JOINTS

Chapter 9

Anatomy and Physiology Lecture
JOINTS

(Bones are too rigid to bend without causing damage.)

(Bones are held together at joints by flexible connective tissue.)

(Imagine how a cast over the knee prevents flexibility.)

Articulation (Joint) is a point of contact between bones, between cartilage and bone, or between teeth and bones.

Arthrology - Scientific study of joints.

*The joints structure determines how it functions.

(Some joints permit no movement, others permit slight movement, and still others afford considerable movement.)

*The looser the fit, the greater the movement.
*Loosely fitted joints are prone to dislocation.

CLASSIFICATION OF JOINTS

1. Structural classification
2. Functional classification

1. Structural Classification
   1. Fibrous Joints
   2. Cartilaginous Joints
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3. Synovial Joints

Structural classification of joints are based on:

a. The presence or absence of a synovial (joint) cavity (a space between the articulating bones); and

b. The kind of connective tissue that binds the bones together. **Structurally** joints are classified as:

   a. **Fibrous** - In which there is no joint cavity and bones are held together by fibrous connective tissue;
   b. **Cartilaginous** - In which there is no joint cavity and the bones are held together by cartilage and
   c. **Synovial** - In which there is a joint cavity and the bones forming the joint are united by a surrounding articular capsule and frequently by accessory ligaments.

2. **Functional classification**

Takes into account the degree of movement they permit.

Joints are classified as:

A. **Synarthroses** is an immovable joint.
B. **Amphiarthroses** is a slightly movable joint.
C. **Diarthroses** is a freely movable joint.

A. **Synarthrosis (immovable joint)**

-Lack a synovial cavity.
-Articulating bones held closely together by fibrous connective tissue.
-Permit little or no movement.

**Three types of (synarthrosis)**
1. **Suture**
   A fibrous joint composed of a thin layer of dense fibrous connective tissue;
   - Unites the bones of the skull
   - Found between bones of the skull
   - United by a thin layer of dense fibrous connective tissue (Irregular (interdigitated) structure gives them added strength and decreases chances of fractures).
   - Functionally classified as Synarthroses (are immovable).

2. **Gomphosis**
   To bolt together.
   - A fibrous joint in which a cone-shaped peg fits into a socket.
   - Found in articulation of the roots of the teeth with the alveoli (sockets) of the Maxillae and mandible.

3. **Synchondrosis**
   A cartilaginous joint in which the connecting material is hyaline cartilage.
   - Joint between the rib and the sternum
   - Epiphyseal plate
   * Is a temporary joint since it is eventually replaced by bone
when growth ceases.

B. **Amphiarthrosis (Slightly Moveable Joint)**

- Do not have Synovial Cavity
- Like fibrous joints, they allow little or no movement

**Two types of Amphiarthrosis Joint:**

1. **Syndesmosis**, and
2. **Symphysis**

1. **Syndesmosis**

   - A fibrous joint in which there is considerably more fibrous connective tissue than in suture.
   - Found in the distal articulation of the *tibia* and *fibula*

2. **Symphysis**

   - A cartilaginous joint in which the connecting material is a broad, flat disc of fibrocartilage.
   - Found between bodies of vertebrae
   - The pubis symphysis between the anterior surface of hip-bones.

C. **Diarthrosis (Freely Movable Joint)**

1. **Structure**
Synovial Joint is a joint in which there is a space between articulating bones.

Synovial (Joint) Cavity is the name of that space.

Articular Cartilage covers the surface of the articulating bones but does not bind the bones together.

Articular Capsule encloses the synovial cavity and unites the articulating bones. Composed of two layers:

a. Fibrous Capsule - is the outer layer.
   - Consists of dense connective (collagenous) tissue.
   - The fibers are arranged in parallel bundles and are highly adapted to resist recurrent strain.

*Such fibers are called Ligaments.*

b. Synovial Membrane - is the inner layer.
   - Composed of loose connective tissue with elastic fibers and a variable amount of adipose tissue.
   - Secretes Synovial Fluid (SF)

*Synovial Fluid lubricates the joint and provides nourishment for the articular cartilage.

*Synovial fluid is similar in appearance and consistency to uncooked egg white.*

- One interesting feature of some synovial joint is their ability to produce a cracking sound when pulled apart.

2. Contact and Movement at a Diarthrosis

a. Structure (shape) of the articulating bones - how they fit with respect to each other.
b. Tension of ligaments - tense ligaments restrict the range of movement.
c. Muscle arrangement and tension.
d. Apposition of soft parts - may limit mobility. (eg. if you bend your arm at the elbow, it can move no further as the anterior surface of the forearm presses against the arm.)
e. Hormones, eg. Relaxin,

TYPES OF DIARTHROSIS

**Synovial Joints** are classified according to the shape of the adjoining articular surface. They are divided into six subtypes:

a. Plane or Gliding
b. Hinge
c. Pivot
d. Ellipsoidal
e. Saddle, and
f. Ball-and-Socket

a. **Plane or Gliding Joints** are usually flat.
   - Only side-to-side and back-and-forth movements are permitted.
   - Twisting and rotation are inhibited at gliding joints, generally because ligaments or adjacent bones restrict the range of movement.
   
   *Gliding joints are referred to as Nonaxial, because it does not move around an axis.

   **Example**: Joints between carpal bones, tarsal bones, the sternum and clavicle, and the scapula and clavicle.

b. **Hinge or Ginglymus Joint** is one in which the convex surface of one bone fits into the concave surface of another bone.
-Movement is usually Flexion and Extension. (Motion is similar to that of a hinged door.)

-Movement is primarily in a single plane, and the joint is therefore known as Monoaxial or Uniaxial.

Flexion decreases the angle between articulating bone. Extension increases the angle between articulating bones, often to restore a body part to its anatomical position after it has been flexed. Hyperextension continuation of extension beyond the anatomical position, such as when the head bends backward.

c. Pivot or Trochoid Joint a rounded, pointed, or conical surface of one bone articulates within a ring formed partly by another bone and partly by a ligament.

- The primary movement permitted is rotation, and the joint is therefore Monoaxial.

Example: Joint between the atlas and axis (atlantoaxial).
Joint between the proximal ends of the radius and ulna.

*Supination and Pronation of the palms and rotation of the head from side to side.

d. Ellipsoidal or Condyloid Joint an oval-shaped condyle of one bone fits into an elliptical cavity of another bone.
- Since the joint permits side-to-side and back-and-forth movements, it is Biaxial.

Example: Joint at the wrist between the radius and carpals (when you flex and extend, and abduct and adduct and circumduct the wrist.)

e. Saddle or Sellaris Joint the articular surface of one bone is
saddle-shaped and the articular surface of the other bone is shaped like a rider sitting in the saddle.

-Movement at a saddle joint are side to side and back and forth, thus, the joint is **Biaxial**.

*Example:* Joint between the trapezium of the carpus and metacarpal of the thumb.

f. **Ball-and-Socket or Spheroid Joint** consists of a ball-like surface of one bone fitted into a cuplike depression of another bone.

-Such a joint permits **Triaxial** movement, or movement of three planes of motion: Flexion-extension, abduction-adduction, and rotation-circumduction.

*Example:* Shoulder joint and CoxA (hip) joint.

**Types of Movements**

A. **Gliding Movement** - Is the simplest kind that can occur at a joint.

-One surface moves back and forth and from side to side over another surface without angular or rotary motion.

**Examples:** Joints between **carpals** and between **tarsals**.

B. **Angular Movement** - Increases or decreases the angle between bones. **Examples are:**

(i) **Flexion** - Involves a decrease in the angle between the surfaces of the articulating bones. **Examples:** Bending the head forward (the joint is between the occipital bone and the atlas); bending the elbow; and bending the knee.
(ii) **Extension** - Involves an increase in the angle between the surfaces of the articulating bones.

- Restores a body to its anatomical position after it has been flexed.

**Examples:** Head to anatomical position. Straightening the arm after flexion; straightening the leg after flexion.

(iii) **Hyperextension** - Continuation of extension beyond the anatomical position.

**Example:** Bending the head backward.

(iv) **Abduction** - Usually means movement of a bone away from the midline of the body.

**Example:** Moving the arm upward and away from the body until it is held straight out at right angles to the chest.

(v) **Adduction** - Is usually movement of a part toward the midline of the body.

**Example:** Returning the arm to the side after abduction.

C. **Circular Movement** – Involves the rotation of a structure around an axis or movement of the structure in an arc.

(i) **Rotation** – Is the turning of a structure around its long axis.

**Example:** Rotation of the head, the humerus, or the entire body.

(ii) **Pronation** – Is rotation of the forearm so that the palm faces posteriorly in the relation to the anatomic position.

(iii) **Supination** – Is rotation of the forearm so that the palm faces
anteriorly in relation to the anatomic position

(iv) **Circumduction** - Is a combination of flexion, extension, abduction, and adduction.

It involves a $360\degree$ rotation.

**Example:** Moving the outstretched arm in a circle to wind up to pitch a ball.

D. **Special Movements** – Movements that are unique to only one or two joints; that do not fit neatly into one of the other categories.

(i) **Inversion** is the movement of the sole of the foot inward (medially) so that the soles face toward each other.

(ii) **Eversion** is the movement of the sole outward (laterally) so that the soles face away from each other.

(iii) **Dorsiflexion** involves bending of the foot in the direction of the dorsum (upper surface).

(iv) **Planter Flexion** involves bending the foot in the direction of the planter surface (sole).

(v) **Protraction** is the movement of the mandible or shoulder girdle forward on a plane parallel to the ground.

**Example:** Thrusting the jaw outward is protraction of the mandible.

Bringing your arms forward until the elbows touch requires protraction of the clavicle or shoulder girdle.

(vi) **Retraction** is the movement of a protracted part of the body backward on a plane parallel to the ground.

**Example:** Pulling the lower jaw back in line with the upper jaw
is retraction of the mandible.

(vii) **Supination** is a movement of the forearm in which the palm of the hand is turned anterior or superior (facing up).

*Example:* Flexing of forearm at the elbow to prevent rotation of the humerus in the shoulder joint.

(viii) **Pronation** is a movement of the forearm in which the palm is turned posterior or inferior (facing down).

(ix) **Elevation** is an upward movement of a part of the body.

*Example:* You elevate your mandible when you close your mouth.

(x) **Depression** is a downward movement of a part of the body.

*Example:* You depress your mandible when you open your mouth.

*Shoulders* can also be **elevated** and **depressed**.

E. **Knee (Tibiofemoral) Joint**

Structure of knee joint illustrates the complexity of a diarthrosis.

*Knee (Tibiofemoral) joint* is the largest joint of the body.

**Anatomical Components of the Knee Joints:**

1. Articular Capsule
2. Medial and Lateral Patellar Retinacula
3. Patellar Ligament
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4. Oblique Popliteal Ligament
5. Arcuate Popliteal Ligament
6. Tibial (Medial) Collateral Ligament
7. Fibular (Lateral) Collateral Ligament
8. Intra-Articular Ligament
   a. Anterior Cruciate Ligament (ACL)
   b. Posterior Cruciate Ligament (PCL)
9. Articular Discs
   a. Medial Meniscus
   b. Lateral Meniscus
10. Bursae
    a. Anterior Bursae
    b. Medial Bursae
    c. Lateral Bursae

SUMMARY OF JOINTS

Synarthrosis - Immovable Joints
  1. Suture
  2. Synchondrosis
  3. Gomphosis

Amphiarthroses - slightly movable joints
  1. Syndesmosis
  2. Symphysis

Diarthroses - freely movable joints
  1. Gliding
  2. Hinge
  3. Pivot
  4. Ellipsoidal
  5. Saddle
  6. Ball-and-Socket
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Note: 1. A summary of joints based on functional classification

2. A summary of movements that occur at synovial joints

3. Selected Joints of the body, relating their articular components, classification, and movements

4. Disorders: Homeostatic Imbalances