

Anatomy and Physiology Lecture Notes

Fall Test 3- Chapters 6-10

Osseous Tissue and the Skeletal System

The skeletal system consists of bone and cartilages. Cartilage has a rubbery matrix and is avascular. Osseous tissue is very vascular and the matrix contains a collagenous fiber framework (33%) and extensive deposits of mineral salts (67%, mostly Calcium Phosphate and Calcium Carbonate)

Bone Structure:

- Diaphysis- the shaft of the bone and is made of compact bone
 - Epiphysis- the ends or extremities of the bone and are made up of a thin layer of compact bone, covering an interior of spongy bone
 - Medullary cavity- the space within the diaphysis, which contains yellow marrow (fat)
 - Articular Cartilage- thin hyaline cartilage, covering of epiphyseal surfaces (joints)
 - Periosteum- a fascia covering of bone with:
 - o Fibrous layer- outer layer of dense irregular connective tissue
 - o Osteogenic layer- inner layer with many osteoclasts (bone-absorbing cells) and osteoblasts (bone-forming cells)
- The periosteum has a rich supply of blood, nerves, and lymph vessels and is essential for bone nutrition, growth, and repair.
- The collagen fibers in the periosteum extend into the bone matrix, attaching one to the other. The periosteum is in the insertion (or anchoring point) for tendons and ligaments.
- Endosteum- thin connective tissue layer, which lines the medullary cavity and has both osteoclasts and osteoblasts

Skeletal Functions: to support, protect, storage, movement (muscle attachment), and hemopoiesis

- Hemopoiesis (blood cell formation)- a process that mostly occurs in red bone marrow, which, in adults, is found in the spaces in spongy bone, and in children, extends into the medullary cavity
- Compact bone- covers spongy bone, is dense, and provides strength
 - o The structural unit of compact bone is the osteon, which is hard osseous matrix arranged in rings (lamellae) around a

central canal. The canal is connected with the periosteum and its blood vessels by perforating canals.

- o The osteocytes (mature -blasts) live in lacunae. The lacunae connect with each other by canaliculi (tiny canals). The canaliculi have cellular extensions of osteocytes, such that there is a network for nutrient transport.
- Spongy bone- consists of osseous matrix arranged in a lattice work of little “beams” called trabecula. The spaces between the trabecula contain red bone marrow (hemopoiesis) and blood vessels.
 - o Spongy bone is found sandwiched between compact bone in the epiphyses of long bones and is the bulk of most other bones.

Bone formation (Ossification or Osteogenesis)

- An embryonic skeleton is made of either fibrous membranes or hyaline cartilage. It begins at about 8 weeks after conception and continues until about 22 years of age and these connective tissue models are slowly ossified.
- There are 2 methods of bone formation:
 1. Intramembranous Ossification- results in the formation of flat bones (and some short or irregular ones). The fibrous membrane “model” of the future bone is ossified.
 - Typically, one ossification center appears where osteoblasts begin secreting bone matrix (Ossification). Eventually, spongy bone is formed and later, the outer layers are remodeled into compact bone.
 - The original fibrous membrane “model” now encloses or covers the “new” bone and this membrane becomes the periosteum. As osteoblasts trap themselves in the matrix (lacuna), they are called osteocytes. Bone is then absorbed, destroyed, and reformed many times until adult size and shape are reached.
 2. Endochondral Ossification
 - Long (and some short) bones are formed this way.
 - Involves ossifying a hyaline cartilage model of bone.

- The embryonic skeleton is cartilage, which is enclosed by the connective tissue fascia-perichondrium.
- When blood vessels grow into the perichondrium and bone model, the chondrocytes change into osteoblasts, which begin laying down bone matrix.
- The perichondrium is now the periosteum.
- The area where this begins is called the primary ossification center and it is centrally located (in long bones, it is mid-diaphysis).
- Eventually (between ages 1-5), blood vessels enter the epiphyses and secondary ossification centers develop, but at birth the ends of long bones and edges of others are still cartilage.
- The primary and secondary ossification centers grow toward each other as cartilage is replaced with bone. The area of cartilage remaining between these ossification centers is called the epiphyseal plate. It doesn't ossify until age 18-25, at which time growth/height ends. It is these cartilage plates that grow, making bones longer.
- Growth in diameter is due to osteoblasts in the periosteum, adding new matrix to the outside bone surfaces.
- Initially, all bone begins as spongy bone and it might later be converted to compact bone.
- At some point (age 18-20 in tibia, age 25 in clavicle), the epiphyseal plate's chondrocytes stop dividing, calcification continues, growth occurs in long ends, and the calcified epiphyseal plate is called the epiphyseal line.

Bone Remodeling

There is a continuous balance between bone formation (osteoblasts) and bone reabsorption (osteoclasts) occurring at all periosteal and endosteal surfaces. Bone is constantly replacing itself throughout adult life (ex: the