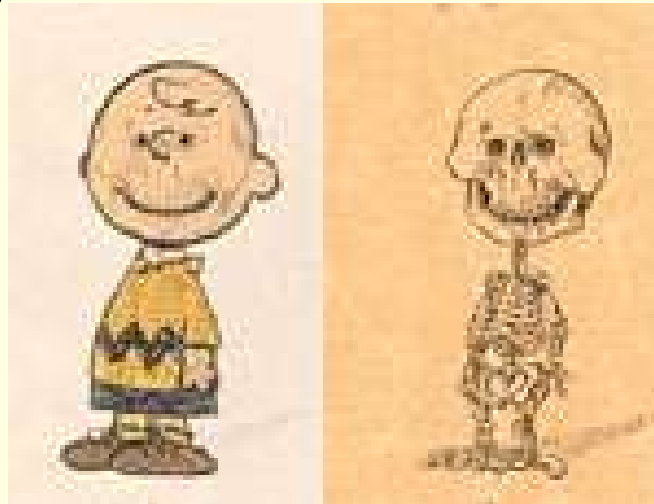


Anatomy / Physiology Overview

Skeletal System

Skeletal System

- Normally, it is composed of 206 bones that give form to the body and, with the joints, allow body motion



Skeletal System

- Bones must be rigid and unyielding to fulfill their function, but they must also be able to grow and adapt as the human body grows (bone growth is usually complete by late teens)
- Bones are just as much living tissue as muscle and skin, a rich blood supply constantly provides the oxygen and nutrients that bones require, each bone also has an extensive nerve supply

Functions

- Support
- Protection
- Movement
- Storage
- Hemopoiesis (production of blood cells)

Functions

- Support

- Bones are as strong or stronger than reinforced concrete. The skeletal system provides structural support for the entire body.

- Protection

- Delicate tissues and organs are surrounded by skeletal elements.

- The skull protects the brain
- The vertebral column protects the spinal cord
- The ribs and sternum protects the heart and lungs
- The pelvis protects the digestive and

Functions

■ Movement

- Bones work together with muscles to produce controlled, precise movements. The bones serves as points of attachment for muscle tendons. Bones act as levers that convert muscle action to movement.

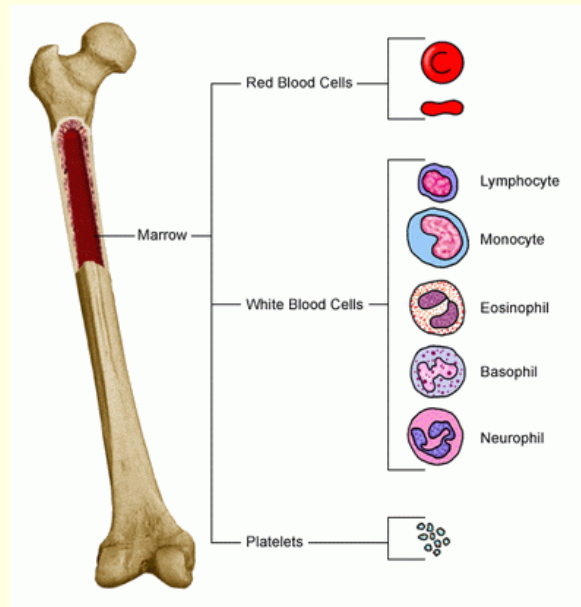
■ Storage

- Bones store minerals that can be distributed to other parts of the body upon demand. Calcium and phosphorus are the main minerals that are stored in bones. In addition, lipids are stored as energy reserves in the yellow bone marrow.

Functions

■ Hemopoiesis

- Red bone marrow produces red blood cells, white blood cells, and platelets.



Classification of Bones

- The bones of the human skeleton have four general shapes
 - Long
 - Short
 - Flat
 - Irregular
- There is also one other category
 - Sesamoid

Classification of Bones

- Long



- Are longer than they are wide.

- Examples: humerus, femur, ulna, metacarpals, metatarsals, phalanges, tibia, and fibula

- Short

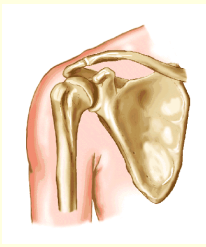


- Are nearly equal in length and width; are somewhat cube shaped.

- Examples: carpals, tarsals

Classification of Bones

■ Flat



- Are thin and relatively broad; have a large surface area for muscle attachment.
 - Examples: scapula, cranial bones, sternum, ribs

■ Irregular



- Have complex shapes that do not fit easily into any other category
 - Examples: facial bones, vertebrae

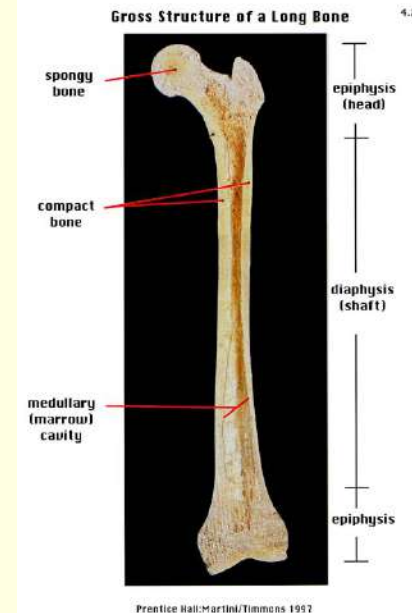
Classification of Bones

- **Sesamoid** – are small bones that are situated within tendons. They are also called floating bones.
 - Examples: patella



Structure of Bones

- Diaphysis – the long central shaft of bone
 - Contains yellow bone marrow
 - Made of compact (dense) bone.
- Epiphysis – the expanded ends of bone
 - Contains the red bone marrow
 - Made of spongy (lighter) bone.
- Epiphyseal line – known as the growth plate
 - this is the area where the diaphysis and epiphysis meet. In growing bone, it is where cartilage is reinforced and then replaced by bone.



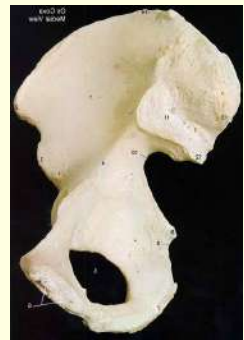
Structure of Bones

- Articular cartilage – a thin layer of cartilage covering the epiphysis or ends of bone. It provides a smooth gliding surface for a joint and helps to protect the ends of the bone.
- Periosteum – a dense fibrous covering around the surface of the bone. It is essential for bone growth, repair, and nutrition. It also functions as a point of attachment for ligaments and tendons.



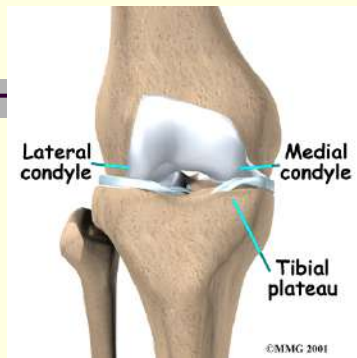
Skeletal Terminology

- Each of the bones in the human skeleton not only has a distinctive shape but also has distinctive external features. These landmarks are called bone markings or surface features.
 - Foramen –a tunnel or hole for blood vessels and/or nerves (examples: pelvis, skull).
 - Fossa – a shallow depression (example: shoulder).



Skeletal Terminology

- Condyle – a smooth, rounded articular process; Knuckle like projection (example: femur, humerus).
- Tuberosity – a small, rough projection (example: tibia, pelvis).
- Crest- a prominent ridge (example: pelvis).
- Sinus – a chamber within a bone, normally filled with air (example: skull).



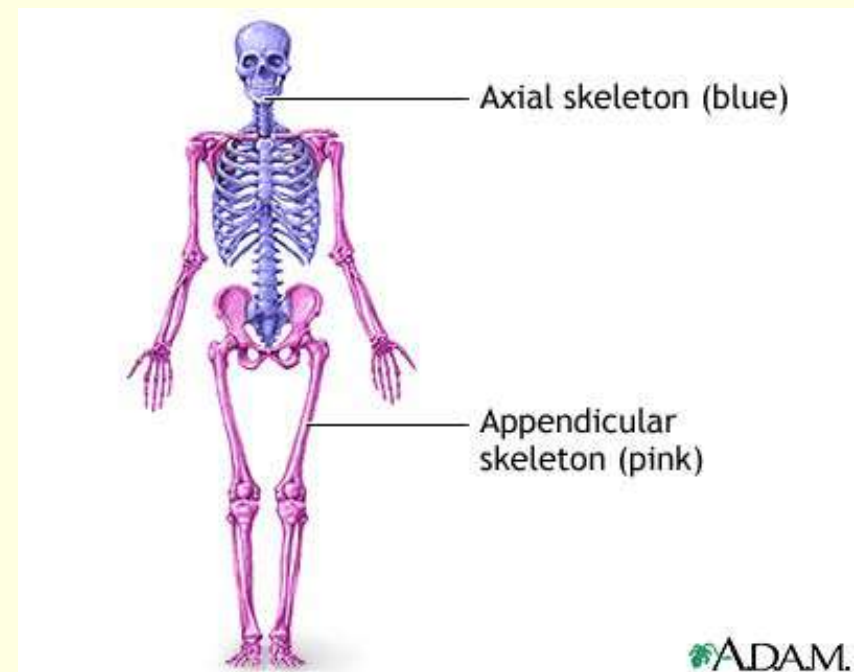
Skeletal Divisions

- The skeletal system consists of 206 separate bones and is divided into the axial and appendicular divisions.



Axial Skeleton

- Forms the long axis of the body.
- The 80 bones of the axial skeleton can be subdivided into:
 - The 22 bones of the **skull** plus associated ones (6 **auditory bones** and the **hyoid bone**).
 - The 26 bones of the **vertebral column**.
 - The 24 **ribs** and the **sternum**.



Appendicular Skeleton

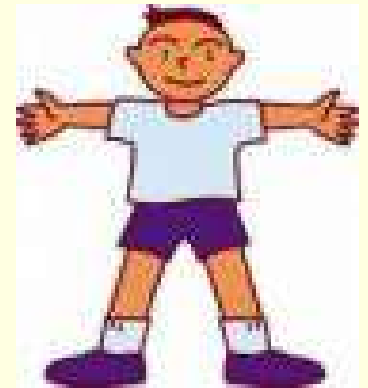
- Forms the limbs and the pectoral and pelvis girdles.
- Altogether there are 126 appendicular bones.
 - 32 are associated with each **upper limb**.
 - 31 are associated with each **lower limb**.

Joints

- Joints or articulations exist wherever two bones meet. The function of each joint depends on its anatomy. Each joint reflects a workable compromise between the need for strength and the need for mobility.
 - Ligaments – connect bone to bone.
 - Bursa – fluid filled sac that reduces friction between soft tissue and bones, also act as shock absorbers.
 - Meniscus – a cartilage disc between some complex joints for shock absorption, cushioning, and stability.

Types of Movement

- Flexion
- Extension
- Abduction
- Adduction
- Circumduction
- Rotation (IR /ER)
- Pronation
- Supination
- Inversion
- Eversion
- Dorsiflexion
- Plantar Flexion
- Opposition
- Protraction
- Retraction
- Elevation
- Depression

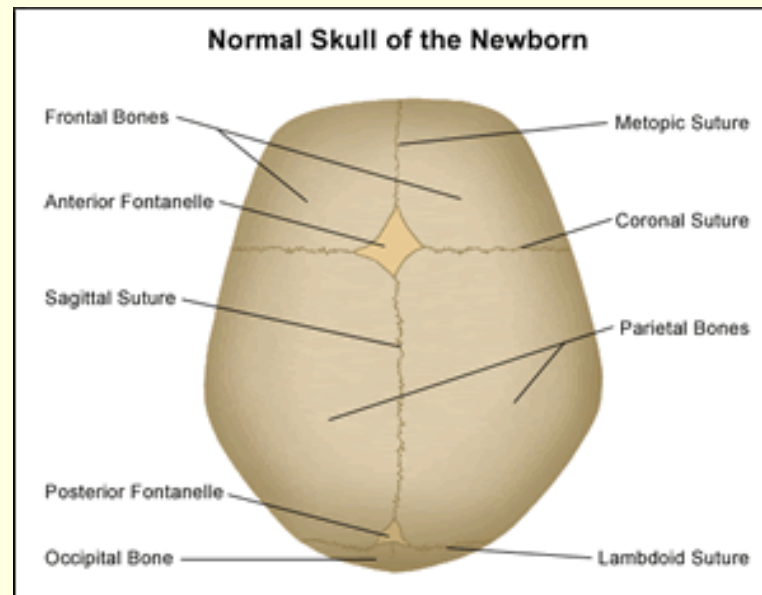


Joint Classification

- Joints can be classified according to the range of motion they permit.
 - Synarthrotic
 - Amphiarthrotic
 - Diarthrotic

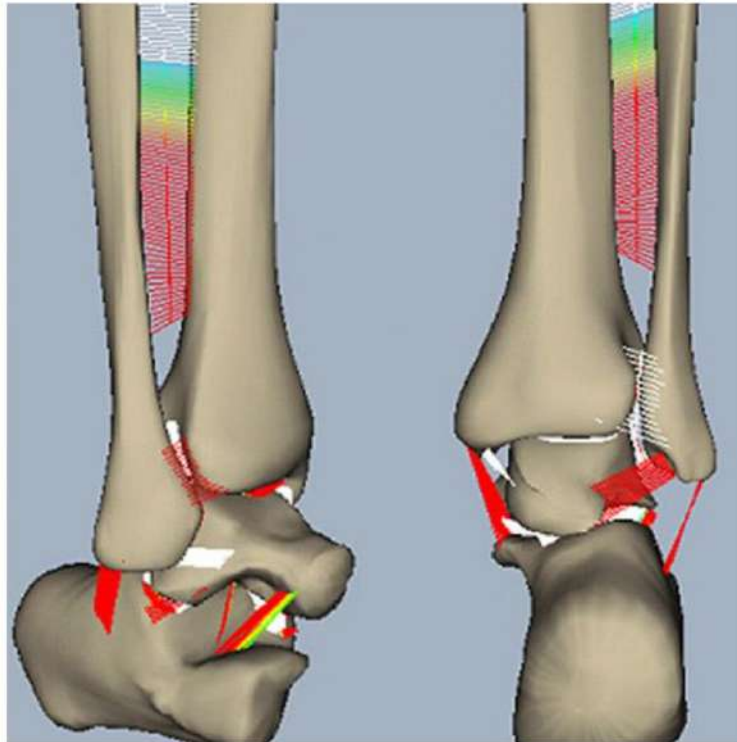
Synarthrotic Joints

- Immovable joints.
- Bones are connected by fibrous tissue or cartilage.
- Examples: sutures – found between bones in the skull.



Amphiarthrotic Joints

- Slightly movable joints.
- Examples: joints between tibia and fibula, joints between vertebrae.



Diarthrotic Joints

- Freely moveable joints permitting a wide range of motion.
- Ends of the bones are covered by cartilage and held together by synovial capsules filled with synovial fluid. This fluid helps to lubricate the joint and permits smooth movement.

Diarthrotic Joints

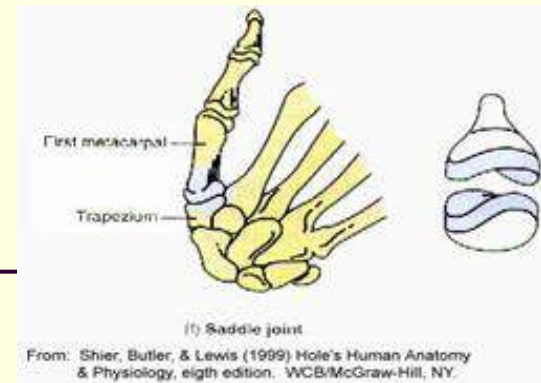
- Categories
 - Gliding joints
 - Hinge joints
 - Pivot joints
 - Saddle joints
 - Ball and socket joints

Diarthrotic Joints

- Gliding joints – have relatively flattened articular surfaces which slide across each other. The amount of movement is relatively small.
 - Examples: between the tarsal and carpal bones, between the clavicle and sternum
- Hinge joints – permit motion in a single plane, like the opening and closing of a door.
 - Examples: elbow, ankle, knee, and interphalangeal joints



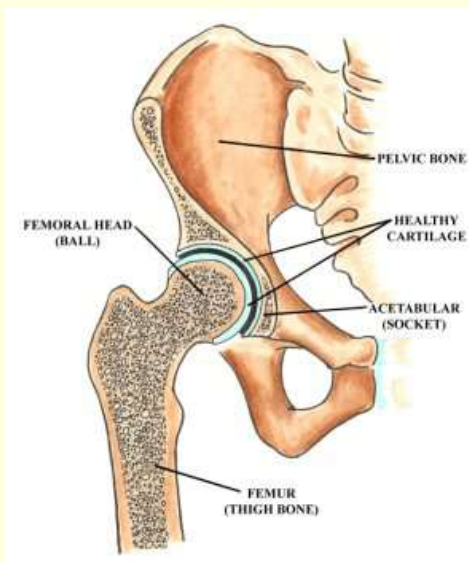
Diarthrotic Joints



- Pivot joints – permit only rotation.
 - Examples: between radius and ulna permitting supination and pronation, between the axis and atlas.
- Saddle joints – articular surfaces that resemble saddles and opposing surfaces nest together. This permits angular motion including circumduction, but prevents rotation.
 - Example: carpometacarpal joint at the base of the thumb.

Diarthrotic Joints

- Ball and socket joints – the rounded head of one bone rests within a cup-shaped depression in another. All combinations of movements, including circumduction and rotation, can be performed at these joints.
 - Examples: shoulder and hip joints.



Exercise and the Skeletal System

- Bone is dynamic and changes with the stress put on it. Bone has the ability to alter its strength in response to stress placed on it.
- Bones that are positively stressed will increase their density and become stronger over a period of time. Conversely, bones that are adversely stressed will become weakened over time.

Exercise and the Skeletal System

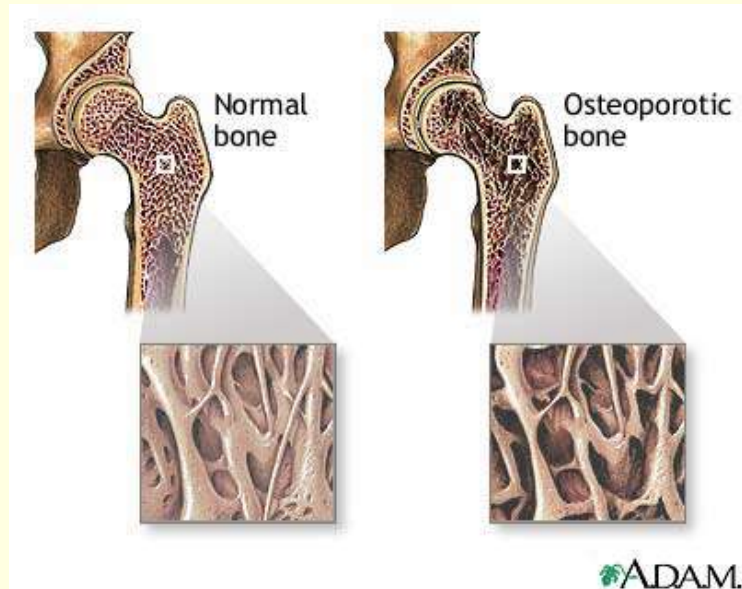
- Exercise enables bone to
 - Increase its deposition of mineral salts and collagen fibers
 - Become considerably stronger than bones of sedentary individuals
 - Maintain its strength and integrity



Common Disorders of the Skeletal System

■ Osteoporosis

- A condition that produces a reduction in bone mass great enough to compromise normal function. Because bones are more fragile, they break easily and do not repair well.



Osteoporosis

■ Causes include

- Decreased estrogen levels (postmenopausal women at greater risk)
- Poor Nutrition (Vitamin D and Calcium deficiency)
- Low activity levels
- Smoking (decreases estrogen levels)
- Race (Caucasians are at greater risk)
- Heredity



Fractures

- A fracture is a break in a bone.
- Fractures are classified according to their external appearance, the site of the fracture, and the nature of the break in the bone. Some fractures fall into more than one category.



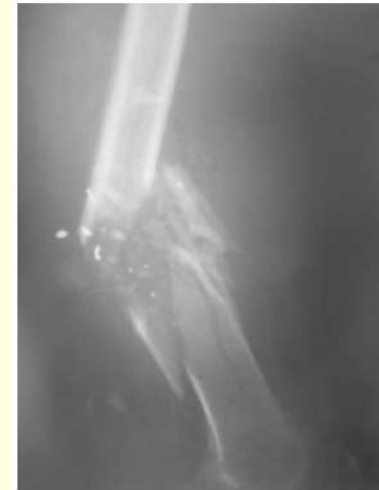
Types of Fractures

- Closed (simple) – a fracture in which the bone does not break through the skin; completely internal
- Open (compound) – a fracture in which the broken ends of the bone protrude through the skin; more dangerous because of the possibility of infection or uncontrolled bleeding



Types of Fractures

- Comminuted – a fracture in which the bone is shattered at the site of impact, and smaller fragments of bone are found between the two main fragments



- Greenstick – a fracture in which one side of the bone is broken and the other side bends; this usually occurs in children whose bones have yet to fully ossify



Types of Fractures

- Spiral – a fracture produced by twisting stresses, spread along the length of the bone
- Compression – a fracture occurring in vertebrae subjected to extreme stresses, as when landed on your seat after a fall
- Pott's fracture – occurs at the distal end of the fibula usually from an eversion ankle sprain



Types of Fractures

Stress fracture – hairline cracks resulting from repeated stress to a bone, and can lead to other fractures

Non-Displaced fracture – the bones remain in normal anatomical alignment

Displaced fracture – the bones are no longer in anatomical alignment



Fracture Signs and Symptoms

- Any athlete who complains of musculoskeletal pain must be suspected of having a fracture.
- Deformity – use the opposite limb to provide a mirror image for comparison.
- Tenderness – usually sharply localized at the site of the break.
- Guarding – inability or refusal to use the extremity because motion increases pain.

Fracture Signs and Symptoms

- Swelling and Ecchymosis – fractures are virtually always associated with swelling and bruising of surrounding soft tissues, however these signs are present following almost any injury and are not specific to fractures.
- Exposed fragments – in open fractures, bone ends may protrude through the skin or be seen in the open wound.

Fracture Treatment

- If a fracture is suspected, appropriate splinting and referral for an x-ray should be accomplished.



Dislocations

- Disruption of a joint so that the bone ends are no longer in contact or in normal anatomical alignment. Joint surfaces are completely displaced from one another. The bone ends are locked in the displaced position, making any attempted joint motion very difficult and very painful.
- Frequently, the ligaments at the joint are torn at the time the joint dislocates.



Dislocation Signs and Symptoms

- Marked deformity of the joint
- Swelling of the joint
- Pain at the joint, aggravated by any attempt at movement.
- Marked loss of normal joint motion (a “locked” joint)

Dislocation Treatment

- All dislocations should be splinted before the athlete is moved.
- Immediate transportation to a medical facility. A physician is required to reduce a dislocation.

Sprains

- Stretching or tearing of a ligament by twisting and/or overstretching.
- Ligament sprains are graded according to the following classifications:
 - 1st degree / Grade 1 (mild) –the ligament is stretched, but there is no loss of continuity of its fibers
 - 2nd degree / Grade 2 (moderate) – the ligament is partially torn, resulting in increased laxity to the joint
 - 3rd degree / Grade 3 (severe) – the ligament is completely torn, resulting in laxity (instability) of the joint

Grading of sprains



Sprain Signs and Symptoms

- Tenderness – point tenderness over the injured ligament
- Swelling and Ecchymosis – there is typically swelling and bruising at the point of ligament laxity
- Instability – gently stressing the injured ligament will increase pain and demonstrates an increased abnormal range of motion

Sprain Treatment

- The management of a sprain depends on the degree of injury.
 - A grade 1 sprain is treated with rest, ice, compression, and elevation until the acute symptoms subside. A rehabilitation program to strengthen the area will prepare the athlete for return to activity.

Sprain Treatment

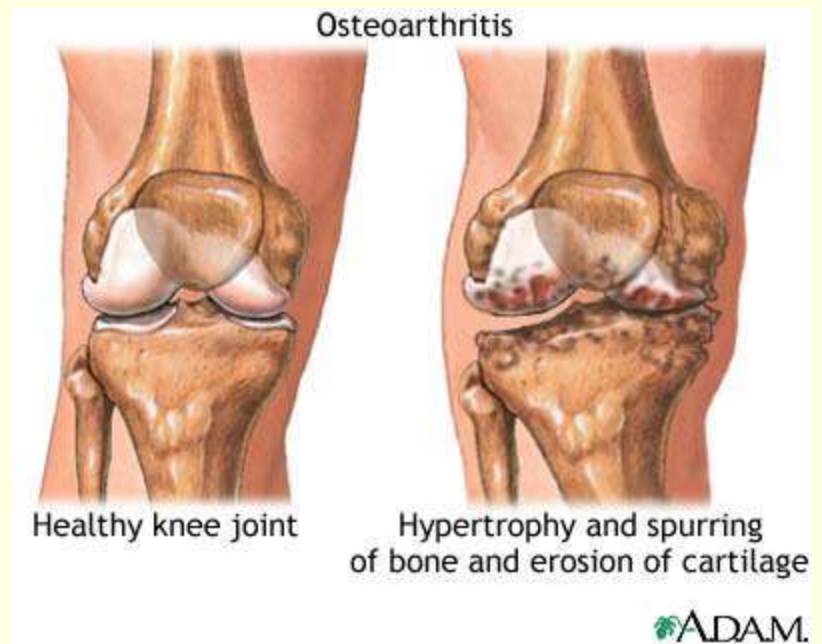
- A grade 2 sprain is treated similarly, but may in addition require immobilization of the injured joint.
- A grade 3 sprain may either require immobilization or surgical intervention to restore continuity of the ligament. Some severe ligamentous injuries can be managed successfully on a conservative program.

Osteoarthritis

- Also known as degenerative arthritis or degenerative joint disease (DJD).
- A degenerative joint disease associated with aging, usually affecting individuals age 60 or older.
- This disease can result from cumulative wear and tear at the joint surfaces or from genetic factors.
- In the U.S. population, 25% of women and 15% of men over age 60 show signs of this disease.

Osteoarthritis Signs and Symptoms

- Degeneration of articular cartilage
- Development of bone spurs
- Pain
- Decreased range of motion



Osteoarthritis Treatment

- Rest
- Gentle exercise – warm up slowly and increase activity level gradually within the confines of comfort. Water sports and activities are excellent for arthritic individuals.
- Weight control
- Medical management
- Joint replacement

Rheumatoid Arthritis

- An inflammatory condition that affects approximately 2.5% of the adult population.
- Some cases result when the immune response mistakenly attacks the joint tissues (cartilage and joint linings). Allergies, bacteria, viruses, and genetic factors have all been proposed as contributing to or triggering the destructive inflammation.

Rheumatoid Arthritis Signs and Symptoms

- Joint inflammation
- Swelling
- Loss of function
- Pain



Rheumatoid Arthritis Treatment

- Regular exercise
- Anti-inflammatory medications
- Gentle exercise, as described before
- Medical management
- Joint replacement

Bursitis

- Inflammation of the bursa caused by acute trauma, infection, or overuse.
- Signs and Symptoms
 - Pain
 - Swelling
 - Tenderness
 - Limited range of motion

Bursitis

- Treatment

- Rest

- Anti-inflammatory medication

- Correction of causes.