Glass was also employed to manufacture the optical lens of early artificial corneas (also known as keratoprostheses): the first prototype was designed by Pellier de Quengsy in 1789 (Chirila and Hicks, 1999) and then implanted in human patients 60 years later (Chirila et al., 1998). Since then, the use of glass lenses in keratoprostheses was alternatively advocated and castigated; today almost all models have a lens of PMMA that is lighter and easily moldable compared to glass, with the unique exception of the so-called "champagne cork" keratoprosthesis in which a glass lens is fixed to the sclera by means of a platinum flange and four stainless steel wires (Volker-Dieben and Worst, 1993; Jarmak et al., 2000).

In the "traditional" applications described above, the function of glass in implantable ocular devices was to act as an optically transparent element through which visible light can pass to reach the retina and allow vision. On the other hand, using implantable bioactive glasses and glass-ceramics aims at a totally different purpose, that is, the improvement of implant biointegration in the ocular tissues in order to maximize postoperative success and tissue tolerance of the implanted device, as reviewed and critically discussed in the following sections.

13.2 CONTEXT OF APPLICATION AND CLINICAL BACKGROUND

The existing literature witnesses the promising—albeit a bit sporadic—experimentation of bioactive glasses and glass-ceramics in three main ophthalmological fields, that is, oculoplastic surgery for the repair of orbital floor fractures, orbital implants for anophthalmic patients who underwent evisceration/enucleation, and artificial cornea.

Orbital floor repair is a clinical field at the interface between ocular surgery and maxillofacial reconstruction. External, traumatic impacts to the midface, such as blunt injuries, can lead to orbital blowout fractures in the inferior or medial orbital wall as a result of the sudden rise in the internal pressure within the orbit (Chang and Monolidis, 2005). A fracture in the orbital floor bone—which, due to its being very thin (below 500 μm), is highly fragile and prone to damage due to mechanical shock—causes herniation of the intraorbital tissues into the maxillary sinus located underneath. Timing of repair, surgical approach, and type of implanted materials are all critical issues that strongly affect the overall outcomes of orbital fracture repair (Ducic and Verret, 2009; Avashia et al., 2012). The major scope of the implant is replacing bone and providing adequate mechanical support at the bone defect site (fracture), as shown in Fig. 13.1. Commercially available and clinically used materials include metallic meshes (titanium alloy), a number of absorbable [e.g., poly(lactic-co-glycolic) acid] and nonabsorbable (e.g., silicone sheet) polymers and hydroxyapatite in the form of porous blocks to promote bone ingrowth (Baino, 2011). Custom-made bioactive glass implants (monolithic plates) have also been experimented with in select cases.