CHAPTER 6   SKELETAL TISSUE

Skeletal System

- Bones
  - Axial Skeleton (central)
    - Skull, vertebrae, ribs, sternum
  - Appendicular Skeleton (extremities)
    - Upper limbs: shoulder, arms, hands
    - Lower limbs: hips, legs, feet

- Cartilage
  - Joints: discs, growth plates

- Joints
- Fibrous connective tissue
  - Ligaments
  - Periosteum

Bone Functions

- Support
  - Weight bearing
  - Attaches bones
- Movement
  - Joints: muscles, tendons
- Protection
  - Brain, spinal cord, heart, liver, kidneys, uterus, eyes, ears
- Storage
  - Minerals
  - Adipose
  - Hemopoiesis: WBC, RBC, Platelets

Bone Structure

- Classification of Bone Structure
  - Long bones: arms, legs, fingers, thumbs
  - Short bones: carpal bones, tarsal bones, metacarpals, metatarsals
  - Flat bones: scapula, clavicle, cranial bones, pelvis, ribs
  - Irregular bones: facial bones, vertebrae, calcaneus

Bone Tissue = Osseous tissue

- Connective tissue = cells + matrix
  - Cells = osteocytes - adult bone cells
  - Osteoclasts - cells that destroy bone tissue
  - Osteoblasts - cells that build bone tissue
  - Osteoid - proteins 1/3 matrix

Bone matrix = Osteons tissue

- Mineral content includes Ca, Mg, P, F, mostly inorganic Ca₃(PO₄)₂, calcium phosphate

Osteoid: proteins 1/3 matrix

Minerals: inorganic 2/3 Ca, Mg, P, F, hydroxyapatites

Mostly calcium phosphate, Ca₃(PO₄)₂, hydroxyapatites

Where do osteoblasts get the Calcium?

Bone matrix

Bone Tissue = osteons tissue

Maintain matrix and mineral content
Secret protein and deposit minerals
Return minerals to blood
bone tissue types

• 2 types of bone tissue:
  − Compact dense, solid outer layers
  − Spongy loose network of bony tissue inner layers

• all bone has both types of tissue
  − varying amounts

compact bone

• compact bone = cortical bone
  − solid tissue
  − thickest in long bones

• Haversian system = Osteon
  − lamellae - layers of matrix
  − haversian canal = central canal
  − lacunae
  − Volkmann’s canal

bone tissue – spongy bone

• Spongy = Trabecular
  • many branches (trabeculae) + spaces
  • inner layers of all bones
    − most in flat, irregular bones, epiphyses
  • no osteons
  • resists stresses in several directions
  • red bone marrow in spaces between trabeculae

c.t. membranes

• periosteum covers bone
  − fibrous (irreg) c.t connects tendons, ligaments
  − stem cells bone growth and repair
  − Sharpey’s fibers connect periosteum to bone

anatomy of long bone

• diaphysis

• epiphysis

• epiphyseal plate

• medullary cavity

• periosteum

• articular cartilage
Osteogenesis

- ossification = replacing tissue with bone
  - embryonic
  - childhood
  - adult
- calcification = depositing calcium into any tissue
- intramembranous ossification
  fibrous c.t. → bone
- endochondral ossification
  cartilage → bone

intramembranous ossification

- Skull, flat bones of clavarium
  - fibrous c.t. → bone
  - ossification - starts at center of tissue; grows outward
  - not complete at birth ends about age 2.
  - Fontanels spaces between bones allow compression during birth
    - anterior
    - posterior
    - sphenoid = anterolateral
    - mastoid = posterolateral
  - sutures

endochondral ossification

- cartilage model froms first
- bone replaces cartilage
- primary ossification center diaphysis
- secondary ossification center epiphysis

- later: trabeculae form; spongy bone
  - blood vessels invade and form red bone marrow
  - medullary cavity forms
- epiphyseal plate cartilage left between ossification centers
- articular cartilage remnant of cartilage model

long bone growth - Childhood

- interstitial growth length
- epiphyseal plate = cartilage
  - growth zone - mitosis of chondrocytes grows toward epiphysis
  - osteogenic zone - bone replaces cartilage near diaphysis
- epiphyseal closure complete ossification ends growth
appositional growth width bones get wider

hormones – bone metabolism

• bone growth:
  • growth hormone increase mitosis epiphyseal plates
  • testosterone testes
  • estrogen ovaries
calcium:
  • calcitonin
  • parathyroid hormone
  • estrogen

Calcium functions

• nerve impulses
• muscle contraction
• blood clotting
• mitosis
• bone matrix
• least important - bone

bone remodeling

• constant process
• bone deposition
  — osteoblasts
  — adds matrix and Ca++
• bone resorption
  — osteoclasts
  — remove Ca++ from bone
• Wolff’s law

fracture repair

• hematoma blood clot
• soft callus formation
  — cartilage and collagen unite broken ends
• bony callus bone replaces cartilage
• bone remodeling osteoclasts
  — return to original shape

bone fractures

• simple nondisplaced; skin intact
• compound breaks skin = open fracture
• comminuted > 1 break
• compression crushed
greenstick bending; pediatric
epiphyseal epiphysis; epiphysis slips
spiral twisting injury
what else could go wrong?

- osteomalacia
  - soft bone
  - ↓ calcium in bone

- osteoporosis
  - bone with holes
  - ↓ matrix ( % Ca may be normal!)
  - causes:
    - ↓ estrogen; diet; exercise
    - drugs - corticosteroids

- osteopenia
  - any decrease of bone tissue

- arthritis
  - inflammation of joint

- osteoarthritis
  - inflammation of joint and bone

- atrophy
  - decreased bone mass