

Chapter 6: Bone and Bone Tissue

Skeletal system

= _____, _____, _____

Bones are main organs:

- osseous tissue
- dense regular and irregular CT, plus bone marrow

→ Module 6.1: Introduction to Bones as Organs

FUNCTIONS OF THE SKELETAL SYSTEM

• Functions:

1. Protection
2. Mineral storage and _____
3. Blood cell formation: _____ involved in formation of blood cells
(hematopoiesis or hemopoiesis)
4. Fat storage: in yellow bone marrow of _____
5. Movement: bones are sites for skeletal muscle attachment
6. Support: supports weight and provides _____

BONE STRUCTURE CLASSIFICATION

(based on shape)

1. Long bones
 - longer than they are wide;
 - include most bones in arms and legs
2. Short bones
 - roughly cube-shaped
 - include carpals and _____

3. Flat bones

- thin and broad bones
- ribs, pelvis, sternum and _____

4. Irregular bones

- include _____ and certain skull bones

5. Sesamoid bones

- located within _____

BONE STRUCTURE

Structure of long bone:

- Periosteum
 - membrane surrounds outer surface
- Perforating fibers (Sharpey's fibers)
 - anchors periosteum firmly to bone surface
- Diaphysis – _____
- Epiphysis - _____ of long bone (proximal & distal)
- Articular cartilage – hyaline cartilage
- Marrow cavity – contains bone marrow (red or yellow)
- Endosteum – thin membrane lining marrow cavity

Compact bone

- hard, dense outer region
- allows bone to resist stresses (compression & twisting)

• **Spongy bone** (_____ bone)

- found inside cortical bone
- *honeycomb-like framework* of bony struts;
- resist forces from many directions

• **Epiphyseal lines**

- *separates* epiphyses from diaphysis
- remnants of epiphyseal plates

- **Epiphyseal plates** (_____ plates)
 - hyaline cartilage found in developing bones of children

Structure of short, flat, irregular, and sesamoid bones

- covered by periosteum
- diploë = two outer layers of thin compact bone with middle layer of spongy bone
- sinuses = air-filled spaces _____



Bone Marrow Transplantation

- Diseases of blood
- Needle is inserted into pelvic bone
- Recipient's marrow is destroyed
- Complications –
 - Many recipients can return to a healthy life if transplant “takes”

→ **Module 6.2: Microscopic Structure**

MICROSCOPIC STRUCTURE

Extracellular matrix of bone:

- **Inorganic matrix** (65%)
 - consisting of _____ (hydroxyapatite salts of Ca & P)
- **Organic matrix** (35%)
 - osteoid
 - consists of collagen fibers and *usual ECM*

Bone cells :

- **Osteogenic** – differentiate into osteoblasts
- **Osteoblasts** – _____
- **Osteocytes** – mature bone cells in lacunae
- **Osteoclasts**
 - bone _____
 - secrete acid and enzymes

HISTOLOGY OF BONE

Structure of compact bone:

Osteon (Haversian system)

- **Lamellae** = **concentric** rings of *thin layers of bone*
- **Central canal** = contains blood vessels & nerves
- **Lacunae** = _____ for osteocyte
- **Canaliculi** = _____
- **Perforating canals (Volkmann's canals)** *perpendicular to central canals*

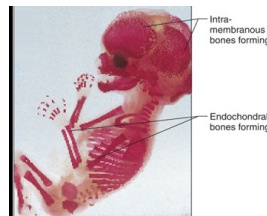
→ Module 6.3: Bone Formation and Ossification

OSSIFICATION

• Ossification (osteogenesis)

- Process of bone formation
- Begins in embryonic period and continues throughout adulthood

[fetal "skeleton"]



[14 weeks]

cartilage template fibrous CT
endochondral

fibrous CT
intramembranous

BONE

INTRAMEMBRANOUS OSSIFICATION

• Intramembranous ossification

- forms many _____ (bones of skull and clavicles)
- formed within a *mesenchymal* _____
- spongy bone ossifies before outer compact bone layers
- forms **primary ossification center**

- _____ = areas of incomplete intramembranous ossification

ENDOCHONDRAL OSSIFICATION

- **Endochondral ossification (Figure 6.12):**

- Bone development for all bones below head except _____
- Many bones *complete ossification* by age 7

- Endochondral ossification

- bones begin within *hyaline* _____
 - Hyaline cartilage model made of *chondrocytes, collagen, and ECM* surrounded by CT **perichondrium**
 - Cartilage breaks down
 - Collar formation (periosteum)
 - _____ **ossification center** mid-diaphysis
 - **secondary ossification centers** at _____
- Most bones of skeleton formed this way.



Osteoporosis and Healthy Bones

- Most common bone disease in U.S
- Diagnosed by *bone density measurement*
- **Causes** – *dietary* (calcium and/or vitamin D deficiency)
- **Prevention**
- **Treatment**

→ **Module 6.4: Bone Growth in Length**

GROWTH IN LENGTH

Growth in Length

- Long bones lengthen via **longitudinal growth**; involves division of _____ (not osteocytes or osteoblasts) in epiphyseal plate
- Bone growth takes place at epiphysis on side *closest to diaphysis*
- **Epiphyseal plate**

1. **Zone of reserve cartilage** – (found closest to epiphysis) contains cells that are not directly involved in bone growth but *can be recruited* for cell division if need arises
 2. **Zone of proliferation** - consists of *actively dividing chondrocytes* by endochondral ossification
 3. **Zone of hypertrophy and maturation** (next region closer to diaphysis) contains *mature chondrocytes*
 4. **Zone of calcification** (second to last region) contains dead chondrocytes, some of which have been calcified
Calcified cartilage is replaced with bone.
 5. **Zone of ossification** (last region) consists of *calcified chondrocytes and osteoblasts*
- Longitudinal growth continues at epiphyseal plate as long as *mitosis continues* in zone of proliferation:
 - Mitotic rate slows around ages of 12-15 years old
 - Between ages of 18-21 epiphyseal plate is **closed**
 - _____ is a *calcified remnant* of epiphyseal plate

GROWTH IN WIDTH

Appositional growth = _____

- Osteoblasts, *lay down new bone*
 - Appositional growth does not result in immediate formation of osteons; instead, *new circumferential lamellae* are formed
 - Bones may *continue to increase in width* even after epiphyseal plates have *closed* and bone is no longer *lengthening*



Achondroplasia

- Most common cause of **dwarfism**; gene defect
- Defective gene produces an *abnormal growth factor receptor*
- Bones form and grow abnormally
- Long-term problems

ROLE OF HORMONES IN BONE GROWTH

- _____ (GH) – secreted by *anterior pituitary gland*;
enhances protein synthesis and cell division in most all tissues, including bone
- _____ - pronounced effect on bone growth:
 - Increases appositional growth in males
 - Increases *rate of mitosis in epiphyseal plate*; leads to “growth spurts” in teenage years
- **Estrogen** also plays a role in bone growth:
 - Increases *rate of longitudinal growth* and inhibits *osteoclasts*
 - Accelerates closure of epiphyseal plate at much *faster rate than testosterone*
→ *average height differences* between genders



Gigantism and Acromegaly

- *Excess GH* can produce two conditions, depending on when in life it develops; both generally caused by a _____ that secretes hormone
- **Childhood** – condition is _____
- **Adulthood** – condition is _____

→ Module 6.5: Bone Remodeling and Repair

BONE REMODELING

- **Bone remodeling** = new bone is formed by **bone** _____ and old bone is removed by **bone** _____
 - Maintenance of *calcium ion homeostasis*
 - *Replacement* of old brittle bone with newer bone
 - *Adaptation* to tension and stress
- **PTH** (parathyroid hormone from parathyroid gland) stimulates effects that _____
blood Ca⁺² levels
 - o Increases osteoclast activity
 - o Increases *absorption* of calcium from gut
 - o Inhibits calcium *loss* in urine
- **Calcitonin** (from thyroid gland)
causes _____ blood Ca⁺² levels
 - o Inhibits osteoclasts
 - o Increases calcium loss in urine

Thyroid Gland Secretes _____

Parathyroid Glands Secretes _____

- Factors influencing bone remodeling are summarized:

BONE REPAIR

Fractures:

- **Simple fractures** vs _____ **fractures**
- *Spiral*
- *Compression*
- *Comminuted*
- *Avulsion*
- *Greenstick*
- *Epiphyseal plate*

Chapter 7: The Skeletal System

Skeletal System = _____ bones plus cartilages

- Axial (80 bones)
- Appendicular (126 bones)

→ Module 7.1: Overview of the Skeletal System

STRUCTURE OF THE SKELETAL SYSTEM

& SKELETAL CARTILAGES

Axial skeleton

– Skull, vertebral column, thoracic cage (ribs, sternum), _____

• Appendicular skeleton

– Bones of pectoral girdle, upper limb, pelvic girdle, and lower limb

Pectoral girdle – _____; *anchors* upper limb to trunk

Pelvic girdle – _____ bones; *anchors* lower limb to trunk

BONE MARKINGS

Fossa –

Canal (meatus)–

Condyle -

Head -

Foramen –

→ Module 7.2: The Skull

OVERVIEW OF SKULL STRUCTURE

- Skull = 22 bones organized in *two groups*:
 - **Cranial bones** – collectively known as **cranium**, composed of _____ bones (STEP OFF my skull)
 - Frontal -1
 - Occipital -1
 - Ethmoid -1
 - Sphenoid – 1
 - Parietal – 2
 - Temporal – 2

– **Facial bones** = _____ bones

- Maxillary – 2
- Zygomatic -2
- Nasal -2
- Lacrimal -2
- Palatine -2
- Inferior nasal concha -2
- Mandible -1
- Vomer -1

- Sinuses = _____, membrane-lined *spaces*;
paranasal sinuses = frontal, ethmoid, sphenoid, maxillary

CAVITIES OF THE SKULL

- **Orbit** – FLEZMS 7 *fused bones*; form walls that encase eyeball, lacrimal gland, and their associated blood vessels, muscles, and nerves
 - **Frontal bone**
 - **Lacrimal**
 - **Ethmoid**
 - **Zygomatic**
 - **Maxilla**
 - **Sphenoid bone**
 - and _____ bones

THE FETAL SKULL

Fontanel (soft spot) = area of incomplete _____

Anterior

Posterior

Sphenoid

Mastoid

HYOID BONE

- **Hyoid**
 - doesn't *articulate* with any other bones
 - C-shaped bone
 - Provides numerous muscle attachment points involved in _____



Forensic Skull Anatomy

- Forensic investigators often must identify human remains with little to go on except bones; can provide many clues (particularly skull); one of most basic traits that can be identified from a skull is *gender*
- Four obvious differences:

→ Module 7.3: Vertebral Column & Thoracic Cage

OVERVIEW OF THE VERTEBRAL COLUMN

Vertebral column (spine) – composed of *about* _____ bones (**vertebrae**)

- 7 **cervical** – located in _____
 - 12 **thoracic** – articulate with _____
 - 5 **lumbar** – in _____
 - 5 fused **sacral** (collectively called **sacrum**)
 - 3-5 fused **coccygeal** (collectively called **coccyx**)
- **Spinal curvatures** – C-shaped vertebral column of newborn → S-shaped secondary curvatures as infant grows
 - **Primary curvatures** (_____ and *sacral*) present during fetal dev.
 - **Secondary curvatures** (_____ and *lumbar*) dev. after fetal period
 - **Abnormal spinal curvatures:**
 - o **Scoliosis** – abnormal _____ *curvatures*
 - o **Lordosis (swayback)** – exaggerated *cervical* and _____ *curvatures*
 - o **Kyphosis (hunchback)**
 - exaggeration of _____ *curvature*

STRUCTURE OF THE VERTEBRAE

- **Cervical (7)** – smallest vertebrae
 - _____ **foramina** allows passage of vertebral arteries and veins
 - **C1** (_____)
 - Lacks **vertebral body**
 - Articulates with *occipital condyles* and C2
 - **C2** (_____)
 - **Dens (odontoid process)** protrudes from body
 - Allows for *rotational movement* of head at neck; (shaking your head “no”)

- **Thoracic vertebrae (12)**

- long spinous processes
- **Superior and inferior costal facets** (articulate with **head of rib**)
- **Transverse costal facets** on transverse processes (articulate with _____ on rib)

Posterior view: Shaped like _____

- **Lumbar vertebrae (5)**

- *largest and heaviest* of all vertebrae (_____)

Posterior view- shaped like _____

- **Sacrum** – 5 fused sacral vertebrae

- **Sacral promontory** – bony *projection* at anterior margin of base (superior aspect)
- **Sacral foramina** – 4 pairs of holes allows for _____

- **Coccyx** = 4 fused (3-5) vertebrae

STUDY BOOST: REMEMBERING SKULL
BONES AND VERTEBRAE

- **PEST OF 6** (*six cranial bones*): Parietal, Ethmoid, Sphenoid, Temporal, Occipital, Frontal
- **Virgil Is Now Making My Pet Zebra Laugh** (*facial bones*): Vomer, Inferior nasal conchae, Nasal, Mandible, Maxillae, Palatine, Zygomatic, Lacrimal
- **For Easier Sinus Memorization** (*paranasal sinuses*): Frontal, Ethmoidal, Sphenoidal, Maxillary
- **Breakfast at 7, lunch at 12, dinner at 5** (*number of vertebrae*): 7 cervical, 12 thoracic, and 5 lumbar

Sphenoid = Bat bone

Ethmoid = iceberg in skull



Thoracic giraffe



Lumbering moose



INTERVERTEBRAL DISC

- **Intervertebral disc**
= *fibrocartilage pad* found between bodies vertebrae
- **Nucleus pulposus** – *jelly-like* substance; shock absorber
- **Anulus fibrosus** – outer ring of _____
Herniated disc or “slipped disc”



Herniated Disc

- A tear in anulus fibrosus can allow nucleus pulposus to *protrude*, a condition known as a **herniated disc** (commonly called a **slipped disc**)
- Bulging nucleus pulposus *compresses* nerve
- Treatments

THE THORACIC CAGE

- **Thoracic cage**
=
– **sternum**
 - **Manubrium** – *superiormost*
 - **Body** - middle
 - **Xiphoid process** – inferior

Rib cage= 12 pairs of ribs and their costal cartilages

- Ribs 1–7 (_____ **ribs** or **vertebrosternal** ribs) attach to sternum via their *costal cartilages*
- Ribs 8–12 (_____ **ribs**) not directly attached to sternum
 - **Vertebrochondral** ribs 8–10 – attached to *cartilage of 7th rib*
 - _____ or **vertebral** ribs 11 & 12
 - are not attached to sternum

Structure of a typical rib.



The Sternum and CPR

- **Cardiopulmonary resuscitation (CPR)**
- *Correct placement of hands on sternum is critical*

→ **Module 7.4: Bones of the Pectoral Girdle and Upper Limb**

PECTORAL GIRDLE

- **Pectoral girdle – clavicle and scapula**
 - **Clavicle**
 - Sternal end
 - Acromial end
 - **Scapula**
 - **Acromion**
 - **Coracoid process**
 - **Subscapular fossa** (anterior aspect)
 - **Glenoid cavity** (articulates with head of humerus)
 - **Spine** (_____ *ridge*)
 - **Supraspinous fossa**
 - **Infraspinous fossa**

THE HUMERUS

- **Humerus**
 - **head** articulates with *glenoid cavity* at shoulder joint
 - _____ **neck** is a groove surrounding head
 - _____ **neck** proximal diaphysis
 - **greater & lesser tubercle** lateral and anterior to head
 - olecranon fossa
 - coronoid fossa
 - capitulum
 - trochlea

BONES OF THE FOREARM

Bones of forearm (antebrachium)

- **Radius** (_____ bone)
 - head, neck, radial tuberosity, styloid process
- **Ulna** (_____)
 - trochlear notch, olecranon, coronoid process, radial notch, styloid process

BONES OF THE WRIST: CARPALS

Wrist (carpus) – _____ (carpals)

(lateral to medial)

- **Scaphoid** , **Lunate** , **Triquetrum**, **Pisiform** (proximal)
- **Trapezium**, **Trapezoid**, **Capitate**, **Hamate** (distal)

BONES OF THE HAND AND FINGERS: METACARPALS AND PHALANGES

Metacarpals – 5 each hand

Phalanges – 14 each hand

- **proximal**, **middle**, and **distal** _____
- **Thumb** proximal & distal phalanx



Wrist Fractures

- Wrist is the most *frequently injured* region of upper limb;
- Fractures

Colles fracture

→ **Module 7.5: Bones of the Pelvic Girdle and Lower Limb**

BONES OF THE PELVIC GIRDLE AND LOWER LIMB

Pelvic girdle =

- **coxal bones** (also known as **os coxae**)
- Articulates with **sacrum** (axial skeleton)

Pelvis – bowl-shaped sacrum and two coxal bones; creates *boundary* for pelvic cavity

Pelvic inlet – oval *opening* formed by sacrum and pelvic girdle

Pelvic brim – bony *ridge* surrounding inlet that defines boundaries between **greater** and **lesser pelvis**

- Each _____ is composed of 3 *fused bones*:
ilium, **ischium**, and **pubis**

Female and male pelvis differ between genders:

female pelvis (adapted for *childbirth*) is *wider* and *shallower* than male

- **Shape of greater pelvis:**
 - pelvis is *wider* in females with *flared* iliac crests
 - increases distance between ASIS
- **Coccyx and sacrum:**
 - female sacrum is *wider* and *shorter* than male sacrum
 - while female coccyx is more *moveable* and more *posterior* than male
- **Pelvic inlet and outlet:** female inlet is usually *wider* and *oval-shaped* whereas male inlet is *narrow* and *heart shaped*; female outlet is generally *wider* than male
- **Acetabula:** generally *farther apart* in females and pointed more *anteriorly* than in males
- **Pubic arch:**
 - angle measured in females = _____
 - male arch measures between _____

FEMUR AND PATELLA

- **Femur** – *largest* and *strongest* bone
 - head articulates with _____ at hip joint
 - Neck
 - Greater and Lesser trochanter
 - Linea aspera
 - Medial and a lateral condyles
 - Patellar surface
- **Patella**

BONES OF THE LEG: TIBIA AND FIBULA

- **Tibia** (_____ bone) larger bone, wt. bearing
 - Tibial tuberosity
 - Medial malleolus
- **Fibula** (_____ bone)
 - Lateral malleolus

BONES OF THE ANKLE AND FOOT:
TARSALS, METATARSALS, AND PHALANGES

- **Tarsals** – 7 *short bones*
 - *Proximal* tarsals: _____, **calcaneus**, and **navicular**
 - *Distal* tarsals medial to lateral: 3 **cuneiforms** (**medial**, **intermediate**, **lateral**) and **cuboid**
- **Metatarsals** – 5 in each foot
- **Phalanges** – 14 in each foot

STUDY BOOST: REMEMBERING BONES OF THE ARM AND LEG

Carpals: Stop Letting The People Touch The Cadaver's Hand

= Scaphoid, Lunate, Triquetrum, Pisiform, Trapezium, Trapezoid, Capitate, Hamate
(Mentions “hand”, so remember that it describes carpals, not tarsals; trapeziUM is by thUMb)

Tarsals: College Needs Me In Lab Classes

= Talus, Calcaneus, Navicular; Medial, Intermediate, & Lateral cuneiform, Cuboid

Chapter 8: Articulations

Articulations (joints) = where bones meet

- allow _____
- provide _____
- allow long bones to _____ (epiphyseal plate)

→ Module 8.1: Classification of Joints

FUNCTIONAL CLASSIFICATION

Based on _____:

- **Synarthrosis** – no *movement* between articulating bones
- **Amphiarthrosis** – small amount of *movement* between articulating bones
- **Diarthrosis** – freely *moveable*, allowing a wide variety of specific movements

STRUCTURAL CLASSIFICATION

Based on their _____ features:

- **Fibrous joints** – *dense regular collagenous CT* ;
(synarthroses or amphiarthroses)
- **Cartilaginous joints** – *cartilage*; (synarthroses or amphiarthroses)
- **Synovial joints** – fluid-filled joint capsule with hyaline cartilage at articular ends;
(diarthrosis)

→ Module 8.2: Structural Classification: Fibrous Joints

FIBROUS JOINTS

3 types:

- **Suture**
- **Gomphosis**
- **Syndesmosis**

- **Suture** - fibrous CT
_____ of cranium; *immoveable* joint
- **Gomphosis** – tooth in bony socket (**periodontal ligament**);
_____ joint
- **Syndesmosis** – joint between tibia & fibula, ulna & radius (interosseous membrane);

→ **Module 8.3: Structural Classification: Cartilaginous Joints**

CARTILAGINOUS JOINTS

2 types:

- **Synchondrosis**
- **Symphysis**

Synchondrosis - *hyaline cartilage*;

Synarthroses (epiphyseal plate, 1st sternocostal and costochondral joints);



Epiphyseal Plate Fractures

- **Epiphyseal plate** in a child's long bone is one of the *weakest parts* of a developing skeleton
- **Treatment**

FIBROUS JOINTS

- **Symphysis** – *fibrocartilaginous pad; amphiarthrosis*
 - _____
 - **Pubic symphysis**

→ **Module 8.4: Structural Classification: Synovial Joints**

SYNOVIAL JOINTS

Synovial Joints:

- **Joint cavity (synovial cavity)** – space found between articulating bones
- **Articular capsule** – double-layered structure
 - Outer fibrous layer
 - Inner synovial membrane → synovial fluid (lubricates, metabolic fcn., shock absorber)
- _____ **cartilage** – hyaline cartilage; *covers* all exposed articulating bones within a joint
- **Diarthrosis**

STABILIZING AND SUPPORTING FACTORS

- Synovial joints allow more *mobility*
 - less *stable* than other joint types
 - structures that provide additional stabilization:
 - Ligament** – dense regular CT connects _____
 - Tendon** - dense regular CT connects _____
- Bursae and tendon sheaths** provide stabilization forces



Bursitis

- Most *common sites* of bursitis
 - Clinical features

ARTHRITIS

- **Arthritis** – defined as *inflammation* of one or more joints which results in pain and limitations of joint movement:
 - **Osteoarthritis (OA)** – most common; associated with _____, *injuries*, and advanced *age*; characterized by pain, joint stiffness, and lost mobility
 - **Rheumatoid arthritis (RA)** – associated with joint destruction; _____
 - **Gouty arthritis** – joint damage due to inflammatory reaction to _____ deposits

→ Module 8.5: Functions of Synovial Joints

MOVEMENTS AT SYNOVIAL JOINTS

- **Gliding movements** – *sliding motion* between articulating surfaces
- **Flexion, Extension, Hyperextension**
- **Abduction, Adduction**
- **Circumduction, Rotation**
- **Inversion, Eversion**
- **Supination, Pronation**
- **Dorsiflexion, Plantar flexion**

→ **Module 8.6: Types of Synovial Joints**

TYPES OF SYNOVIAL JOINTS

- **Plane joint** (gliding joint) – most simple and least mobile articulation between *flat surfaces* of two bones
- **Hinge joint** – *convex* articular surface of one bone interacts with *concave* depression of second bone
- **Pivot joint** – one bone pivots or rotates around other
- **Condylar (ellipsoid) joint** – *convex* surface of one bone fits into concave articular surface of a second bone
- **Saddle joint** – each bone's articulating surface has both a *concave* and *convex* region
- **Ball-and-socket joint** – spherical surface of one bone fits into *cup-shaped depression* in second bone

SPECIFIC HINGE JOINTS

Elbow – very stable hinge joint:

- **Humeroulnar joint** – articulation between *trochlea* of humerus and *trochlear notch* of ulna
- **Humeroradial joint** – articulation between *capitulum* of humerus and *head* of radius

A & P FLIX: MOVEMENT AT THE ELBOW

- **Knee:**
 - _____ **joint** – articulation between *femoral and tibial condyles*
 - **Patellofemoral joint** – articulation between posterior surface of *patella* and anterior patellar surface of *femur*
 - **Medial and lateral meniscus** – fibrocartilage *pads* between femoral and tibial condyles
 - **Tibial collateral ligament** (medial collateral) – connects femur, medial meniscus, and tibia to one another to provide *medial joint stabilization*

A & P FLIX: MOVEMENT AT THE KNEE JOINT



Knee Injuries and the Unhappy Triad

- **Shoulder** (_____) – ball-shaped head of *humerus* and *glenoid cavity*:
 - **Glenoid labrum** – *fibrocartilaginous ring*; increases depth of glenoid cavity to provide more *stability*
 - **Biceps brachii tendon** - helps keep head of humerus within glenoid cavity
 - **Rotator cuff**, providing most of joint's structural stabilization: _____, **infraspinatus**, **subscapularis**, and _____

A & P FLIX: MOVEMENT AT THE GLENOHUMERAL JOINT

- **Hip** (_____) – *acetabulum* and ball-shaped *head of femur*:
 - **Acetabular labrum** – *fibrocartilaginous ring* that helps to stabilize head of femur within acetabulum

A & P FLIX: MOVEMENT AT THE HIP JOINT



Hip Joint Replacement Surgery

- **Hip replacement** – surgical procedure that replaces a painful damaged joint with an *artificial prosthetic device*
- Severe *arthritis*, *trauma*, *fractures*, and *bone tumors* can all progress to point where hip joint replacement is an option
- **Total replacement**
- **Partial replacement**

