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Short Review on Osteology

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Introduction

The skeletal system is a dynamic organ with many functions, despite frequently being thought of as a static support structure. These functions include giving us our distinctive human shape, enabling locomotion and motor function, facilitating respiration, safeguarding vital organs, producing marrow-derived cells, and playing a significant role in homeostasis.

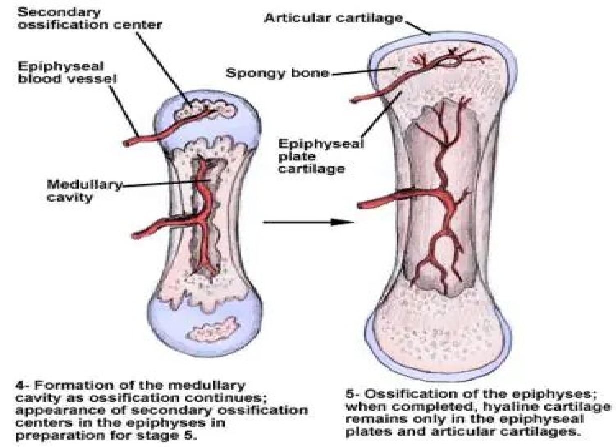
Bones are dynamic structures that constantly reconstruct and change in reaction to their environment, which is constantly changing. In fact, there is so much turnover that a young person's skeleton will look radically different in 4 years than it does now. Bones are among the few organs that can regenerate without leaving a scar after being fractured. They can change size in response to environmental stimuli, grow larger or smaller, and strengthen themselves as needed. The human body contains 206 bones. Bones are among the few organs that can regenerate without leaving a scar after being fractured. They can change size in response to environmental stimuli, grow larger or smaller, and strengthen themselves as needed.

The human body contains 206 bones (other sources claim 213). There is some variety because different people have varying numbers of different bones (such vertebrae and ribs). The size of bones varies greatly, from the small inner ear bones that convey mechanical sound waves to the sensory organs to the enormous (nearly 2 ft long) femur bone that can support 30 times an individual's body weight. There is some variety because different people have varying numbers of different bones (such vertebrae and ribs).

Gross Anatomy

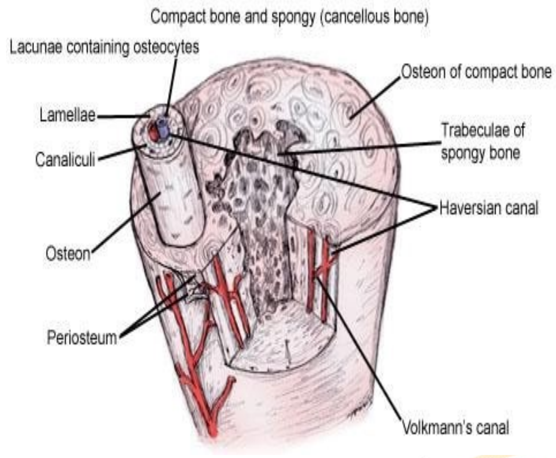
Bones can be divided into 3 generic groups: long bones, short bones, and flat bones.

Long bones are formed from a cartilage model precursor by endochondral ossification (see the image below) and can range in size from a phalanx to a femur. They are typically tubular, have distinct anatomic zones, and are longer than they are wide. Short bones arise from the same precursors but are not necessarily structurally similar to long bones, often taking on unique shapes (e.g, carpal bones). Flat bones are formed without a precursor by intramembranous ossification and can have unusual shapes (eg, skull or sternum).



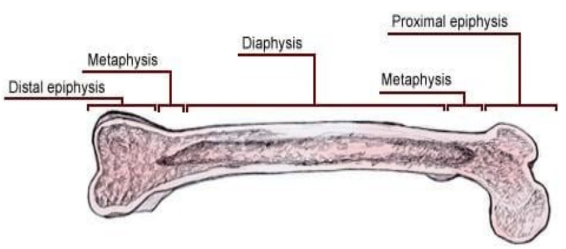
Most bones have a thick, well-organized outer shell (cortex) and a less dense mesh of bony struts in the center (trabecular bone) (see the image below). The ratio of cortical bone to trabecular bone varies widely; in adults, this ratio is typically 80:20.

The only bones that lack a true cortex are the vertebrae, which are covered by a compact condensation of trabecular bone. All bones are encased in a soft tissue envelope known as the periosteum, which is vital for perfusion and nutrient supply to the outer third of the bone (see the image below). The remainder of the blood supply is through nutrient vessels that pierce the cortex and supply the marrow cavity and the inner two thirds of the cortical bone.



Long bone

Epiphysis, Metaphysis, and Diaphysis are the three different zones found in mature long bones (see the illustration below). The epiphyseal plate, or physis, is a fourth zone that divides the epiphysis and metaphysis during development. The cartilaginous portion of the bone serves as the starting point for the bone's longitudinal growth. By adulthood, all epiphyseal plates have closed, and all that is left of this crucial structure is a bony scar. The femur, tibia, fibula, humerus, radius, ulna, metacarpals, metatarsals, and phalanges are examples of long bones.



Epiphysis

The area near the polar ends of long bones is known as the epiphysis. It typically consists of a thin, compact bone shell with numerous bony struts (trabecular bone) supporting the cortical shell and is most frequently found on joint surfaces. The bony strut network beneath the little shell is perfectly suited for its function as a shock absorber.

Subchondral bone, also known as the shell or coating of compact bone, is thicker right below a joint and supports the hyaline articular cartilage of the joint directly above it. Since the subchondral bone lacks some of the architecture of cortical bone, it is not truly cortical bone.

In many bones, the epiphysis also acts as a site for attachments, including tendonous attachments, many ligamentous attachments, and joint capsular attachments. It is sturdy like the majority of bone segments, however it lacks the diaphysis' stiffness.

Physis (epiphyseal plate)

The epiphyseal plate, a crucial area in human growth, is in charge of the skeleton's longitudinal growth, which affects a person's height and stature. Numerous epiphyseal plate disorders, including achondroplasia, which prevent the plate from developing normally and can cause a major change in stature, are also referred to as skeletal dysplasias. There are various zones inside the epiphyseal plate itself.

Metaphysis

Between the diaphysis and the epiphysis, there is a transitional zone called the metaphysis. Additionally, it has thick trabecular bone with thinner cortical walls. It frequently serves as the location of tendinous attachments to bone. The area is metabolically active and frequently harbors a sizable amount of bone marrow. The metaphysis is when the epiphyseal plate-created bone is precisely shaped into a diaphyseal structure.

Diaphysis

The diaphysis, a section of dense cortical bone with little trabecular bone, is located in the centre of long bones. It frequently has a smaller diameter than metaphyseal and epiphyseal bone because it does not need a great diameter to transfer its load due to the strength of its thick cortical layer.

Short Bones

They vary in size and shape. Examples include the carpal bones, vertebrae, patella, and sesamoid bones. They vary in size and shape. Examples include the carpal bones, vertebrae, patella, and sesamoid bones.

Flat bones

Flat bones are fundamentally different in their embryologic genesis from the previously listed bones, albeit sharing certain similarities in other ways. Flat bones are formed from sheets of mesenchymal tissue, and they never go through a cartilaginous model. The mesenchymal sheets arrange, compress, and ultimately ossify. They develop from periosteal or membranous growth.

They frequently have a broad, flat shape and are made up of a cortical shell and a cancellous interior. They give both protection (such as the skull) and wide, flat surfaces for muscular attachment (such as the scapula).

Microscopic Anatomy

Cortical bone

The dense, incredibly strong bone that surrounds bones is called cortical bone. The skeleton comprises 80% of it. Although its primary purpose is mechanical, it also contributes to calcium homeostasis. Mature cortical bone has a characteristic layered structure and is lamellar, as shown in the illustration below. Osteons are the main microscopic component of bone. An osteon is a network of bone that is cylinder-shaped and located around a vessel that flows longitudinally through the bone's haversian canal. Volkmann canals obliquely link longitudinal haversian canals, forming a network or plexus of vessels.

Trabecular bone

Trabecular bone is found on the interior of cortical bone and is less dense. It is formed of a network of plates and rods. Plates are usually broad and flat, whereas rods are more cylindrical.

Woven bone

Woven bone is disordered bone. Calluses, intramembranous bone, and bone produced by malignancies all contribute to the production of primary bone. Collagen and minerals are randomly organized to make it.

Periosteum

The periosteum is a tough layer of connective tissue that surrounds bones

Endosteum

The endosteum is a 1-cell-thick lining on the trabecular and inner cortical surfaces of the bone.

Bone matrix

Bone as a whole has a low cell content and is made primarily of noncellular matrices. There are 2 forms of extracellular matrix (ECM): osteoid and mineralized matrix. Osteoid is immature matrix excreted by osteoblasts. It is then converted to mature mineralized matrix over time. Bone matrix consists of mineral, proteins (collagens), glycoproteins, proteoglycans, and water.

Osteoid

Osteoid is made by osteoblasts (see the image below) and is found in areas of new bone formation

Bone collagens

There are numerous collagens in the human body, many of which play some role in the form or function of bone; however, type I collagen is by far the most important.

Bone cells

There are 4 major cell types within bone tissue itself: osteoclasts, osteoblasts, osteocytes, and bone lining cells. Within the cavities of the bone, there is also bone marrow, which has numerous cell types, including the progenitor cells for the hematopoietic cell lineages.

Osteoblasts

The osteoblast is the cell responsible for construction of new osteoid.

The osteoblast is also the key cell in regulating bony absorption and the function of the osteoclast. This is known as coupling.

Bone lining cells

Bone lining cells are old osteoblasts that no longer play a role in synthesis. They are flat thin cells with little activity.

Osteocytes

The osteocyte is an osteoblast that has been incorporated into the cortical bone. It survives in single cell-sized hole in the bone known as a lacuna.

Osteoclasts

The osteoclast is derived from the hematopoietic macrophage lineage. The stem cells undergo multiple steps before becoming a mature osteoclast, each of which is highly regulated.

Calcium homeostasis

Regulation of calcium in the serum is principally controlled by parathyroid hormone (PTH), vitamin D, and calcitonin.

Coupling and remodeling

Bone remodeling, the interplay between bone absorption and bone formation, involves intricate interactions between multiple bone cell types

Absorption is always followed by formation, except in pathologic states. This coupling of the 2 processes is crucial to bone homeostasis.

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