ARTICULATIONS
In Anatomy Today

(b) Knee joint, sagittal section

Bursa
Capsule
Synovial membrane
Meniscus
Femur
Patella
Articular cartilage
Fat pad
Patellar ligament
Joint cavity
Meniscus
Intracapsular ligament
Quadriiceps tendon
Classification of Joints

• **Criteria**
  – How bones are joined together
  – Degree of mobility

• **Minimum components**
  – 2 articulating bones
  – Intervening tissue
    • Fibrous CT or cartilage

• **Categories**
  – Synarthroses – no movement
  – Amphiarthrosis – slight movement
  – Diarthrosis – freely movable
Synarthrosis

- Immovable articulation
- Types
  - Sutures
  - Schindylesis
  - Gomphosis
  - Synchondrosis
Synarthrosis

Sutures

• Found only in skull
• Immovable articulation
• Flat bones joined by thin layer of fibrous CT
• Types
  – Serrate
  – Squamous (lap)
  – Plane
Synarthrosis

Sutures

- **Serrate**
  - Serrated edges of bone interlock
  - Two portions of frontal bones

- **Squamous (lap)**
  - Overlapping beveled margins forms smooth line
  - Temporal and parietal bones

- **Plane**
  - Joint formed by straight, nonoverlapping edges
  - Palatine process of maxillae
Synarthrosis
Schindylesis

- Immovable articulation
- Thin plate of bone into cleft or fissure in a separation of the laminae in another bone
- Articulation of sphenoid bone and perpendicular plate of ethmoid bone with vomer
Synarthrosis
Gomphosis

- Immovable articulation
- Conical process into a socket
- Articulation of teeth with alveoli of maxillary bone
- Periodontal ligament = fibrous CT
Synarthrosis

Synchondrosis

- Cartilagenous joints
  - Ribs joined to sternum by hyaline cartilage

- Synostoses
  - When joint ossifies
  - Epiphyseal plate becomes epiphyseal line
Amphiarthrosis

• Slightly moveable articulation
• Articulating bones connected in one of two ways:
  – By broad flattened fibro-cartilage discs
    • Fibrocartilage
    • Symphisis
  – By interosseous ligaments
    • Syndesmosis
Amphiarthrosis
Symphysis

(b) Pubic symphysis (fibrocartilage)

(c) Intervertebral disc (fibrocartilage)
Body of vertebra
Amphiarthrosis
Syndesmosis

- Two bones joined by interosseous membrane
- Example
  - Radioulnar joint
  - Tibulofibular joint
Diarthrosis

- Synovial joints
- Freely movable
- Types
  - Hinge
  - Gliding
  - Pivot
  - Saddle
  - Condyloid
  - Ball and socket
Synovial Joint Structure
General Anatomy

- Articular cartilage
  - Hyaline cartilage
  - Covers ends of bones

- Joint capsule
  - Encloses joint cavity
  - Retains synovial fluid
  - Two parts
    - Fibrous capsule
    - Synovial membrane

- Synovial fluid
  - Produced by fibroblasts
  - Lubricates joint
  - Nourishes articular cartilage
  - Removes waste
  - Contains albumin and hyaluronic acid
General Anatomy

- **Meniscus**
  - Cartilages that do not cross joint
  - Found in knee
  - Shock absorbers
  - Guide movement of bone
  - Stabilize joint

- **Accessory Structures**
  - Tendon
  - Ligaments
  - Bursae (pl.)
    - Fibrous sac filled with synovial fluid
Temperomandibular Joint

- Articular disc
  - Fibrocartilage pad crosses joint capsule
  - Found in temporomandibular and radioulnar joints
Diarthroses

Hinge Joints

• Monaxial
• Articulation between concave and convex surfaces
• Locations
  – Knee
  – Elbow
  – Between phalanges
Diarthroses
Gliding Joints

- Biaxial
- Articular surfaces flat or slightly concave and convex
- Side to side or back/forth motion with slight rotation
- Locations
  - Between carpals
  - Between tarsals
Diarthroses
Pivot Joints

- Monaxial
- Conical bone fits into a depression
- Rotation around a central axis
- Locations
  - Radius/ulna
  - Atlas/axis
Diarthroses
Saddle Joints

• Each articular process is concave in one direction, convex in another
• A modified condyloid articulation with a wider range of movement
• Locations
  – Between the trapezium and 1st metacarpal
  – Between the malleus and incus
Diarthroses
Condyloid Joints

- **Biaxial**
- Convex surface is oval shaped
- Up/down, side to side movements
- **Locations**
  - Radius/carpals
  - Metacarpals/phalanges
Diarthroses
Ball and Socket Joints

- Multiaxial
- Greatest range of movement of all synovial joints
- Rounded convex surface with a cuplike cavity
- Locations
  - Shoulder
  - Hip
Movements of Synovial Joints

Movement Terminology

• Flexion, Extension, and Hyperextension
• Abduction and adduction
• Elevation and depression
• Protraction and retraction
• Lateral and medial excursion
• Circumduction
• Rotation
• Supination and pronation
• Opposition and reposition
• Dorsiflexion and plantar flexion
• Inversion and eversion
Flexion, Extension, and Hyperextension

• Flexion
  – Decrease in the angle of the joint
  – Usually in a sagittal plane
  – Ex) bending the elbow

• Extension
  – Straightens joint and returns body part to anatomical position
  – Ex) straighten the elbow

• Hyperextension
  – Extension of joint beyond 180°
  – Ex) looking upward at the ceiling
Abduction and Adduction, Elevation and Depression

- **Abduction**
  - Movement away from the median plane
  - Ex) Raising arm

- **Adduction**
  - Movement toward the median plane
  - Ex) Lowering arm

- **Elevation**
  - Movement that raises bone vertically
  - Ex) Shrugging shoulders

- **Depression**
  - Movement that lowers bone vertically
  - Ex) Lowering mandible to open mouth
Protraction, Retraction, Lateral and Medial Excursion

• Protraction
  – Movement of bone forward on a horizontal plane
  – Ex) thrusting pelvis forward

• Retraction
  – Movement of bone posteriorly

• Lateral and medial excursion
  – Lateral: Sideways movement right or left
  – Medial: Movement back to midline
  – Ex) side to side grinding of teeth
Circumduction and Rotation, Supination and Pronation

• Circumduction
  – Movement conscribes a conical space
  – Ex) winding up for a pitch

• Rotation
  – Bone turns on its longitudinal axis
  – Ex) twisting at waist

• Supination (forearm only)
  – Rotation of forearm so that palm faces forward or upward

• Pronation (forearm only)
  – Rotation of forearm so that palm faces toward rear or downward
Opposition and Reposition, Dorsiflexion and Plantar Flexion

- **Opposition**
  - Movement of thumb toward fingertips

- **Reposition**
  - Movement of thumb back to anatomical position parallel to index finger

- **Dorsiflexion**
  - Upward movement of foot

- **Plantar flexion**
  - Stepping downward
Inversion and Eversion

• Inversion
  – Turning soles of feet inward medially toward each other

• Eversion
  – Turning soles of feet outward away from each other
Lever Systems

• Components
  1. Rigid rod: the stationary bone
  2. Effort
     • applied force: supplied by muscle contraction
  3. Fulcrum
     • pivot point: joint
  4. Resistance
     • the load moved by the applied force
     • the movable bone and anything attached
First Class Levers

- Fulcrum positioned between effort and resistance
- Joint works like a see-saw
- Example
  - atlanto-occipital joint (nodding)
Second Class Levers

- Resistance positioned between the effort and fulcrum
- Joint works like a wheelbarrow or crowbar
- Example
  - contraction of the calf muscles to elevate the body
Third Class Levers

- Effort positioned between the fulcrum and resistance
- Most common
- Joint works like forceps
- Example
  - elbow joint
Range of Motion vs Power

- Range of motion and speed
  - Variety of movements
  - Number of movements per unit time
- Power (leverage)
  - the amount of force
- Effort closer to the fulcrum (3rd class)
  - increases range of motion and speed
- Resistance (load) closer to the fulcrum (2nd class)
  - increases power