Cortical bone surrounds the bone marrow and the cancellous bone plates. In long or tubular bones, the diaphysis is constituted almost totally by dense cortical bone, while the cancellous bone is little or absent in this region. The thick cortical walls of the diaphysis become thinner and increase in diameter as they form the metaphysis, where plates of cancellous bone orient themselves to provide support for a thin shell of subchondral bone that underlies the articular cartilage.

Short and flat bone usually comprises more cancellous bone and thinner cortical walls compared to the diaphysis of long bones, comprising more cancellous bone. Most of the cancellous bone can be found in the vertebral bodies, the pelvic bones, and the metaphysis of long bones, while the diaphysis of long bones consist primarily of thick cortical bone. The difference in structure of cortical and cancellous bone reflects their primary functions. In fact, cortical bone provides mechanical and protective functions while cancellous bone provides metabolic functions (Buckwalter et al., 1995).

The cortical bone is characterized by a highly organized microstructure, the structural unit of which is called osteon or the Haversian system. The osteon has the shape of an elongated cylinder with a diameter between 150 and 350 μm (Van Oers et al., 2008), orientated parallel to the long axis of the bone and surrounded by concentric lamellae of bone (Buckwalter et al., 1995). In each lamella, collagen fibers are densely packed and orientated in a single direction, while in adjacent lamellae they always run in different directions. The collagen fibrils frequently interconnect also between lamellae, increasing the strength of bone. The central canals of osteons, referred to as Haversian canals, contain blood vessels, lymphatic vessels, and nerves.

The osteocytes occupy the lacunae at the junctions of the lamellae and their cell processes extend in a radial pattern from the central canal through small canaliculi. These canaliculi connect the central canal to osteocytes and pass from osteocyte to osteocyte. Cortical bone microstructure organization allows the diffusion of nutrients in the hard, mineralized matrix.

The central canals also branch and anastomose with obliquely orientated vascular branches known as Volkmann canals. These structures allow extended communication from the periosteum to the endosteum (Downey and Siegel, 2006). The interstitial lamellae fill the gap between forming osteons or are remnants of osteons that have been cut through by bone remodeling. The cortical bone is separated from the periosteum through circumferential lamellae, which extend around the entire circumference of the diaphysis. A thin layer of the organic matrix constitutes the outer border of each osteon. This surrounding cement lines mark the sites where the bone resorption stopped and new bone formation began (Buckwalter et al., 1995).

Trabecular bone consists in a network of trabeculae (plates and rods), the distribution of which is highly anisotropic. In adults, a preferential orientation of the trabecular plates was observed along the direction of the stress which is exerted on the bone (Chappard et al., 2008). The trabeculae of cancellous