Chapter #4
Joint Mechanics and Joint Injuries

Arthrology: The study of joints
Types of Joints

- With one exception (the hyoid bone), every bone in the body is connected (articulated) to or forms a joint with at least one other bone.
Joints perform **two functions** in the body:

1. Hold bones together
2. They allow the rigid skeleton some flexibility so that gross movements can occur.
Joints

- They may be more or less freely movable, or fixed, allowing no movement whatsoever between the bones they join.
- Joints are classified according to their *structure and/or their function*.
Functionally joints are classified as: (...how they move)

1. Immovable Joints (synarthroses)
   - arthrose = joint, syn = together
   - bone stuck together
   - two adjacent bones separated by a small amount of fibrous tissue
   - eg. sutures
2. Slightly Movable Joints (amphiarthroses)

- *arthrose* = joint, *amphi* = both
- In between immovable and freely movable
- Two adjacent bones separated by a substantial amount of cartilage
- Eg. Between the bodies of the vertebrae
- Eg. The symphysis pubis
3. **Freely movable joints (diarthroses)**

- *arthrose = joint, dia = apart*
- bone apart, can move easily
- two bones encased within a synovial cavity
- Eg. Shoulder, knee, hip, ankle, foot
Structurally joints are classified as:
*(Their structural classification is based on the nature of the material comprising them.)*

1. **Fibrous joints**
   - joints held together by fibrous connective tissue, allow no movement, lack joint cavity
   - eg. sutures

2. **Cartilaginous joints or Fibrocartilaginous joints**
   - (held together by cartilage, lacking a joint cavity, slight movement is possible)
   - eg. intervertebral discs of the vertebral column

3. **Synovial joints**
   - allow the most movement
   - the joint contains a synovial cavity
   - eg. Knee, shoulder, and the ankle
1. FIBROUS JOINTS

- In fibrous joints, the bones are united by dense connective tissue consisting of collagen fibres which run between the bones.
- There is NO JOINT CAVITY.
FIBROUS JOINTS (con’t)

- The degree of movement permitted depends on the **length** of the collagen fibers, and on the **shape** and extent of the **bone surface** at the joint.

Examples:

- **Sutures**- connecting fibres are short
- **Syndesmosis**- tib/fib jt.-a fibrous membrane connects the shafts of two long bones (connecting fibres are long)
- **Gomphosis** - peg-in-socket fibrous joint, where a tooth joins its bony socket
Gomphosis
FIBROUS JOINTS

Suture

dense fibrous connective tissue

Syndesmosis

ulna
radius
interosseous membrane
tibia
fibula
ligament
CARTILAGINOUS JOINTS

- The bones are united with each other by cartilage.
- NO JOINT CAVITY.
- Ex. - the cartilaginous epiphyseal plate which separates the epiphysis from the diaphysis in long bones during growth.
  - Obliterated by bone in adults
CARTILAGINOUS JOINTS

- Ex. -the joint between the first rib and the sternum. (hyaline cartilage) **Synchondrosis**.
- Ex.- the pubic symphysis and the intervertebral discs.(contains both hyaline cartilage and fibrocartilage)
- **Bone is covered with hyaline cartilage**
- **Fibrocartilage joins bones together**
CARTILAGINOUS JOINTS

Symphyses
CARTILAGINOUS JOINTS

Synchondrosis

epiphysis

epiphyseal plate:
hyaline cartilage
diaphysis

manubrium
hyaline cartilage

first rib
SYNOVIAL JOINTS

- The majority of articulations between bones are synovial joints.
- Freely moveable
- Contains a joint cavity (synovial cavity).

Label the diagram of the synovial joint using page #70 of your text!
The Characteristics of a Synovial Joint

- Bone
- Blood vessels
- Nerve
- Joint cavity
- Synovial membrane
- Fibrous capsule
- Tendon sheath
- Tendon
- Articular cartilage
- Membranous layer
- Fibrous layer
- Periosteum
The articulating surfaces of the bones are covered by a thin layer of very smooth hyaline cartilage (articular cartilage) and lubricated by a special fluid, the synovial fluid, secreted by the synovial membrane which lines the cavity.

This fluid is highly viscous and slippery, and reduces friction.
The joint cavity is enclosed by a double layered membrane: the joint capsule.

The outer layer is a tough membrane of collagen fibers which is firmly attached to the surface of the bones on either side of the joint. It is continuous with the periosteum. (Fibrous capsule)

The internal layer is the synovial membrane which covers all internal joint surfaces that are not hyaline cartilage.
• Synovial joints are reinforced by a number of ligaments.
• In some joints such as the knee, complete or partial discs (menisci) of fibrocartilage occur within the synovial cavity.
• They act as swabs to spread synovial fluid into the joint and help to stabilize the joint.
• These discs (often called 'knee cartilages') are frequently torn or displaced in body contact sports.
A Meniscus Tear: The two most common causes of a meniscus tear are due to traumatic injury (often seen in athletes) and degenerative processes (seen in older patients who have more brittle cartilage).
Symptoms of a Meniscus Tear?

- Individuals who experience a meniscus tear usually experience pain and swelling as their primary symptoms. Another common complaint is joint locking, or the inability to completely straighten the joint. This is due to the torn cartilage physically preventing the normal motion of the knee.
http://www.youtube.com/watch?v=jRHF6KY8REA

http://www.youtube.com/watch?v=EC6J_pj0SRQ&feature=channel
Bursae (singular = bursa) are closed, partially collapsed balloon containing synovial fluid. They are found in the vicinity of joints where movement between two adjacent tissues might otherwise result in excessive friction.
• Tendon sheaths are similar to bursae, but differ in shape.
• They look like sausage-shaped balloons that wrap around long tendons subjected to friction.
Tendon Sheath Infection
Synovial Joints

- Synovial joints are classified according to the shape of the articulating surfaces, which, in turn, determines the range of movement permitted.
Names of Joints

Interphalangeal joints

Metacarpophalangeal joint

Metacarpals

Carpometacarpal joint

Carpals

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1. Gliding/Plane

- Connects flat or slightly curved bone surfaces.
- Only sliding motion in all directions are allowed. Since there is no bone movement around an axis, the joints are nonaxial.

- Eg. Joints in the foot between the tarsals and in the hand between the carpals
  - Intercarpal
  - Intertarsal
  - Sternocostal
  - Vertebrocostal
2. Hinge

- Convex surface of one bone fits smoothly into concave surface of the second bone.
- The movements allowed are similar to those allowed by a mechanical door hinge. Since the movements (flexion/extension) are all in one plane and around one axis, the joints are uniaxial.
  - Elbow
  - Ankle
  - Interphalangeal joints
  - Knee-modified hinge!
3. Pivot

- A rounded, pointed or conical surface of one bone is inserted into a ring made partly of another bone and partly of a ligament.
- Since the only movement allowed is the rotation of one bone around its own axis, the Joints are uniaxial.
- Eg. Joint between the first two vertebrae of the neck that allows for the rotation of the neck
- Eg. Radialulnar joints (proximal and distal)
4. Ellipsoidal/Condyloid

- Oval-shaped surface fits into an oval-shaped cavity (ellipse means oval).
- The movements allowed are flexion/extension, adduction/abduction and circumduction but NO ROTATION. Since bones can move in both planes: side to side and back and forth movements the joints are biaxial.
- Eg. wrist (radiocarpal joint), knuckle (metacarpophalangeal joint)
5. Saddle

- First bone's articular surface is concave in one direction and convex in the other while the second bone is just the opposite (or if you prefer, one bone is shaped like a saddle, and the other is shaped like its rider).

- Eg. Carpometacarpal joint (thumb)
5. Saddle con’t

- The saddle joint is similar to the Ellipsoidal Joint but the movements are freer.
- The movements allowed are flexion/extension, adduction/abduction and circumduction but NO ROTATION. Since bones can move in both planes: side to side and back and forth movements the joints are biaxial.
- Eg. Thumb
6. Ball and Socket

- Ball-shaped head fits into a cup-shaped depression
- These joints are the most freely moving of all synovial joints.
- The movements are allowed in all axes and planes: flexion/extension, adduction/abduction, circumduction and rotation. These joints are multiaxial.
- Eg. Hip and shoulder
Guess the type of joint...

–Guess the bones (identified by letters)
#1.

A: __________(bone)

B: __________(bone)

1: __________

(type of SYNOVIAL joint)
#1: Ball and Socket

- **A**: Femur
- **B**: Pubis

**J**: Ball and socket (synovial joint): because the head of the femur fits into the socket of the hip bone (acetabulum). You can see the articular shapes of the two bones clearly in these two X-rays. This joint is one of the most freely moving of all synovial joints. The movements are allowed in all axes and planes: flexion/extension, adduction/abduction, circumduction and rotation. This freedom of movements is typical of the "Ball and Socket" subtype.
#2.

A: _______________

B: _______________

C: _______________

J1: ____________

J2: ____________

J3: ____________

J4: ____________

J5: ____________
A: Carpals (wrist)
B: Metacarpals (palm)
C: Phalanges (fingers)

J1: Plane/gliding (Synovial joint)
J2: Plane/gliding (Synovial joint)

J3: Saddle (Synovial joint)
J4: Elipsoidal (Synovial joint)
J5: Hinge (Synovial joint)
#3.

A: ________
B: ________
1: ________

(TYPE OF JOINT)
A: C3  
B: C4

1-Cartilaginous Joints: Limited movements are allowed (bending your neck for example).
#4.
A: ________
B: ________
1: ________
SUBTYPE: ____________________
#4

- A: Mandible
- B: Tooth
- 1-Fibrous joint
  SUBTYPE: Gomphosis
A: ________
B: ________
C: ________
J1: ________
Ball and socket (synovial joint): because the head of the humerus fits into the socket (glenoid cavity) of the scapula. You can see the articular shapes of the two bones clearly in these two X-rays. This joint is one of the most freely moving of all synovial joints. The movements are allowed in all axes and planes: flexion/extension, adduction/abduction, circumduction and rotation. This freedom of movements is typical of the "Ball and Socket" subtype.
#6
A: ________
B: ________
C: ________
Joint: ________
A: Metacarpals
B: Radius
C: Ulna

The hand of a child:

• The epiphyseal plates (arrows) of long bones do not show in X-rays because they are made of cartilage.

○ Cartilaginous joint because the epiphyseal plates are made of hyaline cartilage only. No movement is allowed between the epiphysis and diaphysis of a long bone.
#7
A: ________
B: ________
C: ________
J1: ________
#7.

A: Humerus
B: Radius
C: Ulna

- Hinge (synovial joint)
- The ulna and radius articulate with the humerus. The only movements allowed are flexion/extension. This is characteristic of the hinge joint.
Identify the type of synovial joint.

#8.

A: _______
B: _______
C: _______
D: _______
E: _______
#8: Answers

- A: pivot
- B: modified hinge
- C: condyloid/ellipsoidal
- D: ball and socket
- E: saddle
# Classifications of Joints WS

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