Articulations

I. Introduction
   A. Articulation – point of contact between bones.
   B. Joints are mostly very movable, but others are immovable or allow only limited motion.
   C. Movable joints allow complex, highly coordinated, and purposeful movements to be executed.

II. Levers
   A. Bones connected by joints acted upon by muscles form lever systems for body movement.
   B. All levers consist of three parts:
      1. Pull – the power put into the lever system.
      2. Load – the work done by the lever system.
      3. Fulcrum – a point around which the lever moves.

III. Classes of Levers
   A. First class lever
      1. The fulcrum is positioned between the pull and the load.
      2. This lever system has equal speed and strength.
      3. Examples:
         a. See-saw
         b. Scissors
         c. Atlanto-occipital joint
   B. Second class lever
      1. The load is positioned between the fulcrum and the pull.
      2. Strength is greater than speed.
      3. Examples:
         a. Wheelbarrow
         b. Nutcracker
         c. Plantar flexion of the ankle.
   C. Third class lever
      1. The pull is positioned between the fulcrum and the load.
      2. Speed is greater than strength.
      3. Examples:
         a. Shovel
         b. Golf club
         c. Elbow flexion

IV. Classification of Joints
   A. Joints may be classified using a structural or functional scheme.
      1. Structural classification – joints are named according to one of the following:
         a. Type of connective tissue that joins bones together (fibrous or cartilaginous joints).
         b. Presence of a fluid-filled joint capsule (synovial joint).
2. Functional classification – joints are named according to degree of movement allowed:
   a. Synarthroses—immovable joint.
   b. Amphiarthroses—slightly movable.
   c. Diarthroses—freely movable.

B. Fibrous joints (synarthroses) – bones of joints fit together closely, allowing little or no movement.
   1. Syndesmoses – joints in which ligaments connect two bones.
   2. Sutures – found only in skull; projections from adjacent bones interlock with each other.
   3. Gomphoses – between root of a tooth and the alveolar process of the mandible or maxilla.

C. Cartilaginous joints (amphiarthroses) – bones of joints are joined together by hyaline cartilage or fibrocartilage; allow very little motion.
   1. Synchondroses – hyaline cartilage present between articulating bones.
   2. Symphyses – joints in which a pad or disk of fibrocartilage connects two bones.

D. Synovial joints (diarthroses) – freely movable joints.
   1. Structures of synovial joints:
      a. Joint capsule – sleeve-like casing around ends of bones, binding them together.
      b. Synovial membrane – lines joint capsule and also secretes synovial fluid.
      c. Articular cartilage – hyaline cartilage covering articular surfaces of bones.
      d. Joint cavity – small space between the articulating surfaces of the two bones of the joint.
      e. Menisci (articular disks) – pads of fibrocartilage located between articulating bones.
      f. Ligaments – strong cords of dense, white, fibrous tissue that hold bones of synovial joint more firmly together.
      g. Bursae – synovial membranes filled with synovial fluid; cushion joints and facilitate movement of tendons.

V. Types of Synovial Joints
A. Uniaxial joints – synovial joints that permit movement around only one axis and in only one plane.
   1. Hinge joints – articulating ends of bones form a hinge-shaped unity that allows only flexion and extension.
   2. Pivot joints – a projection of one bone articulates with a ring or notch of another bone.

B. Biaxial joints – synovial joints that permit movements around two perpendicular axes in two perpendicular planes.
1. **Saddle joints** – synovial joints in which the articulating ends of the bones resemble reciprocally shaped miniature saddles; only occurrence in body is in thumbs.

2. **Condyloid (ellipsoidal) joints** – synovial joints in which a condyle fits into an elliptical socket.

C. **Multiaxial joints** – synovial joints that permit movements around three or more axes in three or more planes.
   1. **Ball and socket (spheroid) joints** – most movable joints; ball-shaped head of one bone fits into a concave depression.
   2. **Gliding joints** – relatively flat articulating surfaces that allow limited gliding movements along various axes.

**VI. Representative Synovial Joints**

A. **Humeroscapular joint (glenohumeral joint)**
   1. **Shoulder joint.**
   2. Most mobile joint because of the shallowness of the glenoid cavity leads to instability.
   3. **Glenoid labrum** – narrow rim of fibrocartilage around glenoid cavity that lend depth to the cavity.
   4. Structures that strengthen the shoulder joint are ligaments, muscles, tendons, and bursae.

B. **Elbow joint**
   1. **Humeroradial joint** – lateral articulation of capitulum of humerus with head of radius.
   2. **Humeroulnar joint** – medial articulation of trochlea of humerus with trochlear notch of ulna.
   3. Both components of elbow joint surrounded by single joint capsule and stabilized by collateral ligaments.
   4. **Classic hinge joint.**
   5. Medial and lateral epicondyles are externally palpable bony landmarks.

C. **Proximal radioulnar joint** – between head of radius and medial notch of ulna.
   1. Stabilized by annular ligament.
   2. Permits rotation of forearm.
   3. Dislocation of radial head called “pulled elbow.”

D. **Distal radioulnar joint** – point of articulation between ulnar notch of radius and head of ulna.
   1. Together with proximal radioulnar joint, permits pronation and supination of forearm.

E. **Radiocarpal (wrist) joints**
   1. Only radius articulates directly with carpal bones distally (scaphoid and lunate).

F. **Intercarpal joints**
   1. Between 8 carpal bones.
   2. Stabilized by numerous ligaments.
   3. Joint spaces usually communicate.
4. Movements generally gliding, with some abduction and flexion.

G. Carpometacarpal joints
1. Thumb carpometacarpal joint is unique and important functionally
   a. Loose-fitting joint capsule.
   b. Saddle-shaped articular surface.
   c. Movements – extension, adduction, abduction, circumduction, and opposition.
   d. Opposition – ability to touch tip of thumb to tip of other fingers—movement of great functional significance.

H. Metacarpophalangeal joints
1. Rounded heads of metacarpals articulate with concave bases of proximal phalanges.
2. Capsule surrounding joints strengthened by collateral ligaments.
3. Primary movements are flexion and extension.

I. Interphalangeal joints
1. Typical diarthrotic, hinge-type, synovial joints.
2. Occur between heads of phalanges and bases of more distal phalanges.
3. Two categories:
   a. PIP joints – proximal interphalangeal joints (between proximal and middle phalanges).
   b. DIP joints – distal interphalangeal joints (between middle and distal phalanges).

J. Iliofemoral joint (hip joint)
1. Stable joint because of shape of head of femur and of acetabulum.
2. A joint capsule and ligaments contribute to joint’s stability.

K. Tibiofemoral joint (knee joint)
1. Largest and one of most complex and most frequently injured joints.
2. Tibiofemoral joint is supported by a joint capsule, cartilage, and numerous ligaments and muscle tendons.
3. Permits flexion and extension and, with knee flexed, some internal and external rotation.

L. Tibiotalar joint (ankle joint)
1. Hinge type of synovial joint.
2. Articulation between lower ends of tibia and fibula and upper part of talus.

Diseases of the Joints
I. General Terminology
A. Dislocation – displacement of a bone from its joint; usually involves damage to the surrounding tissue.
   2. Indications/Contraindications: refer to doctor; never try to reduce or “set” a dislocation; energy work is appropriate, but no stretching or massage should be done until pain and inflammation subside.
B. Subluxation – partial dislocation of a bone from its joint; usually follows a ligament injury.
   1. Cause: previous trauma; ligament injury; lax ligaments.
   2. Indications/Contraindications: use caution; energy work can be effective; may be advisable to consult with client’s doctor.

II. Disorders
A. Bursitis – inflammation of the fluid-filled pad between tendon and bone.
   1. Causes: infection; trauma; overuse.
   2. Indications/Contraindications: avoid deep work on affected areas; in acute cases, massage can increase inflammation; use caution around all painful areas.
B. Tendonitis – inflammation of a tendon.
   1. Causes: infection; trauma; overuse.
   2. Indications/Contraindications: avoid any areas that have acute inflammation.
C. Osteoarthritis (OA) – most common degenerative joint disease; progressive, unsymmetrical deterioration and breakdown of articular cartilage, mainly in weight-bearing joints; loose bodies may develop in the joint space and react with the synovial membrane to cause pain; bone spurs may develop as a result of damage of the joint capsule; no known way of stopping OA once it has had an effect; treatment includes weight loss, reduced activity, and replacement of the affected joint.
   1. Cause: “wear and tear” on the joint leading to death of chondrocytes and subsequent thinning and degeneration of articular cartilage.
   2. Indications/Contraindications: avoid areas of inflammation; be cautious of possible bone spurs.
D. Rheumatoid arthritis (RA) – severe form of chronic synovitis; stiffness and pain result from thickening synovium and projection of synovium into the joint; inflammation of the smaller joints of the hands, wrists, ankles, and feet is very common and symmetrical; may also affect the heart, lungs, and skin; signs include ulnar deviation of the fingers and radial deviation of the wrist.
   1. Cause: autoimmune reaction, usually initiated by an infection.
   2. Indications/Contraindications: avoid affected joints when in an acute and inflamed stage; paraffin bath is the medical treatment of choice.
E. Gout – a metabolic disorder involving the development of tophi (masses of uric acid crystals with macrophages and scar tissue cells) in and around joints and the ear lobes; 75% of attacks involve the great toe, but other joints often become involved; affected joints are inflamed, red, and very tender; acute episodes can subside within 3 to 10 days.
   1. Cause: 90% of cases are of unknown cause in which the body is not able to excrete enough urea in the urine; predisposing factors include high alcohol intake, excessive red meat in diet, and obesity.
2. Indications/Contraindications: avoid affected joints when in an acute and inflamed stage; refer to doctor.

F. Osgood-Schlatter disease – partial separation (avulsion) of the tibial tuberosity from the tibial shaft resulting in inflammation of the bone and connective tissue of the anterior knee; usually occurs in male children 10 to 16 years of age; calcification of the tibial tuberosity is incomplete, making it more easily fractured; symptoms include pain when kneeling, running, climbing stairs, or riding a bicycle and disappear at approximately 18 years of age; usually necessitates bracing or at least decreased activity levels for an extended period.
   2. Indications/Contraindications: avoid affected area.

G. Chondromalacia patellae – softening and deterioration of the articular cartilage on the posterior patella; pain usually experienced when forcefully extending the knee.
   1. Cause: instability of the knee; substantial misalignment of the patella on the femur; overuse; chronic subluxation of the patella.
   2. Indications/Contraindications: obtain advice and approval of client’s doctor before performing bodywork because of potential damage; massage to and stretching of the quadriceps would be beneficial and could relieve the pain.

H. Temporomandibular joint dysfunction (TMJ dysfunction or TMD) – any kind of abnormal functioning of the temporomandibular joint.
   1. Causes: trauma (often MVA); poor posture; overuse from bruxism (teeth grinding).
   2. Indications/Contraindications: condition can change the position of the jaw, causing natural teeth, dentures, or bridges to fit together improperly; massage can relax muscles and relieve symptoms; work with dentist or physician if necessary.

I. Degenerative disk disease – deterioration of the intervertebral disks in the spinal column; 80% of damage occurs in the posterior half of the disk; repetitive movements cause fissuring in the annulus fibrosis, which allows the nucleus pulposus to migrate into the fissure, reducing the potential for the annulus to heal; increased pressure in the outer annulus may cause pain or paresthesia in the back or trunk, or the pain may refer to the lower extremities; nuclear migration also leads to protrusion of the disk into the intervertebral foramen, which puts pressure on the nerve root, causing weakness and pain in the lower extremities.
   1. Causes: poor posture; repetitive movements of the spine such as flexion combined with rotation when carrying or lifting heavy objects; low tension for long periods can cause the same amount of damage as high tension for short periods.
   2. Indications/Contraindications: do not massage painful areas; consult with client’s doctor.
Sample Questions

The sutures in the skull are examples of what kind of joint?
A. Synovial
B. Amphiarthrosis
C. Fibrous
D. Diarthrosis

Which class of lever is good for generating speed but poor for generating power?
A. First-class lever.
B. Second-class lever.
C. Third-class lever.
D. Fourth-class lever.

The interphalangeal joints of the hands and feet are examples of what kind of joint?
A. Hinge.
B. Ball and socket.
C. Gliding.
D. Saddle.

Bones are attached to other bones by:
A. periosteum.
B. osseous tissue.
C. ligaments.
D. tendons.

Which of the following is a metabolic disorder involving the development of tophi in and around joints?
A. Osgood-Schlatter disease.
B. Bursitis.
C. Rheumatoid arthritis.
D. Gout.

A history of abnormal wear and tear on the joints and deterioration of the articular cartilage suggests:
A. Osgood-Schlatter disease.
B. osteoporosis.
C. osteoarthritis.
D. rheumatoid arthritis.

Which of the following statements is not true about synovial joints?
A. They are freely movable joints that possess a joint cavity encapsulated by ligamentous structures.
B. They are also called synarthroses.
C. They contain synovial fluid that is secreted by the synovial membrane.
D. The ends of these joints are lined with hyaline cartilage.

What is the structure that encases and encloses the joint, adds stability to the joint, and restricts movement?
A. Myomucosal membrane.
B. Ligamentum nuchae.
C. Joint capsule.
D. Nucleus pulposus.
What disease affects the bones and joints and is considered an immune disorder?

A. Osteoporosis.
B. Osteoarthritis.
C. Rheumatoid arthritis.
D. Fibromyalgia