Articulations

Joint Types:
1. Synarthrosis (sin-arthrosis) immovable joints
   a. suture:
      • Located in bones of skull (means sewing together)
      • Bone edges are interlocked & bound by dense connective tissue.
   b. gomphoses (gom-phosis):
      • means bolting together
      • synarthrotic joint between tooth root and socket; is the periodontal ligament.

2. Amphiarthrosis (am-far-throsis):
   a. syndesmosis (sindezmosis):
      • bones are connected by a ligament
   b. symphysis:
      • bones separated by a pad of fibrocartilage
        i.e.- intervertebral cartilage, pubic symphysis

c. synchondroses (sin-chon-drosis):
   • a rigid cartilaginous bridge between to articulating bones
     i.e.- connections of ribs to sternum

d. synostoses (sin-os-tosis):
   • totally rigid, immovable joint
     • two separate bones fuse so well the boundary between them disappears.
3. Diarthroses (di-ar-THRÔ-sis):
   - Freely movable joints
     *i.e.* synovial joints
   - Joint surrounded by an articular capsule
   - A synovial membrane lines the articular cavity
   - Typically found at the end of long bones
   - Bones in synovial joints don’t touch each other because they are covered with articular cartilage

Articular Cartilage

- Smooth, slick
- No perichondrium
- More H₂O than normal hyaline cartilage
- Normally don’t touch, because separated by a thin film of synovial fluid, this keeps friction in the joints to a minimum

Synovial Fluid

- Thick, viscous fluid (consistency of molasses)

With 3 main functions:

1. **Lubrication**
2. **Nutrient Distribution**
   - The circulating fluid carries wastes away from & brings nutrients to CT
3. **Shock Absorption**

### Synovial Accessory Structures

1. **Cartilages & Fat Pads**
   - **Meniscus** - pad of fibrocartilage btn. opposing bones in a synovial joint, provides shock absorption and channeling of synovial fluid
   - **Fat Pads** - usually superficial to the joint, act as fillers/space keepers

### Table 4.2 Coefficients of Friction

<table>
<thead>
<tr>
<th></th>
<th>μs</th>
<th>μk</th>
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</thead>
<tbody>
<tr>
<td>Steel on steel</td>
<td>0.74</td>
<td>0.57</td>
</tr>
<tr>
<td>Aluminum on steel</td>
<td>0.61</td>
<td>0.47</td>
</tr>
<tr>
<td>Copper on steel</td>
<td>0.53</td>
<td>0.36</td>
</tr>
<tr>
<td>Rubber on concrete</td>
<td>1.00</td>
<td>0.80</td>
</tr>
<tr>
<td>Wood on wood</td>
<td>0.25–0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Glass on glass</td>
<td>0.94</td>
<td>0.40</td>
</tr>
<tr>
<td>Wax on wax</td>
<td>0.14</td>
<td>0.10</td>
</tr>
<tr>
<td>Wax on dry snow</td>
<td>—</td>
<td>0.04</td>
</tr>
<tr>
<td>Metal on metal (lubricated)</td>
<td>0.15</td>
<td>0.06</td>
</tr>
<tr>
<td>Ice on ice</td>
<td>0.10</td>
<td>0.03</td>
</tr>
<tr>
<td>Teflon on Teflon</td>
<td>0.04</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*Synovial joints in humans* | 0.01 | 0.003 |
2. Ligaments
   a. accessory ligaments
      • localized thickening of articular capsule
      • reinforce capsule
      • strengthen capsule
      • may limit range of motion of joint

   b. extracapular ligament
      • interconnect articulating bones
      • comes outside capsule
      • support wall of the joint

   c. intracapular ligament
      • found inside the capsule
      • prevent extreme movements

Sprain
   • A ligament is stretched to the point at which some of the collagen fibers are torn, but the ligament as a whole survives, and the joint is not damaged.
   • Ligaments are very strong, and one of the attached bones typically breaks before the ligament tears.
   • In general, a broken bone heals much more quickly and effectively than does a torn ligament.

Tendons
   • While not part of the articulation itself, tendons passing across or around a joint may limit the range of motion and provide mechanical support.

   i.e.- Tendons assoc. with the muscles of the arm provide much of the bracing for the shoulder joint.
**Bursae**
- **Bursae** are small, fluid-filled pockets in CT. They contain synovial fluid and are lined by synovial membrane.
- They form where a tendon or ligament rubs against other tissues.
- Their function is to reduce friction and act as a shock absorber.
* BURSITIS: inflammation of the bursae due to repetitive motion or pressure.
  *i.e.* - bunions, housemaids knee, students elbow

**Stressed Joints**
- When a joint is stressed beyond its reinforcing structures ability to hold it, there can be a complete or partial dislocation (luxation / subluxation)

**People who are Double Jointed**
- “double joints” are weakly stabilized
- Generally greater range of motion, but more likely to dislocate

**Types of Joint Movement**
1. **Gliding** - movement can occur in any direction, but is slight
   *i.e.* – wrist(carpals), ankle(tarsals) & clavicle/sternum
2. **Angular Motion**
   - **extension & flexion**
     - occur in one plane
     - reduce the angle between articulating elements
     - these are opposite movements

**1. Complete** (luxation)
- Articulating surfaces forced out of position.
  - a. may damage articular cartilage
  - b. may tear ligaments
  - c. may distort the joint capsule
* No pain receptors in joint, but surrounding nerves are very sensitive

**2. Partial** (subluxation)
- The damage accompanying a partial dislocation
**flexion**: movement in the anterior/posterior plane that reduces the angle between the articulating elements

  *i.e.* - head to chest

**extension**: movement in the anterior/posterior plane that increases the angle between the articulating elements

  *i.e.* - head back up (return to anatomical position)

*If extension occurs beyond the anatomical position it’s called hyperextension*

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**b. abduction & adduction**

- **abduction** moves the joint away from the body in a longitudinal plane

- **adduction** moves the joint toward the body in a longitudinal plane

**c. circumduction**

- circular motion of the joint

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**Rotation**

- Left/right rotation of the head

- **Lateral** (external) / **medial** (internal) rotation of elbows

**Supination** - ulna and radius parallel

**Pronation** - ulna and radius cross
Special Movement

a. inversion
- twisting motion of the foot to turn the sole inward

b. eversion
- twisting motion of the foot to turn the sole outward

c. dorsiflexion
- flexion of the ankle (lift up toes)

d. plantar flexion
- extends ankle and elevates heel, as when you stand on tiptoe

e. opposition
- special movement of thumb allowing it to touch the other finger tips on the same hand (allows grasping)
f. protraction
- moves part of body anteriorly in a horizontal plane

g. retraction
- opposite of protraction (move part of body dorsally in horizontal plane)

h. elevation
- move a joint superiorly

i. depression
- move a joint inferiorly

j. lateral flexion
- spine moves to the side

A Structural Classification of Synovial Joints

Gliding joints- permit limited movement, generally in a single plane.

i.e.- joints btn. vertebrae

Hinge Joint- are monaxial joints that permit only angular movement in one plane.

i.e.- elbow

Pivot joints- a monaxial joints that permit only rotation.

i.e.- atlas & axis

Ellipsoidal joints- are biaxial joints with an oval articular face that nestles within a depression in the opposing surface.

i.e.- radiocarpals & phalanges w/metacarpals or metatarsals
Saddle joints - are biaxial joints with articular faces that are concave one axis and convex on the other.

i.e.- base of thumb

Ball-and-socket joints - are triaxial joints that permit rotation as well as other movements.

i.e.- glenohumeral

Intervertebral Articulation

• The articular processes of vertebrae form gliding joints with those of adjacent vertebrae. The bodies form symphyseal joints.

• They are separated and cushioned by intervertebral discs, which contain an inner nucleus pulposus and an outer annulus fibrosus.

Intervertebral disc - fibrocartilage that separates and cushions vertebrae.

Nucleus pulposus - a soft, elastic gelatinous core that gives the disc resiliency and enables it to act as a shock absorber. (75% water; the rest is scattered reticular & elastic fibers)

Annulus fibrosus - tough outer layer of fibrocartilage; the collagen fibers attach the disc to the bodies of adjacent vertebrae.

• Several ligaments stabilize the vertebral column.
**Problems with Intervertebral Discs**

**Slipped disc**- a common name for a condition caused by distortion of an intervertebral disc. The distortion applies pressure to the spinal nerves, causing pain and limited range of motion.

**Herniated disc**- a condition caused by an intervertebral compression severe enough to rupture an annulus fibrosus and release the nucleus pulposus which may protrude beyond the intervertebral space.

**Laminectomy**- removal of the vertebral laminae; may be performed to access the vertebral canal and relieve symptom of a herniated disc.

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**The Shoulder Joint**

- The shoulder joint, or *glenhumeral* (scapulohumeral) joint, is formed by the glenoid cavity and head of the humerus.

- This articulation permits the greatest range of motion of any joint in the body.

- It is a *ball-and socket diarthrosis* with various stabilizing ligaments.

- Strength and stability are sacrificed to obtain mobility.

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**The Elbow Joint**

- The elbow joint or *olecranal joint*, permits only flexion/extension.

- It is a hinge diarthrosis whose capsule is reinforced by strong ligaments.
The Hip joint

• The hip joint is a ball-and-socket diarthrosis formed by the union of acetabulum with the head of the femur.

• The joint permits flexion/extension, adduction/abduction, circumduction, and rotation.

• It is stabilized by numerous ligaments.

The Knee Joint

• The knee joint is a hinge joint formed by the union of the condyles of the femur with superior condylar surfaces of the tibia.

• The joint permits flexion/extension and limited rotation, and it is stabilized by several ligaments.

  i.e.- MCL, LCL, PCL, ACL

• A pair of fibrocartilage pads, the medial and lateral menisci, lie b/t the tibial and femoral surfaces.

The Menisci:

  (1) Act as cushions
  (2) Conform to the shape of the articulating surfaces as the femur changes position
  (3) Provide lateral stability to the joint

• Prominent fat pads cushion the margins of the joint and assist many bursae reducing friction b/t the patella and other tissue.
Osteoarthritis

• Also known as degenerative arthritis or degenerative joint disease (DJD), generally affects individuals 60 or over.

• DJD may result from cumulative wear and tear at joint surfaces or from genetic factors affecting collagen formation.

• In the U.S. population, 25% of women and 15% of men over age 60 show signs of this disease.

Rheumatoid Arthritis

• An inflammatory arthritis that affects roughly 2.5% of the adult U.S. population.

• The cause is uncertain, although allergies, bacteria, viruses, and genetic factors have all been proposed.

• The primary symptom is synovitis, swelling and inflammation of the synovial membrane.