melt-derived glasses, that is, 1–98 ($5.9Na_2O$-$7.1K_2O$-$7.6MgO$-$23.9CaO$-$0.9B_2O_3$-$0.9P_2O_5$-$53.8SiO_2$ mol%) and 28-04 ($4.9Na_2O$-$7.2K_2O$-$9.0MgO$-$16.2CaO$-$2.6B_2O_3$-$60.1SiO_2$ mol%) compositions. Glasses were pressed and sintered to produce ring-shaped structures with a 3D network of interconnected macropores. Biological tests using human keratocytes showed that both glasses induced no inflammatory response and the adherent corneal cells exhibited an elongated and spindle-shaped morphology, which revealed a good biocompatibility in vitro. A certain tendency to dissolve during contact with aqueous media was reported for both glass compositions, and therefore the use of a bioinert backbone structure was suggested to support in vivo the optical core of keratoprosthesis in the long term.

Liang et al. (2001) implanted experimental glass-ceramic disks (diameter 8 mm, thickness 0.5 mm, total porosity 37–62 vol%, pore size within 20–70 µm) in albino rabbit corneas. The implants with a porosity above 50 vol% were all extruded due to breakage and some clinical complications were observed in the other cases, for example, corneal edema with severe degrees of corneal neovascularization and corneal opacity. Perhaps an optimization of implant structure and composition could contribute to reducing the high brittleness and undesired surface roughness of these materials, in the attempt to make them more suitable for ocular applications.

13.5 COMPOSITES

Bioactive glass inclusions were incorporated in polymer-matrix ocular devices to impart extra functionalities or elicit a therapeutic response that cannot be exerted by the main, usually bioinert, phase. The added values carried by bioactive glasses are often related to the local delivery of inorganic ionic species that can direct cell activity toward paths of regeneration and self-repair (Hoppe and Guldal, 2011). For example, dissolution products from bioactive glasses are known to promote angiogenesis (Gorustovich et al., 2010), and this property was recently exploited to accelerate fibrovascularization of porous orbital implants. Fibrovascularization usually occurs spontaneously but quite slowly within bioinert orbital implants made of hydroxyapatite, polyethylene, or alumina (the process takes several weeks) and is key to ensure the postoperative clinical success of the ocular device (Chalasani et al., 2007). In fact, a well-vascularized implant is generally less prone to migrate or extrude because the fibrovascular tissue grown within the macropores mechanically anchors the soft tissues of the orbit to the material, and a vascular supply permits immune surveillance, thereby diminishing the risk of postoperative infections and promoting tissue healing around the implant (Alwitry et al., 2007).

45S5 Bioglass particles (tradenamed as Novabone) were successfully coupled with polyethylene granules for orbital volume augmentation in a rabbit model (Amato et al., 2003); on the basis of these promising results, composite orbital implants were developed and launched on the market under the