Efficacy of biocompatible phase developed in eggshell-derived porous glass-ceramic orbital implants

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When the patients have suffered an eye ailment or accident. Orbital implants are typically used to fill the anophthalmic socket and maintain surrounding tissues after the removal of the eyeball in surgery. Calcium silicate porous glass-ceramic materials were used to form an orbital implant due to their biocompatible property with an abundance of pores for ingrowth of fibrovascular tissue to fasten the implants to orbital tissues. In this research, less expensive $CaCO_3$ from eggshells was used to produce calcium silicate porous glass-ceramic material. The key morphological features of the porous glass-ceramic product were evaluated, and its ability to endure in body fluid was investigated. The porous glass-ceramic orbital implants were prepared by fabricating X mol% $CaCO_3$ (or eggshell) - 10mol% Na_2O - 60mol% SiO_2 glass systems with varying eggshell contents (X = 30 - 50 mol%). After heating at 870°C and 1000°C, the microstructure, mineral composition, and porosity of glass-ceramic orbital implants were comparatively studied. By soaking in simulated body fluid, the efficacy of the bio-compatible phase developed in eggshell-derived calcium-silicate porous glass-ceramic orbital implants was investigated. The compatibility of porous glass-ceramic with simulated human body fluid was reported in the form of weight change and bio-phase formation after the test for 2 weeks to 3 months. The maximum contents of eggshell in making the calcium silicate glass was 40 mol%, in which a pure amorphous structure was formed for fabrication of glass-ceramic orbital implants. A pure biocompatible wollastonite ($CaSiO_3$) phase was obtained after heat treatment at 1000ºC. In comparison to glass-ceramic orbital implants made from commercial $CaCO_3$, those made from eggshells had an open-macropore network with porosity over 30% that allowed fibrovascular tissue to grow. The glass-ceramic implants made from eggshells demonstrated good chemical stability in simulated body fluids (90-days *in vitro* test). This innovative porous glass-ceramic material is therefore a promising alternative low-cost biomedical implant for ocular prosthesis applications.