



**FIG. 16.2** SEM pictures of cancellous bone harvested from a (A) young (22-year-old) male human patient and (B) elderly female patient (osteoporotic woman in her 80s). As the aging process progresses, the bone trabeculae become gradually thinner, thereby affecting both morphological and mechanical features of the tissue.

intraosseous membrane insertions (Clarke, 2008). The periosteum has an important role in the contribution of the blood supply to the bone, and the periosteal cells are involved in bone metabolism. The periosteal cells reside in the periosteum inner vascularized layer, referred to as the osteogenic layer, which is covered by the dense and fibrous periosteal outer layer. The cells from the osteogenic layer have the ability to differentiate into osteoblasts, to form hyaline cartilage under proper conditions, and they play an important role in the formation of extra osseous callus during fracture-healing (Buckwalter et al., 1995; Augustin et al., 2007).

The endosteum is a connective membrane that covers the internal bone surfaces. In particular, apart from covering the trabeculae of the cancellous bone, the endosteum lines the canals that pass through the cortical bone. It also contains osteogenic cells (Clarke, 2008).

The bone marrow is supported and surrounded by the bone tissue and the periosteum, and it represents an essential source of bone cells. The blood vessels present in the bone marrow form a critical part of the circulatory system in bone, and disorders or mechanical disruption of the bone marrow can affect the activities of bone and periosteal cells (Buckwalter et al., 1995).

From a macroscopic viewpoint, there are two forms of bone tissue: cortical (or compact) bone, and cancellous (or trabecular) bone. The matrix composition is the same for both cortical and cancellous bone, but there are some differences in the mass per unit, which is much greater in the cortical than in the cancellous bone (Ng et al., 1997). In fact, the porosity of the cortical bone is ~10 vol.% while the pore content of the cancellous bone is significantly higher (50–90 vol.%) (Buckwalter et al., 1995). These differences in the macrostructure of cortical and cancellous bone are responsible of marked variations in the mechanical properties of specific bones and skeletal sites, depending on the cortical-to-cancellous bone ratio.