

MECH2901: ANATOMY AND PHYSIOLOGY FOR ENGINEERS

LECTURE 1: SKELETAL SYSTEM → Bones and Bone Tissue

Function of the Skeletal System

Support → Bone is hard and rigid; cartilage is flexible yet strong. Cartilage in nose, external ear, thoracic cage and trachea. Ligaments- bone to bone

Protection → Skull around brain; ribs, sternum, vertebrae protect organs of thoracic cavity

Movement → Produced by muscles on bones, via tendons. Ligaments allow some movement between bones but prevent excessive movement

Absorbs Shock → Impacts during motion need to be absorbed to reduce strain on bone and joints and damage to soft tissues.

Storage → Calcium and Phosphorus Stored then released as needed. Fat stored in marrow cavities

Blood Cell Production → Bone provides a niche for bone marrow that gives rise to blood cells and platelets

Structure of a Long Bone

Diaphysis → Shaft and Compact bone

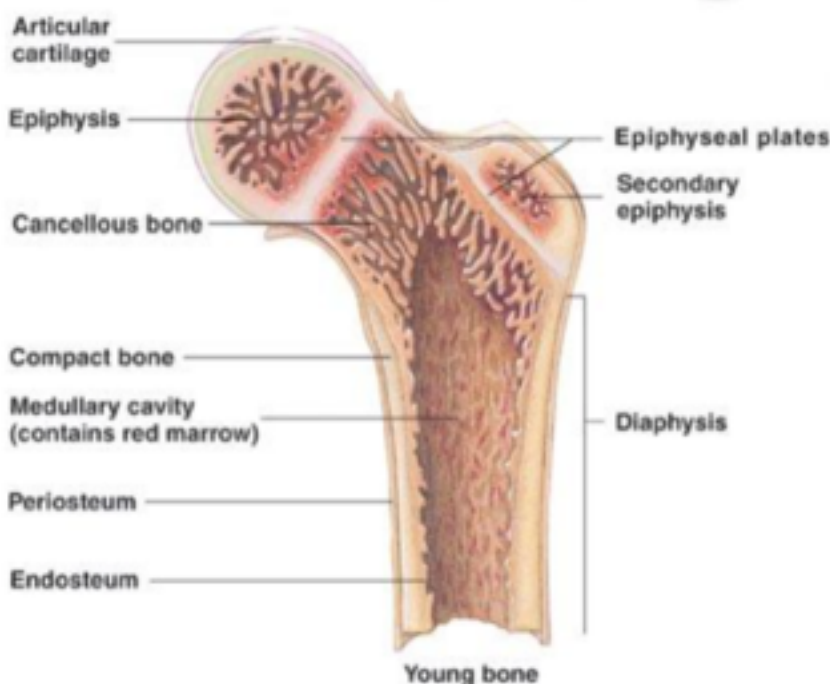
Epiphysis → End of the bone and Cancellous bone

Epiphyseal plate: growth plate → Hyaline cartilage; present until growth stops

Epiphyseal line → bone stops growing in length

Medullary cavity → In children medullary cavity is red marrow, gradually changes to yellow in limb bones and skull (except for epiphyses of long bones). Rest of skeleton is red.

Trabeculae → Interconnecting rods or plates of bone. Like scaffolding. (Spaces filled with marrow, Covered with endosteum and Oriented along stress lines)



Bone Fractures

Open (compound) → bone break with open wound. Bone may be sticking out of wound.

Closed (simple) → Skin not perforated.

Incomplete → doesn't extend across the bone.

Complete → extends across the bone.

Greenstick → incomplete fracture that occurs on the convex side of the curve of a bone

Hairline → incomplete where two sections of bone do not separate. Common in skull fractures

Comminuted fractures → complete with break into more than two pieces

Impacted fractures → one fragment is driven into the cancellous portion of the other fragment.

Critical sized defect → Gap too large to be filled by natural repair – leads to non-union if untreated

Osteoporosis

In osteoporosis, bone resorption is increased, bone formation is decreased and trabeculae perforated.

Inadequate bone formation in Haversian Remodelling systems increases cortical porosity and decreases strength

LECTURE 2: JOINTS

Outline

Articulations → body movements occurs at joints (articulations) where two bones connect

Joint Structure → Determines direction and distance of movement (ROM) → Joints strength decreases as mobility increases

Classifications

Structural Classifications → Bony, Fibrous, Cartilaginous and Synovial

Functional Category	Structural Category	Type	Description
<i>Synarthrosis (No Movement)</i>	Fibrous	Suture	A suture is a synarthrotic joint located only between the bones of the skull. The edges of the bones are interlocked and bound together at the suture by dense fibrous connective tissue.
	Fibrous	Gomphosis	A gomphosis is a synarthrosis that binds the teeth to bony sockets in the maxillae and mandible. The fibrous connection between a tooth and socket is a periodontal ligament.
	Cartilaginous	Synchondrosis	A synchondrosis is a rigid, cartilaginous bridge between two articulating bones. The cartilaginous connection between the ends of the first pair of vertebrosteral ribs and the sternum is a synchondrosis.

The Hip Joint (Coxal Joint)

Strong ball-and-socket diarthrosis and has a wide range of motion

Structure of the hip joint → Head of femur fits into it, socket of acetabulum which is extended by fibrocartilaginous *acetabular labrum*

The Knee Joint

A complicated hinge joint → Transfers weight from femur to tibia → Articulations of the knee joint (two femur–tibia)

Major Supporting Ligaments

1. Patellar ligament (*anterior*)
- 2 & 3. Two popliteal ligaments (*posterior*)
- 4 & 5. Anterior and posterior cruciate ligaments (*inside joint capsule*)
6. Tibial collateral ligament (*medial*)
7. Fibular collateral ligament (*lateral*)

Effects of Aging

Degenerative Changes

Rheumatism → A pain and stiffness of skeletal and muscular systems

Arthritis → All forms of rheumatism that damage articular cartilages of synovial joints

LECTURE 3: MUSCLE

Muscle Tissue

Primary muscle tissue is divided up into 3 types → Skeletal, Cardiac and Smooth muscle tissue

Skeletal Muscles

Are attached to the skeletal system and allow for movement

Function → Produce skeletal movement, maintain posture and body position, supports soft tissue, guards entrances and exits, maintain body temperature and stores nutrient reserves

Organisation → Muscle tissue (cells or fibres), connective tissue, nerves and bloody vessels

- *Muscle Tissue*
 - Connective Tissue → Muscle attachments occur at the ends of muscles to form connective tissue attachment to bone matrix.
- *Blood Vessels and Nerves*
 - Muscles have extensive vascular systems that supply large amounts of oxygen, nutrients and carry away wastes.