bone regeneration. The particular feature that controls this dissolution behavior is the ratio of CaO to P_2O_5, which is relatively high in Bioglass, and leads to ready dissolution in physiological fluids. This, in turn, creates critical concentrations of biologically active species at locations where they can promote proliferation and differentiation of cells (Profeta and Prucher, 2015).

A parameter that is important in determining dissolution behavior is the network connectivity of the glass in question. The connectivity is controlled by the composition of the silica network and the method of glass fabrication. Glasses with high silica content have high connectivity, due to the large proportion of oxygen atoms that form bridging units between the silica tetrahedral. This results in slow or negligible rates of dissolution and a corresponding lack of bioactivity.

Introducing network-modifying cations, such as sodium or calcium, increases the proportion of nonbridging oxygens in the structure. This is because units of the type $-Si-O^{-}Na^{+}$ are created in place of $-Si-O-Si-$ bridges, thereby lowering the connectivity of the glass. The lack of connectivity, as well as the charged nature of the species involved, creates a structure that is capable of dissolving in water or body fluids.

Network connectivity can be quantified in terms of the number of bridging oxygens per silicon atom, N_c, and this in turn can be used to predict the bioactivity of the glass (Hill and Brauer, 2011; Hill, 1996). Glasses with N_c values above 2.6 are unlikely to show any useful degree of bioactivity because they are resistant to dissolution (Eden, 2011). By contrast, melt-derived Bioglass (45S5) has a calculated N_c of 2.12, a value which is consistent with its ideal rate of dissolution and exceptional level of bioactivity (Jones, 2013).

The high rate of dissolution of bioactive glasses is responsible for another biologically useful effect, namely, the raising of the pH around the implanted glass, with resulting antimicrobial effects (Stoor et al., 1998). This has been shown to be effective against the bacteria that cause periodontal disease, as well as those that cause caries (Allan et al., 2001). Owing to of this, bioactive glasses tend to be associated with reduced incidence of postoperative infections, a further advantage of these materials in bone reconstruction and related surgery.

9.6 PERIODONTAL APPLICATIONS OF BIOACTIVE GLASSES

(a) Granular fillers for bone augmentation

The structures supporting the teeth are complex. They include hard tissues in the form of trabecular and cortical bone, and also soft tissues, such as bone marrow and the periodontal ligament (Abbasi et al., 2015). As we have seen, periodontal disease affects all of these tissues, and treatment has involved a variety of approaches, of which the use of granular bioactive glass has been shown to be particularly effective.