

matrices for bone regeneration due to their similar chemical composition to the inorganic element of bone, which consists of hydroxyapatite (HA). Inorganic phosphate and bioactive glass are thought of as biomimetic, as they can activate the formation, precipitation, and deposition of inorganic phosphate, resulting in increased bone-matrix interfacial adhesion. Calcium sulfate can also act as a carrier for therapeutic agents due to its high binding affinity with proteins (Samavedi et al., 2013; Dorozhkin, 2012).

## 5.3 BONE

A bone is a rigid organ that establishes part of the vertebrate skeleton. Bones protect and support various organs of the body that produce red and white blood cells, store minerals, provide structure and support for the body, and enable mobility. Bone is not uniformly solid but includes a tough flexible matrix (Minary-Jolandan and Yu, 2009).

### 5.3.1 Composition of Bone

Human bone is a polymer-ceramic composite. It is largely composed of ceramic HA,  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ , and  $\beta$ -tricalcium phosphate [ $\text{Ca}_3(\text{PO}_4)_2$ ]. Therefore, these calcium phosphate-based materials are considered ideal candidates to develop scaffolds for bone regeneration. 35% of the total mass of the bone is composed of the organic phase, which predominantly consists of collagen matrix (90%), and the remainder is composed of other noncollagenous proteins, water, lipids, and cells (Eyre et al., 1988).

Cortical bone is characterized by its low porosity (approximately 5%–10%) and is commonly found in the shafts of long bones such as the pelvis, scapula, and vertebrate. Its function is to bear load, transfer mechanical forces from muscles, and facilitate movement. This dense structure of bone can be further divided into either woven or lamellar bone and their structural units are referred to as lamellae and osteons, respectively (Viguet-Carrin et al., 2006), while trabecular bone is a highly porous (75%–95%) form of bone tissue that is organized into a network of interconnected rods and plates which surround bone marrow filled pores (Fig. 5.1).

### 5.3.2 Bone Repair

The natural bone recovery process can heal a small sized defect or less severe areas of damage. However, pharmacological aid or surgery is essential for damaged bone when the damage level is too severe for self-healing (Tang et al., 2016; Paris et al., 2015). Generally, clinical therapies, including repair, replacement, remodeling, and removal of bone, provide the patients with temporary or permanent support while facilitating the regeneration of the damaged bone tissues (Kumar et al., 2016). A great number of patients suffer from bone failure, but there are relatively few donors. Therefore, the number of patients who need