Chapter 9

Joints

Classification by Function & Structure

Features of Synovial Joints

Types of Movements
Joints = Articulations

- Point where two bones meet (*whether or not* the bones are movable at their interface)

- Functions of joints
  - Give skeleton mobility
  - Hold skeleton together
• Two Classification Systems

  – **Functional** = degree of movement

  – **Structural** = type of material between bones and/or capsule
Functional Classification of Joints

- Amount of movement (function) that joint allows

- Three functional classifications:
  - Synarthroses—immovable joints
  - Amphiarthroses—slightly movable joints
  - Diarthroses—freely movable joints
Structural Classification of Joints

• Based on material binding bones together and the presence or absence of joint cavity

• Three structural classifications
  – Fibrous joints
  – Cartilaginous joints
  – Synovial joints (know in detail!)
Fibrous Joints

- Bones joined by dense fibrous connective tissue
- No joint cavity
- Amphiarthrotic – slightly moveable // Depends on length of connective tissue fibers
- Potential to become synarthroses (immovable)

- Three types: Sutures / Syndesmoses / Gomphoses
Fibrous Joints #1
Sutures

• Rigid, interlocking joints

• Immovable joints for protection of brain

• Contain short connective tissue fibers

• Allow for growth during youth

• In middle age, sutures ossify and fuse
  – After they fuse become **Synarthroses**
Fibrous Joints #1
Sutures

CORONAL SUTURE

Outer compact bone
Spongy bone
Inner compact bone

(a) Suture between skull bones
Fibrous Joints #2
Syndesmoses

• Bones connected by ligaments

• Fiber length varies // determines amount of movement varies

  – large amount of movement at interosseous membrane connecting radius and ulna

  – little to no movement at distal tibiofibular joint
• **Interosseus membranes**

  – most movable syndesmosis joint

  – permits supination and pronation of the ulna and radius

(d) Interosseous membrane between diaphyses of tibia and fibula
Fibrous Joint #2
Syndesmosis

A less movable syndesmosis between tibia to fibula
Fibrous Joints #3
Gomphoses

- Peg-in-socket joints of teeth in alveolar sockets
- A tooth is technically not a bone
- Tooth is held in place within the alveolar socket of maxilla and mandible
- Fibrous connection = periodontal ligament
Cartilaginous Joints

- Bones united by cartilage
- No joint cavity
- Not highly movable
- Two types:
  - Synchondroses (hyaline cartilage)
  - Symphyses (fibrous cartilage)
Cartilaginous Joints #1
Synchondroses

• Described as a bar or plate of hyaline cartilage
  – unites two osseous tissues with hyaline cartilage
  – Temporary epiphyseal plate joints
    • Become synostoses after plate closure
  – Cartilage of 1\textsuperscript{st} rib with manubrium
Cartilaginous Joints #1
Synchondroses

(a) Synchondroses
Bones united by hyaline cartilage

Epiphyseal plate (temporary hyaline cartilage joint)

Sternum (manubrium)
Joint between first rib and sternum (immovable)
Synchondrotic joints eventually become synarthrotic //
Epiphyseal plate become the epiphysial line
Cartilaginous Joints #2
Symphyses

• Fibrocartilage that unites bones
  – Strong, flexible, and amphiarthrotic
Cartilaginous Joints #2
Symphyses

(b) Symphyses

Bones united by fibrocartilage

Body of vertebra

Fibrocartilaginous intervertebral disc (sandwiched between hyaline cartilage)

Pubic symphysis
Cartilaginous Joints #2
Symphyses

Hip bones

PUBIC SYMPHYSIS

(b) Symphysis
Synovial Joints

• Bones separated by fluid-filled joint cavity

• All diarthrotic joints are freely moveable

• Include all limb joints and most common joints of body
Ligament
Joint cavity (contains synovial fluid)
Articular (hyaline) cartilage
Fibrous layer
Synovial membrane (secretes synovial fluid)
Articular capsule
Periosteum
Synovial Joints:
Six Distinguishing Features

1. Articular cartilage: hyaline cartilage // Prevents crushing of bone ends

2. Joint (synovial) cavity // Small, fluid-filled potential space

3. Articular (joint) capsule // Two layers
   - External Fibrous layer // Dense irregular connective tissue
   - Inner Synovial membrane // Loose connective tissue - Makes synovial fluid
4. Synovial fluid
   - Viscous, slippery filtrate of plasma and hyaluronic acid
   - Lubricates and nourishes articular cartilage
   - Contains phagocytic cells to remove microbes and debris

5. Different types of reinforcing ligaments
   - **Capsular**
     • Thickened part of fibrous layer
   - **Extracapsular**
     • Outside the capsule
   - **Intracapsular**
     • Deep to capsule; covered by synovial membrane

6. Nerves and blood vessels
   - Nerve fibers detect pain, monitor joint position and stretch
   - Capillary beds supply filtrate for synovial fluid
Ligament
Joint cavity (contains synovial fluid)
Articular (hyaline) cartilage
Fibrous layer
Synovial membrane (secretes synovial fluid)
Articular capsule
Periosteum
Other Features of Some Synovial Joints

• Fatty pads // For cushioning between fibrous layer and synovial membrane or bone

• Articular discs (menisci) // Fibrocartilage separates articular surfaces
  – improve "fit" of bone ends
  – stabilize joint
  – reduce wear and tear
Sagittal section through the right knee joint
(b) Frontal section
(b) Superior view of the right tibia in the knee joint, showing the menisci and cruciate ligaments.
Anterior view of right knee

- Quadriceps femoris muscle
- Tendon of quadriceps femoris muscle
- Patella
- Lateral patellar retinaculum
- Fibular collateral ligament
- Fibula
- Medial patellar retinaculum
- Tibial collateral ligament
- Patellar ligament
- Tibia
Posterior cruciate ligament
Medial condyle
Tibial collateral ligament
Anterior cruciate ligament
Medial meniscus
Patellar ligament
Patella
Quadriceps tendon

(e) Anterior view of flexed knee, showing the cruciate ligaments (articular capsule removed, and quadriceps tendon cut and reflected distally)
Structures Associated with Synovial Joints

- **Bursae** = Sacs lined with synovial membrane // Contain synovial fluid

- **Tendon Sheaths** = Elongated bursa wrapped completely around tendon subjected to friction

Both of these structures reduce friction where ligaments, muscles, skin, tendons, or bones rub against each other.
Frontal section through the right shoulder joint

- Acromion of scapula
- Subacromial bursa
- Fibrous layer of articular capsule
- Joint cavity containing synovial fluid
- Articular cartilage
- Synovial membrane
- Fibrous layer
- Humerus
- Tendon sheath
- Tendon of long head of biceps brachii muscle
Bursa rolls and lessens friction.

Humerus head rolls medially as arm abducts.

Enlargement showing how a bursa eliminates friction where a ligament (or other structure) would rub against a bone.
Three Stabilizing Factors at Synovial Joints

• 1) Shapes of articular surfaces (minor role)

• 2) Ligament number and location (limited role)

• 3) Muscle tendons that cross joint (most important)
  – Muscle tone keeps tendons taut
  – Extremely important in reinforcing // Shoulder and Knee joints // Also arches of the foot
Range of Motion
(a) Atlanto-occipital and cervical intervertebral joints
(b) Shoulder joint
(c) Elbow joint
(d) Wrist joint

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Flexion

Extension

Hyperextension
Lateral flexion

(g) Intervertebral joints
(b) Wrist joint

Abduction

Adduction
(c) Hip joint
(d) Metacarpophalangeal joints of the fingers (not the thumb)
(a) Shoulder joint

(b) Hip joint
(a) Shoulder joint

Circumduction
(a) Atlanto-axial joints
(b) Shoulder joint
(c) Hip joint

Lateral rotation

Medial rotation

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(a) Temporomandibular joints (b)
(c) Temporomandibular joints (d) Retraction

Protraction
Dorsiflexion

Plantar flexion

(g) Ankle joint

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(h) Radioulnar joints