Composition of Bone

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The human skeleton starts to form within the first six weeks of gestation. Initially, the fetus has over 400 bones, but this number decreases as some of the bones fuse. By the time a baby is born, they have approximately 270 bones. This process of bone fusion continues into early adulthood and by the time we reach our full height, the number of bones decreases to 206. The reason for this decrease is that, as we grow, some of the bones in our body fuse together, which usually happens when two bones meet at a joint and are held together by ligaments. Over time, the two bones grow closer together, and eventually, fusion occurs. A reduced number of bones may sound like a bad thing, but it actually results in a stronger and more resilient skeleton. The human skeletal system is composed of bones, cartilage, and connective tissues including ligaments and tendons; it provides the framework for our bodies and protects our organs. Additionally, it stores minerals and produces blood cells. The bones composing the skeleton are connected at joints. The skeletal system not only consists of bones but also cartilage, which is a type of connective tissue that acts as a cushion between joints and allows for fluid movement. The skeleton is further held together by ligaments, which are tough bands of connective tissue that attach bone to bone. There are also tendons connecting muscles to bones. These components work together to allow us, humans, a vast range of activities and enable us to move our bodies in many ways.

Bones can be classified as either compact or spongy. Compact bones are strong and tough, making up the outer layer of long bones in our limbs. Spongy bones, on the other hand, are lightweight and porous and make up most of our skull as well as vertebrae in our spine. The two types of bones have different functions, but both are essential for our overall health. Compact bones are made up of tightly packed cells called osteocytes, which are arranged in a series of concentric circles around a central Haversian canal. This type of bone is strong and durable, making it ideal for bearing weight and providing protection. The majority of our skeletal mass is made up of compact bones, which account for approximately 80% of the total weight of an adult human skeleton. Spongy bone has a spongy texture due to the presence of an open network of thin bony plates and spines. This type of bone is often found in areas where mechanical strength or weight-bearing is not as important and is much lighter and more porous than compact bone, making it ideal for supporting soft tissues and producing blood cells. Spongy bone makes up the innermost layer of all bones and accounts for approximately 20% of the total weight of an adult human skeleton (Nandiraju & Ahmed, 2019). Spongy bone, though not as strong as compact bone, is nevertheless important in protecting delicate organs and keeping the body light enough to move easily. Both compact and spongy bones have two further components—woven bone or lamellar bone. Woven bone is a type of temporary tissue that forms during growth periods or when healing from fractures; it is composed mainly of collagen fibers with few minerals present. Lamellar bone, on the other hand, contains more minerals, which give it greater strength. It makes up most areas of adult bones that are not growing or healing from injury.

Bone is a unique and complex tissue that is made up of both organic and inorganic components. The organic components, which make up the remaining 35% of the bone, include fibers such as collagen and non-collagenous proteins (Kim et al., 2021). These proteins give bone strength and flexibility. Collagen fibers are arranged in a characterized cross-linked pattern that gives bone much of its toughness. Bones are more than just the scaffolding that supports the body. They also protect vital organs, store minerals, and produce blood cells. Without bones, the human body would be a mass of vulnerable tissue unprotected from external elements and internal malfunctions. Bones serve as both armor and a fortress for the organs they encase. The rib cage, for example, protects the heart and lungs from blunt force trauma. The skull protects the brain from damage. Even delicate organs like the ear are shielded by bones. The ossicles are three tiny bones located in the middle ear. Their purpose is to send sound vibrations from the eardrum to the inner ear and protect the eardrum from damage. In addition to providing protection, bones also serve as a storehouse for essential minerals like calcium and phosphorus. The inorganic components of bone, which make up 65% of the total, are calcium phosphate deposits with crystalline hydroxyapatite (Kalka, Zoglowek, Ożyhar, & Dobryczycki, 2019). These minerals give bone strength and rigidity. The inorganic component of bone is made up of calcium phosphate deposits with crystalline properties of hydroxyapatite. Hydroxyapatite is a primary mineral found in bones and teeth, and it gives these tissues their strength and rigidity. The organic component of bone consists of collagen fibers and other proteins that give bone flexibility and resilience. These minerals give our bones their strength and stiffness, as well as provide protection against physical trauma like falls or blows to the body. Our bones are constantly renewing themselves, with old bones being broken down and new bones being formed. This process is known as remodeling, and it is essential for maintaining the strength and health of the skeletal system. Without it, the body would be susceptible to fractures and other injuries. Together, the inorganic and organic components of bone provide the structure and strength necessary for survival.

There are three types of cells involved in bone growth and homeostasis; osteoclasts, osteoblasts, and osteocytes (Al-Bari & Al Mamun, 2020). Osteoclasts break down bone tissue, osteoblasts synthesize new bone tissue, and osteocytes maintain the mineral balance in bones. All three cell types work together to ensure that bones stay strong and healthy. When bone tissue is damaged, osteoclasts break it down so that osteoblasts can build new bone in its place. Furthermore, Osteocytes help to regulate the mineral content of bones, ensuring that they remain strong and resistant to fractures. Together, these three cell types play a vital role in maintaining the health of our bones. Lastly, Osteoclasts break down old bones while osteoblasts build new ones during growth periods or after injuries. Osteocytes act as sensory cells to detect changes in pressure or strain on a particular area so that these can be responded to appropriately by either reducing or increasing mineral deposition for better support or protection from physical stressors respectively. As we can see, it takes cells to maintain balance in the skeletal system and it is an incredible feat of engineering—understanding its components helps us appreciate this even more.

In conclusion, bones are composed of both inorganic and organic components. The inorganic component consists primarily of calcium phosphate deposits with crystalline hydroxyapatite, which give bones their strength and rigidity. The organic component contains collagen fibers and other proteins that give bones flexibility and resilience. Bones play a vital role in our bodies, providing support and structure while also protecting our organs. Finally, cells such as osteoclasts, osteoblasts, and osteocytes are necessary for the maintenance of bones. Together, these components enable us to enjoy a healthy and active life.

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