Joints or Articulations

Joints or articulations are the points of contact between bones. The only bone in the body that does not form a joint is the hyoid bone of the neck.

The structure of joints determines how it functions (immovable, slightly movable, or freely movable). Movement is restricted at tightly fitting joints (strong joints). Loosely fitting joints provide greater movement, but are prone to dislocations. Movement is also determined by the flexibility of the connective tissue that binds the bones together and by the position of ligaments, muscles, and tendons.

Classification of Joints

There are two types of classification:

1. **Structural classification** - based on the kind of connective tissue that binds the bones together and on the presence or absence of a joint cavity.
   a. **fibrous** - No joint cavity; bones are held together by fibrous connective tissue.
   b. **cartilaginous** - No joint cavity; bones are held together by cartilage.
   c. **synovial** - They have a fluid-containing joint cavity. The bones forming the joint are united by a surrounding articular capsule and are frequently associated with ligaments.

2. **Functional classification** - degree of movement
   a. **synarthroses** - immovable joint
   b. **amphiarthroses** - slightly movable joint
   c. **diarthroses** - freely movable joint

Fibrous Joints

There are three types of fibrous joints:

1. **Sutures** - They are found between bones of the skull. The bones have wavy edges that interlock and are united by a thin layer of dense fibrous connective tissue. Some sutures are replaced by bone in adults, forming bony joints or **synostoses**. The functional classification is **synarthroses**.
2. **Syndesmoses** - The bones are connected by a sheet of fibrous connective tissue (ligament or interosseous membrane). The bones are more separated than in a suture.

   The functional classification is *amphiarthroses*, although some classify it as *synarthroses* because the joints have "give" but not true movement.

   Examples: distal articulation of the tibia and fibula
   articulations between the shafts of the ulna and radius

3. **Gomphoses** ("nail" or "bolt") - A tooth fits into a bony alveolar socket of the maxilla and mandible and the fibrous connection is a short periodontal ligament.

   The functional classification is *synarthroses*.

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**Cartilaginous Joints**

There are two types of cartilaginous joints:

1. **Synchondroses** - A bar or plate of hyaline cartilage unites the bones. Hyaline cartilage is eventually replaced by a synostosis (joint is temporary).

   The functional classification is *synarthroses*.

   Examples: joint between the first rib and the manubrium of the sternum
   epiphyseal plate - between the epiphysis and diaphysis regions in long bones

2. **Symphyses** ("growing together") - hyaline cartilage covers the articular surfaces of the bones and is fused with a broad, flat pad or plate of fibrocartilage.

   The functional classification is *amphiarthroses*.

   Examples: pubic symphysis
   intervertebral discs

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**Synovial Joints**

There are five distinguishing characteristics of synovial joints:

1. **Articular cartilage** - hyaline cartilage covers the surfaces of the articulating bones, but does not bind the bones together.

2. **Synovial cavity** (joint cavity) - filled with synovial fluid
3. **Articular capsule** - Encloses the joint cavity and unites the articulating bones.

The articular capsule contains two layers:

a. **fibrous capsule** - Tough, flexible outer layer of dense connective (cartilaginous) tissue attached to the periosteum.

b. **synovial membrane** - Inner layer of loose connective tissue with elastic fibers and adipose tissue. It lines the fibrous capsule internally and covers all internal joint surfaces that are not hyaline cartilage.

4. **Synovial fluid** - The amount of fluid is sufficient only to form a thin film over the articular capsule surface. It lubricates the joint and provides nourishment for the articular cartilage. It contains phagocytic cells that remove microorganisms and debris resulting from wear and tear in the joint. The synovial fluid consists of hyaluronic acid secreted by the synovial membrane and an interstitial fluid from blood plasma. The fluid is thick, or viscous, when there is no joint movement. As movement increases, the fluid warms up and becomes thinner.

5. **Reinforcing accessory ligaments** - They reinforce and strengthen synovial joints.

There are three types of reinforcing ligaments:

a. **intrinsic or capsular** - thickened parts of the fibrous capsule

b. **intracapsular** - within the capsule

c. **extracapsular** - outside the capsule

Pads of fibrocartilage, called **articular discs** or **menisci**, lie between the articular surfaces of the bones and are attached by their margins to the fibrous capsule. They divide the synovial cavity into two separate cavities and allow for a tighter fit between bones and stabilize the joint.

Examples: knee, jaw, and sternoclavicular joints

Some synovial joints also have fatty pads between the fibrous capsule and the synovial membrane or bone.

Closely associated with synovial joints are **bursae** and **tendon sheaths**. **Bursae** are flattened fibrous sacs composed of walls consisting of connective tissue lined with a synovial membrane and they contain a thin layer of synovial fluid. **Bursae** are located
between skin and bone, ligaments and bone, muscles and bone, and tendons and bone. They function in reducing friction in these areas during movement.

A tendon sheath is an elongated bursae that wraps completely around a tendon which is subjected to friction.

Factors Influencing the Stability of Synovial Joints

There are three factors that influence stability:

1. **articular surface** - The shape of the articular surfaces and fit of the articulating bone determines what movements are possible. Large articular surfaces and a snug fit make a bone extremely stable.

2. **ligaments** - Stronger joints have more ligaments. The strength and positioning of ligaments where they unite bones, direct bone movement and prevent excessive or undesirable movement.

3. **muscle tone** - Tension of the muscles are the most important stabilizing factor. Muscle tendons that cross the joint and kept tight at all times by the tone of the muscles stabilize the joint. Low levels of contractile activity (muscle tone) in relaxed muscles keep the muscles ready to react to stimuli. Sensory nerve endings in the articular capsule and ligaments monitor the position of the joints and help to maintain muscle tone. Nerve impulses are sent to the central nervous system when the nerve endings are stretched and a reflexive contraction of muscles surrounding the joint occurs.

Types of Synovial Joints

Although all synovial joints are similar in structure, variations exist in the shape of the articulating surfaces. The functional classification is **diarthroses**.

There are six types of synovial joints:

1. **plane or gliding joint** - The articular surfaces are flat and only a small slipping or gliding movement occurs.

   Examples: joints between carpal bones, joints between tarsal bones, joints between the scapula and clavicle, joints between the sternum and clavicle.
2. **hinge joint** - A convex surface or cylindrical projection of one bone fits into the concave surface of another bone. Movement involves flexion and extension.

Examples: knee, ankle, elbow, joints between the phalanges

3. **pivot joints** - A rounded, pointed, or conical surface of one bone articulates with a ring or "sleeve" formed by a bone or ligament. Movement involves rotation.

Examples: atlas and axis
proximal ends of the radius and ulna
head of the radius rotates within a ringlike ligament attached to the ulna

4. **condyloid joint** - An oval-shaped articular surface or condyle of one bone fits into an oval cavity of another bone. It permits side-to-side, circular, back-and-forth, and all angular movements.

Examples: wrist joint between the radius and carpals
knuckle joints between the phalanges and metacarpals

5. **saddle joints** - The articular surfaces of both bones are concave in one direction and convex in the other (saddle-shaped). It is similar to a condyloid joint, but it allows freer movement. Movement involves side-to-side, circular, and back-and-forth.

Example: joint between the trapezium (carpal) and metacarpal of the thumb

6. **ball-and-socket joint** - A spherical or ball-shaped head of one bone fits into a concave socket or cup-like depression of another bone. Movement involves flexion-extension, abduction-adduction, circumduction, and rotation.

Examples: shoulder joint
hip joint