TYPES OF JOINTS

Introduction

A joint is a region where 2 bones make contact. Joints may be classified histologically or functionally. Histological classification is based on the predominant connective tissue type composing the joint, either fibrous, cartilaginous, or synovial. Functional classification is based on the amount of movement the joint permits. The 3 functional joint types include the immovable synarthrosis, slightly moveable amphiarthrosis, and freely moveable diarthrosis. The 2 joint classification schemes correlate: synarthroses are fibrous, amphiarthroses are cartilaginous, and diarthroses are synovial.

Joints, comprised of bones and connective tissue, embryologically develop from mesenchyme. Bones may develop directly through intramembranous ossification or indirectly via endochondral ossification. Each joint has unique vascular and innervation schemes with recognizable patterns. Muscles stabilize joints. Muscle strength directly correlates with joint stability, particularly in synovial joints.

Many pathophysiological conditions affect joints, with histological class determining the kind of pathology that develops. Joint diseases are common across all ages. A thorough understanding of joint structure and function is of great clinical significance.

Structure and Function

Joint classifications offer a broad understanding of joints. The different joint types are explained below.

Fibrous Joints

A fibrous joint is a fixed joint (synarthrosis) where collagenous fibrous connective tissue unites 2 bones. Fibrous joints are usually immovable and lack a joint cavity. These joints are further classified into sutures, gomphoses, and syndesmoses.

Sutures are immobile joints found only in the cranium (see **Image**. Coronal Suture). The spaces between the bones are termed "fontanelles." The skull's plate-like bones are slightly mobile at birth because of the soft connective tissue binding them in the fontanelles. This initial joint flexibility allows the fetal head to pass through the birth canal at delivery and permits brain enlargement after birth. As the skull enlarges, the fontanelles gradually diminish to form thin fibrous connective tissue layers called "Sharpey fibers," which help bind the bony plates together. Over time, these cranial sutures harden through ossification. Neighboring plates eventually merge into a single bone through a process known as synostosis.

Gomphoses are immobile joints found only between the teeth and their sockets in the mandible and maxillae. The periodontal ligament is the fibrous tissue connecting the tooth to the socket (see **Image**. Periodontium Anatomy).

Syndesmoses are slightly movable joints (amphiarthroses). This fibrous joint type maintains the union between long bones, thus resisting divisive forces. All syndesmoses are amphiarthroses, though specific types may permit variable degrees of movement. For example, the tibiofibular syndesmosis primarily provides leg and ankle strength and stability during weight-bearing. However, the antebrachial interosseous membrane of the radioulnar

syndesmosis permits radial rotation during supination and pronation (see **Image**. Radioulnar Joints). The leg and forearm interosseous membranes are also areas of muscle attachment.

Cartilaginous Joints

Cartilaginous joints have bones attached by hyaline or fibrous cartilage. The joints are further classified as primary or secondary cartilaginous joints, depending on the cartilage type involved.

A synchondrosis, or primary cartilaginous joint, only contains hyaline cartilage and can be temporary or permanent. The epiphyseal plate (growth plate) is the best example of a temporary synchondrosis. The growth plate permits bone lengthening during development while connecting the diaphysis (bone shaft) with the epiphysis (bone tip) in children (see **Image**. Parts of a Long Bone). During development, the cartilaginous plate expands and ossifies, lengthening the diaphysis. Bones complete their linear growth once all hyaline cartilage ossifies, with the diaphysis and epiphysis fusing to form a synostosis. Other temporary synchondroses are found in children's hips, joining the ilium, ischium, and pubic bones. The ilium, ischium, and pubis later fuse completely to form the adult innominate bone.

A permanent synchondrosis does not ossify with age but retains its hyaline cartilage. Permanent synchondroses connect bones without allowing any movement, similar to a synarthrosis. These joints are commonly found in the thoracic cage. For instance, the 1st sternocostal joint unites the 1st rib to the manubrium by its costal cartilage. Other examples include the connections between the anterior ends of the remaining 11 ribs and their respective costal cartilages.

A symphysis, or secondary cartilaginous joint, contains fibrocartilage (see **Image**. Male Pelvis Anatomy). This cartilage type is thick and strong. Thus, symphyses have a remarkable ability to resist pulling and bending forces. However, a symphysis is still often classified as an amphiarthrosis, permitting limited movement despite fibrocartilage uniting adjacent bones.

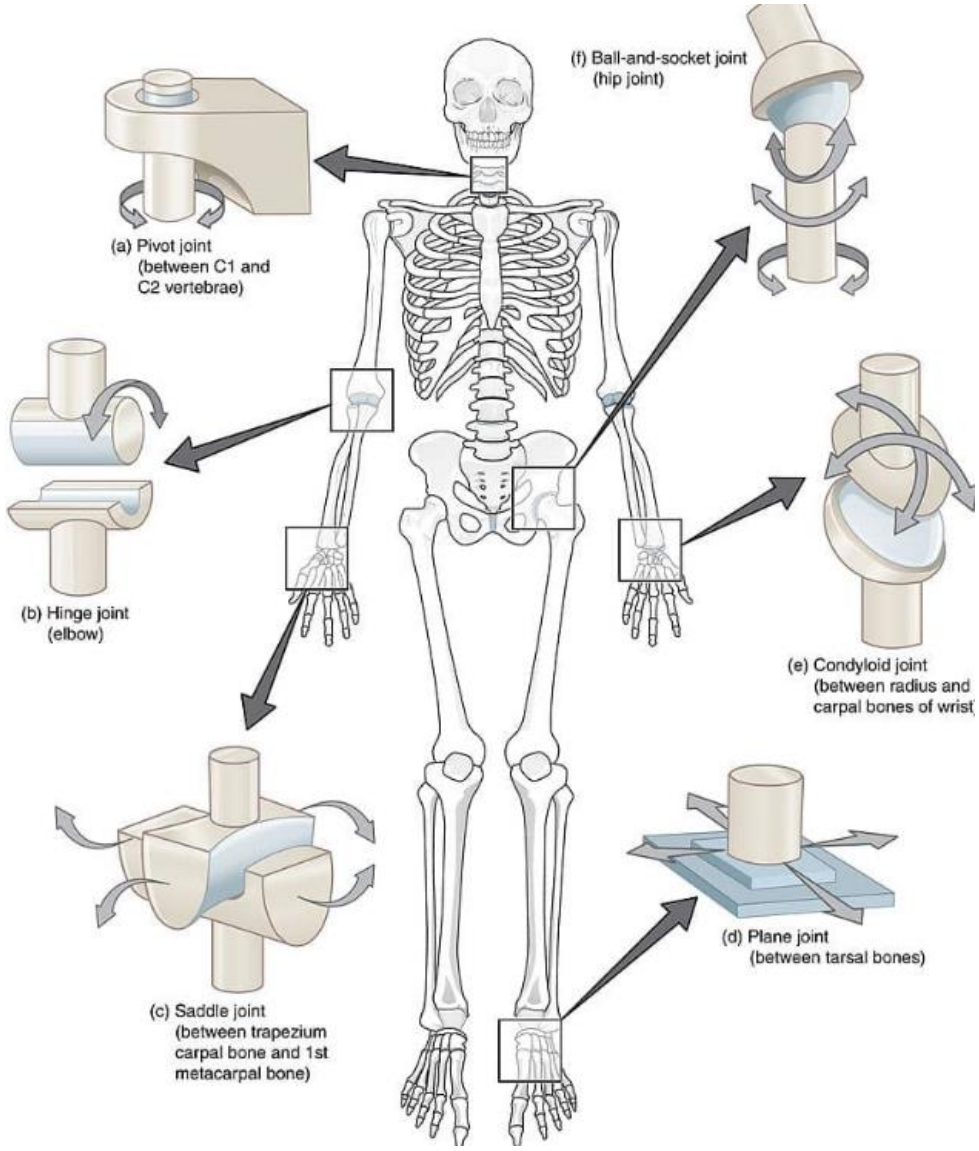
A symphysis may be narrow or wide. Narrow symphyses include the pubic symphysis and manubriosternal joint. In women, the pubic symphysis' slight mobility is critical during childbirth. Meanwhile, an example of a wide symphysis is the intervertebral symphysis, also known as the intervertebral disk (see **Image**. Intervertebral Disk). The thick fibrocartilage pad fills the gap between adjacent vertebrae and provides cushioning during high-impact activity.

Synovial Joints

Synovial joints are freely mobile (diarthroses) and are considered the body's main functional joints (see **Image**. Synovial Joint). The synovial joint is characterized by the presence of a joint cavity. The synovial joint's primary function is to prevent friction between the articulating bones involved in body movements. The joint cavity is surrounded by the articular capsule, a fibrous connective tissue attached to the joint's participating bones just beyond the articulating surface. The joint cavity contains synovial fluid secreted by the synovial membrane (synovium), which lines the articular capsule. Hyaline cartilage forms the articular cartilage covering each bone's articulating surface. The articular cartilage is continuous with the synovial membrane. Some synovial joints, such as the knee menisci, have associated fibrocartilage between articulating bones.

While all synovial joints are diarthroses, the extent of movement varies among subtypes and is often limited by the ligaments connecting the bones. Thus, synovial joints are often

classified by the movement types they permit: hinge, saddle, planar, pivot, condyloid, and ball-and-socket.



These joint classes are explained below.

Hinge

A hinge joint is an articulation between the convex end of one bone and the concave edge of another. This joint type is uniaxial, permitting movement along only one axis. Flexion and extension are typically the only movements allowed by hinge joints. Examples include the elbow, knee, ankle, and interphalangeal joints.

Condyloid

A condyloid joint (ellipsoid joint) is an articulation between the shallow depression of one bone and the rounded structure of one or more other bones. This joint type is biaxial,

permitting movement in 2 axes. Thus, 4 movements are possible at condyloid joints: flexion, extension, abduction, and adduction. Examples of condyloid joints are the knuckles, formed by the distal metacarpals and proximal phalanges of the medial 4 fingers.

Saddle

A saddle joint is an articulation between 2 saddle-shaped bones, which are concave in one direction and convex in another. This joint type is biaxial. One example is the joint formed by the trapezium and 1st metacarpal bone. This joint allows the thumb to flex and extend parallel to the palm and abduct and adduct perpendicular to the palm, making the digit opposable. The opposable thumb is critical for complex hand motions. Thumb loss by any mechanism severely limits hand function.

Planar

A planar joint (gliding joint) is an articulation between 2 flat bones of similar size. Planar joints are multiaxial but restricted by the surrounding ligaments. Examples include the acromioclavicular, intercarpal, and intertarsal joints. The calcaneocuboid joint is unlike other intertarsal joints, as it is classified as a saddle joint.

Pivot

A pivot joint occurs between one bone and the cylindrical end of another, enclosed within a ligamentous ring (see **Image**. Cervical Vertebrae). This joint is uniaxial, allowing rotation around a single axis as the bone moves within the ring. The atlantoaxial joint, formed by the 1st (atlas) and 2nd (axis) cervical vertebrae, is a pivot joint. The atlantoaxial joint permits side-to-side head motion. Another example is the proximal radioulnar joint. The radius sits in the annular radial ligament, which holds the bone in place as it articulates with the ulna's radial notch, thus permitting pronation and supination.

Ball-and-socket

A ball-and-socket joint is an articulation between the rounded head of one bone (ball) and the concavity of another (socket). This joint type is multiaxial, as possible movements include flexion, extension, abduction, adduction, and rotation. The body's only ball-and-socket joints are the hip and shoulder (glenohumeral) joints. The glenoid cavity's shallow socket permits an extensive range of motion in the shoulder. In contrast, the deep acetabular socket and the surrounding ligaments constrain femoral movement in the hip joint.