



FIG. 16.1 Scheme showing the hierarchical organization of bone. Up to level V, the hierarchical levels can be divided into ordered material (green) and disordered material (blue). At level VI, these two materials combine in lamellar bone and parallel fibered bone. Dental hard tissues, which still need to be investigated with respect to the presence of both material types, are depicted in a white box. Level VII depicts the lamellar packets that make up trabecular bone material and the cylindrically shaped lamellar bone that makes up osteonal bone. The fibrolamellar unit comprises the primary hypercalcified layer, parallel fibered bone, and lamellar bone. Legend: c-HAP: carbonated hydroxyapatite; GAGs: glycosaminoglycans; NCPs: noncollagenous proteins. (Reproduced with permission from Reznikov, N., Shahar, R., Weiner, S., 2014. Bone hierarchical structure in three dimensions. *Acta Biomater.* 10, 3815–3826 © Elsevier.)

When the coupling between bone formation and bone resorption is altered, it results in pathologic conditions known as osteoporosis (Arcos et al., 2014; Detsch and Boccaccini, 2015) which leads to important architectural and morphological modification of trabecular bone (Fig. 16.2).

Mature bones are constituted by some or all of the following components: the periosteum, the endosteum, the bone tissue, and the bone marrow. These constituents have different composition, structure, and function and are mutually dependent. The periosteum is a specialized, vascularized and innervated fibrous tissue that covers the external surface of bones except for the regions immediately around or within synovial joints, such as the femoral neck, and the sites of tendon, ligament, and interosseous membrane insertions. The periosteum is connected with the underlying bone tissue by collagen fibers, the so-called Sharpey’s fibers, aligned in the direction in which external loads induce the highest stress. In some regions, such as the diaphysis of long bones, the periosteum can be easily stripped from the underlying bone; meanwhile, it joins firmly near the articular surfaces and at the site of muscle, tendon, and