

ARTICULATIONS (JOINTS)

A. Introduction

1. **Concept**--articulations are the skeletal structures by which bones are joined with each other, as well as the various articular processes and depressions themselves. Between the articular surfaces will be connective tissues which actually hold the bones together.
2. **Variations**--these will be in three contexts:
 - The type of connective tissue(s) joining the bones.
 - The degree of relative movement permitted; this will be from very free to none.
 - During skeletal development, expected changes in the type of articular tissue and relative movement, will occur. [This only involves some synarthroses]
3. **Classification schemes**
 - a. **Development**--some schemes are based on, or at least influenced by, the changes which occur in many articulations from fetal life through the post-maturity period.
 - b. **Structure**--other schemes are based on the joints' appearance and type of tissue(s) involved.
 - c. **Movement**--this involves the relative degree of freedom of movement permitted by the shape of the articulating surfaces, the type of tissues between these surfaces, and how they are bound together.
 - d. **Lack of agreement**--nearly every authority will classify the various articulations in a different way, utilizing one or a combination of the above three schemes. The scheme utilized below represents a synthesis of these; it is no more nor less accurate than any of the others, since there seems to be no consensus.

B. Synarthroses

1. **Concept**--these articulations permit no appreciable movement. The bones actually, or almost, touch.
2. **Syndesmoses**
 - a. **Concept**--dense regularly-arranged fibrous connective tissue, resembling a ligament, joins the two bones. This permits more movement than nearly any other type of synarthrotic joint, while maintaining a great degree of firmness and stability.
 - b. **Sutures**--in the immature condition only; these are the fontanelles between the cranial bones, present before intramembranous ossification is complete.
 - c. **Other examples**--between the shafts of the tibia and fibula, and the radius and ulna.

Sometimes the sacro-iliac joint will become fibrous later in life; originally it is a diarthrotic joint [see below]; not all authorities recognize this distinction, however.

3. **Symphyses**

- a. **Concept**--the articulating bones are joined by hyaline cartilage.
- b. **Permanent**--these are the costal cartilages between the ribs and sternum.
- c. **Replaced**--the most widespread example is the epiphyseal plates (metaphyses) in their immature condition prior to fusion.
There are other examples, such as between the manubrium and gladiolus, and some non-cranial skull bones (e.g. occipital and sphenoid).

4. **Synostosis**

- a. **Concept**--osseous tissue joins the articulating bones. This results in either separate bones being in direct contact, or formerly distinct bones fusing together. This permits no movement.
- b. **Sutures**--this is the mature condition for cranial bones. When immature, though, recall that they are considered to be syndesmoses.
- c. **Metaphyses**--this is the mature condition for epiphyseal plates, when the former symphyses are replaced by osseous tissue. This joins the diaphysis with the epiphyses.
- d. **Fusions**--this involves the maturing of non-metaphyseal joints, which were symphyses, syndesmoses, or symphyses when immature. Examples are the mandible, frontal, and manubrium/gladiolus.

5. **Symphyses**

- a. **Concept**--the bones are joined by fibrous cartilage. A slight degree of movement is permitted.
- b. **Permanent**--between the right and left pubic bones, and the intervertebral discs joining vertebral bodies.
- c. **Temporary**--between the mandibular halves, at the anterior margin.

6. **Gomphosis**--this is a very specialized ligament-like articulation between teeth and the mandibular and maxillary sockets into which they fit. It may be considered as a variation of a syndesmosis.

C. **Diarthroses (synovial joints)**

- 1. **Concept**--these articulations permit much more movement, so they are usually called the freely moveable joints. There are several types, but they have the identical basic structure. They vary in the shapes of the articulating surfaces, and in the amount and direction(s) of movement permitted.

2. Structure

- a. **Articular cartilages**--these are usually hyaline cartilage pads which cover the areas of the two bones which assist in cushioning the bones where they contact each other.
- b. **Joint (synovial) cavity**--in its simplest form this is a small space between the articular cartilages. Its purpose is to contain a substance termed synovial fluid [see below]. In more complicated joints there may be two cavities, since other structures intervene between the articular cartilages.
- c. **Capsule**--this is a dense fibrous connective tissue membrane which essentially surrounds (i.e. encapsulates) the joint. It is continuous with the periosteum of the two bones. Occasionally it will be abbreviated or absent, but replaced by other structures (e.g. tendons) which serve the same function.
- d. **Synovial membrane**--this is a looser fibrous membrane than the capsule. It generally is against the capsule on its inner surface, but not the articular cartilages. It is thus the lining of the joint cavity(-ies). It can vary in composition, sometimes containing more areolar or adipose tissue.
- e. **Synovial fluid (synovia)**--this substance is secreted into the joint cavity by the synovial membrane; it is really tissue fluid. It primarily functions as a lubricant between the bones and as a shock absorber. It is basically composed of water, mucopolysaccharides, and proteins.
- f. **Accessory structures**
 - (1) **Ligaments**--these bands of tissue run between the articulating bones to help hold them together as well as limit the permitted movement(s). They are located outside of and/or within the capsule.
 - (2) **Bursae**--these are flat, pouch-like sacs which have a synovial membrane lining and contain synovial fluid. They assist in cushioning higher stress joints such as the shoulder. They may be located between tendons and the bone, or between the ligaments and capsule.
 - (3) **Tendon sheaths**--these are modified bursae, surrounding and lubricating tendons in areas of high friction such as the wrist and ankle.
 - (4) **Menisci (articular discs)**--these are pads of fibrous cartilage which interrupt the joint structure, since they are located between the articular surfaces. They apparently provide extra cushioning and stability.

3. Types

- a. **Enarthrosis (spheroidal or ball-and-socket)**--this forms from a round head articulating in a round depression. This permits the greatest range of movements, with angular motions possible in many planes, as well as rotation. There are three axes of movement: front to back (termed extension and flexion); raised and lowered to the side (termed abduction and adduction); and, rotation forward and backward. The only examples are the humerus/scapula and femur/pelvis joints.
- b. **Ginglymus (hinge)**--a cylindrical cavity of one bone receives a rounded projection of the other in this type. This only permits movement in one plane, much like a hinged door. Examples are the humerus/ulna, femur/tibia, between phalanges of each digit,

and tibia-fibula/talus.

- c. **Ellipsoidal (condyloid or bicondylar)**--an oval projection will articulate in an ellipsoidal concavity. This permits movement in two perpendicular planes, which is termed bi-axial. Examples are radius/carpal, metacarpal/proximal phalanx, and temporal/mandibular.
- d. **Trochoid (pivot or rotary)**--one bone will rotate around a central axis of the other. This only permits movement in either direction within one axis. Examples are atlas-axis and distal radius/ulna.
- e. **Sellaris (saddle)**--this is a modified condyloid joint, with both bones having a convex as well as a concave surface; this means that each bone will fit into the other while receiving a projection of the latter simultaneously. This set-up permits bi-axial movements as well as some rotation, making it extremely versatile. Examples are the thumb's metacarpal/trapezium joint and calcaneus/cuboid.
- f. **Arthrodia (gliding or plane)**--this joint simply involves two relatively flat surfaces. The movements are not of much extent. Examples are carpal/carpal, tarsal/tarsal, sternum/clavicle, and superior/inferior articular facets of vertebrae.