Articulations

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Classification of joints

• What is an articulation?
• Classification Criteria
  – How bones are joined together
  – Degree of mobility
• Minimum components
  – 2 articulating bones
  – Intervening tissue
    • Fibrous CT or cartilage
Classifications based on structure

• **Fibrous**
  - No joint cavity
  - Ends of bones joined by dense regular CT
  - Ex: tooth to alveoli of mandible

• **Cartilaginous**
  - No joint cavity
  - Cartilaginous pad between ends of bones
  - Ex: pubic symphysis

• **Synovial**
  - Joint cavity
  - Articular cartilage caps ends of bones
  - Synovial fluid-filled joint capsule lined by synovial membrane
  - Ex: glenohumeral joint
Categories based on degree of movement

- **Synarthrosis**
  - Immovable joint
- **Amphiarthrosis**
  - Slightly movable
- **Diarthrosis**
  - Freely movable
Synarthrosis

- Sutura (sutures)
- Schindylesis
- Gomphosis
- Synchondrosis

Immovable articulations
Sutura

• Found only in skull
• Flat bones joined by thin layer of fibrous CT
• Three types
  - Serrate
    • Serrated edges of bone interlock
    • Two portions of frontal bones
  - Squamous (lap)
    • Overlapping beveled margins forms smooth line
    • Temporal and parietal bones
  - Plane (butt)
    • Joint formed by straight, non-overlapping edges
    • Palatine process of maxillae

Immovable articulations
Sutura

(a) Serrate suture

(b) Bone

(c) Dovetail joint

Lap suture

(b) Wood

(c) Miter joint

Plane suture

(b) Wood

(c) Butt joint
Schindylesis

- “Web and groove joint”
- Thin plate of bone into cleft or fissure in a separation of the laminae in another bone
- Ex) articulation of sphenoid bone and perpendicular plate of ethmoid bone with vomer

Immovable articulations
Gomphosis

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

Immovable articulations
Synchondroses

- **Cartilagenous joints**
  - Ribs joined to sternum by hyaline cartilage

- **Synostoses = when joint ossifies**
  - Epiphyseal plate becomes epiphyseal line

**Immovable articulations**
Amphiarthrosis

• Articulating bones connected in one of two ways:
  - By broad flattened fibro-cartilage discs
    • Hyaline cartilage + collagen fibers
    • Symphysis
  - By interosseus ligaments
    • Syndesmosis

Slightly moveable articulations
Amphiarthrosis: symphysis

Slightly moveable articulations
Amphiarthrosis: syndesmosis

- Two bones joined by interosseous membrane
- Ex)
  - Radioulnar joint
  - Tibulofibular joint
Diarthrosis

• Synovial joints
  - Freely movable
  - Types
    • Hinge
    • Gliding
    • Pivot
    • Saddle
    • Condyloid
    • Ball and socket
Synovial joint anatomy

- **Articular cartilage**
  - Hyaline cartilage
  - Covers ends of bones
- **Joint capsule**
  - Encloses joint cavity
  - Retains synovial fluid
  - Two parts
    - Fibrous capsule
    - Synovial membrane
Synovial joint anatomy

- **Synovial fluid**
  - Produced by fibroblasts
  - Functions
    - Lubricates joint
    - Nourishes articular cartilage
    - Removes waste
    - Shock absorber
  - Composition
    - albumin and hyaluronic acid
Synovial joint anatomy

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

- **Accessories**
  - Tendon
    - Muscle to bone
  - Ligaments
    - Bone to bone
  - Bursae
    - Fibrous sac filled with synovial fluid
Synovial joint anatomy
Synovial joint anatomy

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

- Articulation between concave and convex surfaces
- monaxial
  - movement in only 1 plane
- knee, elbow, between phalanges
Diarthroses: Gliding joints

- simplest
- Articular surfaces flat or slightly concave and convex
- side to side or back/forth motion with slight rotation
- between carpals/tarsals
Diarthroses: Pivot joints

- Monaxial
- Conical bone fits into a depression
- Rotation around a central axis
- 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
- between the trapezium and 1st metacarpal
- and between the malleus and incus
Diarthroses: Condyloid joints

- convex surface is oval shaped
- biaxial
- up/down, side to side movements
- radiocarpal, metacarpophalangeal
Diarthroses: Ball and socket joints

- rounded convex surface with a cuplike cavity
- greatest range of movement of all synovial joints
- shoulder and hip
Movements of Synovial Joints

- 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**
  - 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
  - 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**
  - 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
  - Movement conscribes a conical space
  - Ex) winding up for a pitch
• Rotation
  - Bone turns on its longitudinal access
  - Ex) twisting at waist
Supination and Pronation

• **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

(a) Supination (S) and pronation (P)

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• Opposition
  - Movement of thumb toward fingertips

• Reposition
  - Movement of thumb back to anatomical position parallel to index finger
• Dorsiflexion
  - Upward movement of toes
• Plantar flexion
  - Pointing toes downward
• **Inversion**
  - Turning soles of feet inward medially toward each other

• **Eversion**
  - Turing soles of feet outward away from each other

*(b) Inversion and eversion*

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Lever Systems

• Components
  - rigid rod = the stationary bone
  - effort = applied force, supplied by muscle contraction
  - pivot point or fulcrum = joint
  - 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
• atlanto-occipital joint (nodding)
second class levers

- resistance positioned between the effort and fulcrum
- joint works like a wheelbarrow or crowbar
- contraction of the calf muscles to elevate the body
third class levers

- effort positioned between the fulcrum and resistance
- joint works like forceps
- most common, e.g. elbow joint
Herniated disk

Nucleus pulposus
Transition zone
Inner anulus fibrosus
Outer anulus fibrosus

Compressed lumbar spinal nerve
Herniated disc

Nerve Root
L5
Disc
S1
Annular Tear