAGE)
<b>FUNCTIONAL CLASSIFICATION OF JOINT</b>	DIARTHROTIC	SYNARTHROTIC	AMPHI-ARTHROTIC
<b>BONES INVOLVED IN ARTICULATION</b>	HEAD OF FEMUR WITH ACETABULUM OF COXAL	SKULL BONES	PUBIS PORTIONS OF COXAL BONES
<b>SPECIFIC MOVEMENTS ALLOWED BY JOINT</b>	FLEXION, EXTENSION, ABDUCTION, ADDUCTION, CIRCUMDUCTION, ROTATION	NONE	GLIDING
<b>CLASSIFICATION OF JOINT BASED ON MOVEMENTS ALLOWED</b>	BALL -N- SOCKET	N/A	PLANE