Joints

Structural and Functional Classification of Articulations
Agenda

• Joint Basics
• Classification
• Structural Joint Details
• Joint Stability
• Movements of Synovial Joints
• Shape Classification of Synovial Joints
• Joint Concerns/Injuries

• Extra Material – Selected Synovial Joint Detail
Joints

• Rigid elements of the skeleton meet at joints or articulations
• Greek root “arthro” means joint
• Articulations can be:
  – Bone to bone
  – Bone to cartilage
  – Teeth in bony sockets
• Structure of joints
  – Enables resistance to crushing, tearing, and other forces
Classifications of Joints

• Joints can be classified by function or structure

• **Functional classification** – based on amount of movement
  
  – Synarthroses –
    • immovable – common in axial skeleton
  
  – Amphiarthroses –
    • slightly movable – common in axial skeleton
  
  – Diarthroses –
    • freely movable – common in appendicular skeleton
Classifications of Joints

• **Structural classification** based on:
  – Material that binds bones together
  – Presence or absence of a joint cavity
  – Structural classifications include
    • [Fibrous](#)
    • [Cartilaginous](#)
    • [Synovial](#)
Fibrous Joints

• Bones are connected by fibrous connective tissue
• Do not have a joint cavity
• Most are immovable or slightly movable
• Types –
  – sutures – i.e. coronal suture
  – Syndesmoses – i.e. tibiofibular joint
  – Gomphoses – i.e. your teeth!
Fibrous Joints: Sutures

- Bones are tightly bound by a minimal amount of fibrous tissue
- Only occur between the bones of the skull
- Allow bone growth so that the skull can expand with brain during childhood
- Fibrous tissue ossifies in middle age
  - Synostoses – closed sutures
Fibrous Joints: Syndesmoses

• Bones are connected exclusively by ligaments
• Amount of movement depends on length of fibers
  – Tibiofibular joint – an immovable synarthrosis
  – Interosseous membrane between radius and ulna – freely movable diarthrosis
Fibrous Joints: Gomphoses

- Tooth in a socket
- Connecting ligament – the periodontal ligament
Cartilaginous Joints

• Bones are united by cartilage
• Lack a joint cavity
• Two types – 
  – synchondroses
  – symphyses
Cartilaginous Joint: Synchondroses

- Hyaline cartilage unites bones
  - Epiphyseal plates
Cartilaginous Joint: Synchondroses

• Joint between first rib and manubrium
Cartilaginous Joint: Symphyses

• Fibrocartilage unites bones – resists tension and compression

• Slightly movable joints that provide strength with flexibility
  – Intervertebral discs
  – Pubic symphysis
Synovial Joints - Characteristics

- Most movable type of joint
- All are diarthroses (freely moving)
- Each contains a fluid-filled joint cavity called a synovial cavity.
A Typical Synovial Joint

- Fibrous Capsule
- Synovial Membrane
- Cartilage (Articular) Disc
- Synovial Joint Cavity
- Articular Cartilage
General Structure of Synovial Joints

• Articular cartilage
  – Ends of opposing bones are covered with hyaline cartilage
  – Absorbs compression

• Joint cavity (synovial cavity)
  – Unique to synovial joints
  – Cavity is a potential space that holds a small amount of fluid
General Structure of Synovial Joints

• Articular capsule – joint cavity is enclosed in a two-layered capsule
  – Fibrous capsule – dense irregular connective tissue – strengthens joint
  – Synovial membrane – loose connective tissue
    • Lines joint capsule and covers internal joint surfaces
    • Functions to make synovial fluid

• Synovial fluid
  – A viscous fluid similar to raw egg white
    • A filtrate of blood
      – Arises from capillaries in synovial membrane
    • Contains glycoprotein molecules secreted by fibroblasts
General Structure of Synovial Joints

• Reinforcing ligaments
  – Often are thickened parts of the fibrous capsule
  – Sometimes are extracapsular ligaments – located outside the capsule
  – Sometimes are intracapsular ligaments – located internal to the capsule
General Structure of Synovial Joints

• Richly supplied with sensory nerves
  – Detect pain
  – Most monitor how much the capsule is being stretched – why?

• Have a rich blood supply
  – Most supply the synovial membrane
  – Extensive capillary beds produce basis of synovial fluid
  – Branches of several major nerves and blood vessels
Synovial Joints with Articular Discs

• Some synovial joints contain an articular disc
  – Occur in the temporomandibular joint and at the knee joint
  – Occur in joints whose articulating bones have somewhat different shapes
How Synovial Joints Function

• Synovial joints – lubricating devices
• Friction could overheat and destroy joint tissue
• Are subjected to compressive forces
  • Fluid is squeezed out as opposing cartilages touch
  • Cartilages ride on the slippery film
Bursae and Tendon Sheaths

- **Bursae and tendon sheaths:**
  - Closed bags of lubricant
  - Reduce friction between body elements
  - Even though they are lined by a synovial membrane, they are not joints
- **Bursa** – a flattened fibrous sac lined by a synovial membrane
- **Tendon sheath** – an elongated bursa that wraps around a tendon
Factors Influencing Joint Stability

• Articular surfaces
  – seldom play a major role in joint stability
    • Exceptions: the elbow, the knee and the hip do provide stability

• Ligaments
  – the more ligaments in a joint, the stronger it is

• Muscle tone
  – the most important factor in joint stability
  – keeps tension on muscle tendons
Movements Allowed by Synovial Joints

• Three basic types of movement
  – Gliding – one bone across the surface of another
  – Angular movement – movements change the angle between bones
  – Rotation – movement around a bone's long axis

• And a host of “special movements”
  – Supination / Pronation
  – Dorsiflexion / Plantar flexion
  – Inversion / Eversion
  – Projection / Retraction
  – Elevation / Depression
  – Opposition
Gliding Joints

• Flat surfaces of two bones slip across each other
• Gliding occurs between
  – Carpals
  – Articular processes of vertebrae
  – Tarsals
Angular Movements

• Increase or decrease angle between bones

• Movements involve:
  – Flexion and Extension
    • Flexion: movement decreases the joint angle
    • Extension: movement that increases the joint angle
  – Abduction and Adduction
    • Abduction: movement away from midline
    • Adduction: movement towards midline
  – Circumduction
    • Circular motion allowed by a joint
Rotation

• Involves turning movement of a bone around its long axis
  – The only movement allowed between atlas and axis vertebrae
  – Occurs at the hip and shoulder joints
Special Movements

• Supination
  – forearm rotates laterally & palm faces anteriorly

• Pronation
  – forearm rotates medially & palm faces posteriorly
Special Movements

• Dorsiflexion
  – lifting the foot so its superior surface approaches the shin

• Plantar flexion
  – depressing the foot – pointing the toes downward
Special Movements

• Inversion
  – turning the sole medially

• Eversion
  – turning the sole laterally
Special Movements

• **Protraction**
  – nonangular movement of jutting out the jaw

• **Retraction**
  – opposite movement to protraction
Special Movements

• Elevation
  – lifting a body superiorly

• Depression
  – moving the elevated part inferiorly
Special Movements

• Opposition
  – movement of the thumb to touch the tips of other fingers
Synovial Joints Classified by Shape

• Plane joint
  – Articular surfaces are flat planes
  – Short gliding movements are allowed
    • Intertarsal and intercarpal joints
    • Movements are nonaxial
    • Gliding does not involve rotation around any axis
    • Considered a translational movement
Synovial Joints Classified by Shape

• Hinge joints
  – Cylindrical end of one bone fits into a trough on another bone
  – Angular movement is allowed in one plane
  – Elbow, ankle, and joints between phalanges
  – Movement is uniaxial – allows movement around one axis only
Synovial Joints Classified by Shape

• Pivot joints
  – Classified as **uniaxial**
    • rotating bone only turns around its long axis
  – Examples
    • Proximal radioulnar joint
    • Joint between atlas and axis
Synovial Joints Classified by Shape

• Condyloid joints
  – Allow moving bone to travel:
    • Side to side – abduction-adduction
    • Back and forth – flexion-extension

• Classified as **biaxial**
  – movement occurs around two axes
Synovial Joints Classified by Shape

• Saddle joints
  – Each articular surface has concave and convex surfaces
  – Classified as **biaxial** joints
Synovial Joints Classified by Shape

• Ball-and-socket joints
  – Spherical head of one bone fits into round socket of another
  – Classified as **multiaxial** – allow movement in all axes
  – Examples: shoulder and hip joints
Selected Synovial Joints – Sternoclavicular Joint

• **Sternoclavicular joint – General Characteristics**
  – Forms a Saddle joint
  – Muscles and ligaments contribute to joint stability, and the unique joint shape allows for multiple complex movements
Sternoclavicular Joint

(a) Sternoclavicular joint

(b) Sternoclavicular movements
Selected Synovial Joints - TMJ

• Temporomandibular joint (TMJ)
  – Lies anterior to the ear
  – Head of the mandible articulates with the mandibular fossa
  – Two surfaces of the articular disc allow two kinds of movement
    • Hinge-like movement
    • Superior surface of disc glides anteriorly
Selected Synovial Joints - Wrist

• Composed of the radiocarpal and intercarpal joint
  – Radiocarpal joint – joint between the radius and proximal carpals (the scaphoid and lunate); allows for flexion, extension, adduction, abduction, and circumduction
  – Intercarpal joint – joint between the proximal and distal rows or carpals; allows for gliding movement
• The wrist joint is stabilized by numerous ligaments
Wrist Joint

Figure 9.10a
Selected Synovial Joints - Shoulder

• Shoulder (Glenohumeral) joint – General Characteristics
  – The most freely movable joint – lacks stability
  – Articular capsule is thin and loose
  – Muscle tendons contribute to joint stability
Glenohumeral Joint

- Acromion of scapula
- Coracoacromial ligament
- Subacromial bursa
- Fibrous articular capsule
- Glenoid cavity containing synovial fluid
- Hyaline cartilage
- Synovial membrane
- Fibrous capsule
- Humerus
- Tendon sheath
- Tendon of long head of biceps brachii muscle
Selected Synovial Joints

• Elbow joint – General Characteristics
  – Allows flexion and extension
  – The humerus’ articulation with ulna forms the hinge
  – Tendons of biceps and triceps brachii provide stability
Elbow Joint

- Humerus
- Synovial membrane
- Synovial cavity
- Articular cartilage
- Coronoid process
- Tendon of triceps muscle
- Bursa
- Trochlea
- Articular cartilage of the trochlear notch
- Ulna
- Lateral epicondyle
- Articular capsule
- Radial collateral ligament
- Olecranon process
- Anular ligament
- Radius
- Ulna
Elbow Joint

- Anular ligament
- Articular capsule
- Radius
- Coronoind process
- Humerus
- Medial epicondyle
- Ulnar (medial) collateral ligament
- Ulna

- Articular capsule
- Anular ligament
- Coronoid process
- Ulnar collateral ligament
- Radius
- Ulna

(d)
Selected Synovial Joints

• Hip joint – General Characteristics
  – A ball-and-socket structure
  – Movements occur in all axes – limited by ligaments and acetabulum
  – Head of femur articulates with acetabulum
  – Muscle tendons contributes to stability, however
  – Stability comes chiefly from acetabulum and capsular ligaments
Frontal Section and Anterior View of the Hip Joint
Posterior View of the Hip Joint

Figure 9.13c, d
Selected Synovial Joints

- Knee joint – General Characteristics
  - The largest and most complex joint
  - Primarily acts as a hinge joint
  - Has some capacity for rotation when leg is flexed
  - Structurally considered compound and bicondyloid
  - Two fibrocartilage menisci occur within the joint cavity
Knee Joint – External Features

• Capsule of knee joint
  – Covers posterior and lateral aspects of the knee
  – Covers tibial and femoral condyles
  – Does not cover the anterior aspect of the knee
    • Anteriorly – covered by three ligaments
      – Patellar, medial, and lateral retinacula

• Ligaments of the knee joint
  – Become taut when knee is extended
  – These extracapsular ligaments are
    • Fibular and tibial collateral ligament
    • Oblique popliteal ligament
    • Arcuate popliteal ligament
Knee Joint – Internal Features

- Intracapsular ligaments
  - Cruciate ligaments – cross each other like an “X”
    - Prevent undesirable movements at the knee joint
  - Each runs from the proximal tibia to the distal femur
    - Anterior cruciate ligament
    - Posterior cruciate ligament
Anterior View of Flexed Knee

Figure 9.14e, f
Selected Synovial Joint

• Ankle Joint – General Characteristics:
  – A hinge joint between:
    • United inferior ends of tibia and fibula
    • And the talus of the foot
• Allows dorsiflexion and plantar flexion only
Ligaments of the Ankle Joint

Figure 9.17b
General Joint Concerns & Issues

• Structure of joints makes them prone to traumatic stress
• Function of joints makes them subject to friction and wear
• Affected by inflammatory and degenerative processes
Joint Injuries

- Sprains – ligaments of a reinforcing joint are stretched or torn
- Dislocation – occurs when the bones of a joint are forced out of alignment
  - Luxation = complete dislocation
  - Subluxation = partial dislocation
- Torn cartilage – common injury to meniscus of knee joint
Inflammatory and Degenerative Conditions

- **Bursitis** – inflammation of a bursa due to injury or friction
- **Tendonitis** – inflammation of a tendon sheath
- **Arthritis** – describes over 100 kinds of joint-damaging diseases
  - **Osteoarthritis** – most common type – “wear and tear” arthritis
  - **Rheumatoid arthritis** – a chronic inflammatory disorder
  - **Gouty arthritis (gout)** – uric acid build-up causes pain in joints
- **Lyme disease** – inflammatory disease often resulting in joint pain