Lecture title: Orthopedics & Fractures

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Orthopedics & Fractures

Orthopedics

Is a branch of medicine concerned with the preservation and restoration of functions of the skeletal system, and associated structures like joints, muscles, ligaments and tendons.

Major Functions of the Bones

1) Support Bones provide a structural framework for the body, supporting soft tissues and giving the body its shape.
2) Protection Bones protect vital organs from injury: The skull protects the brain. The ribcage safeguards the heart and lungs.
3) Locomotion Bones act as levers that muscles pull on to produce movement. Joints between bones allow a wide range of motions.
4) Blood Cell Production (Hematopoiesis) Bone marrow, found in certain bones, produces red blood cells, white blood cells, and platelets.
5) Mineral Storage Bones store essential minerals, such as calcium and phosphorus, which are released into the bloodstream when needed.

There are three primary types of bones: Woven bone; Cortical bone, and Cancellous bone.

Woven bone

- Is found during embryonic development, during fracture healing (callus formation), and in some pathological states such as hyperparathyroidism.

- It is composed of randomly arranged collagen bundles and irregularly shaped vascular spaces lined with osteoblasts. Woven bone is normally remodeled and replaced with cortical or cancellous bone.

Cortical bone, also called compact or lamellar bone

- The primary structural unit of cortical bone is an osteon, also known as a haversian system.

Cancellous bone, also known as trabecular bone or sponge bone

- Is spongy, soft and found within flat bones and at the ends of long bones.

Red Bone Marrow: Found in trabecular bone of flat bones and ends of long bones.

Yellow Bone Marrow: Found in the medullary cavity of long bones in adults.

The cellular components of bone consist of: Osteogenic precursor cells; Osteoblasts; Osteoclasts and Osteocytes.

Osteoprogenitor cells (osteogenic precursor cells): They make up the deep layer of the periosteum, which invests the outer surface of bone, and the endosteum, which lines the internal medullary surfaces.

Osteoblast cells: Mature, metabolically active, bone forming cells.

Osteocyte cells: Mature osteoblasts trapped within the bone matrix.

Osteoclast cells: Multinucleated, bone-resorbing cells controlled by hormonal and cellular mechanisms. These cells function in groups termed “cutting cones” that attach to bare bone surfaces and, by releasing hydrolytic enzymes, dissolve the inorganic and organic matrices of bone and calcified cartilage.

The periosteum: is a dense, fibrous membrane that covers the outer surface of bones, except at the joints where cartilage is present. It consists of two layers:

Outer fibrous layer: Made of tough connective tissue, providing protection and a site for the attachment of muscles, tendons, and ligaments.

Inner cellular layer (osteogenic layer): Contains cells like osteoblasts and osteoclasts, which are involved in bone growth, repair, and remodeling.

The periosteum also has a rich supply of blood vessels and nerves, which play a crucial role in nourishing the bone and sensing pain.

The endosteum: is a thin, delicate membrane that lines the inner surface of bones, specifically the medullary (marrow) cavity and the trabeculae of spongy bone.

Blood and Nerve Supply of the bone:

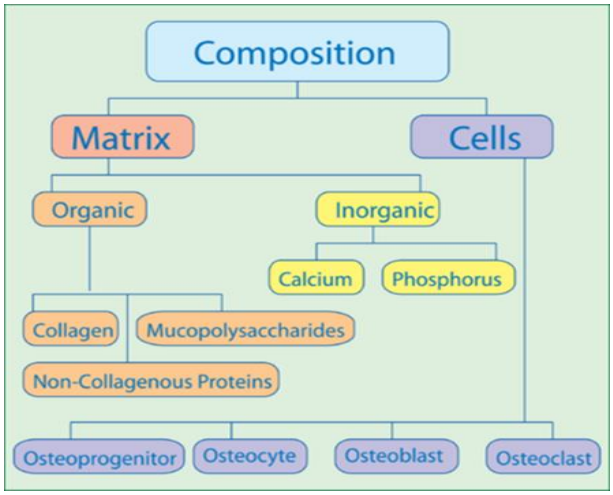
1) **Nutrient Arteries:** The nutrient artery usually enters a long bone through a foramen in its proximal half.
2) **Periosteal Vessels:** Supply the outer layers of bone.
3) **Metaphyseal-epiphyseal blood supply:** are larger than the periosteal vessels and either penetrate the bone and anastomose with the nutrient artery

Nerves: Found in the periosteum, providing sensory input and pain response.

Bone Matrix

i. **Organic Component:**
   1) Collagen fibers (primarily type I collagen) provide tensile strength and flexibility.
   2) Proteoglycans and glycoproteins play roles in hydration and cell signaling.

ii. **Inorganic Component:**
   1) Hydroxyapatite crystals (calcium phosphate) provide hardness and compressive strength.
   2) Stores 99% of the body's calcium.



Associated Structures

1) Joint – anytime 2 or more bones come together
2) Articular Cartilage – cartilage covering the ends of bones that are in contact with adjacent bones to create smooth movement and shock absorption
3) Tendon – connects muscle to bone
4) Ligament – connects bone to bone

Classification of Bones

1) Long Bones –2) Short Bones –3) Flat Bones –4) Sesamoid Bones –5) Irregular Bones