ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
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Chapter 014

Foam Impregnation Method for Artificial Bone Graft Application: Study on the Effect of Drying Time

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Keywords: TCP, PU foam, Drying time, Artificial bone graft, Foam impregnation method.

Abstract. Porous structure especially for artificial bone graft application has attracted researchers to put in effort to study the best possible method to suit this purpose. The physical and mechanical properties are among the critical features to be achieved. Foam impregnation method was applied to produce porous tricalcium phosphate (TCP) with the help of low-cost polyurethane (PU) foam as a template. The drying time was controlled at 24, 48, 72 and 96 hours before the green samples were sintered. Based on the results obtained of the sintered porous TCP, 72 hours has provided enough time for water elimination process given the mechanical strength of 1.02 MPa with 36% porosity.

Introduction

A number of issues related to natural bone graft have driven scientists in finding the best solution in cases of damaged bone treatment and reformation. Artificial materials are foreseen to be the best candidate for replacing the functions of autograft and allograft bone due to their ability to mimic human bones. Artificial bone graft can be made from any materials, normally known as biomaterials, as long as it is able to resemble and replace the functions of natural human bone. Due to this, the expansion of biomaterials field is predicted to grow rapidly since there are major improvements in technology and human life-style of late. Some considerations must be taken into account before deciding on selecting the materials for bone graft development including, a bone-graft substitute must be osteoconductive, osteoinductive, biocompatible, bioresorable, closely resembles the bone formation, easy to use and cost-effective [1].

For artificial bone graft application, the use of bioceramics has increased in demand especially from the calcium phosphate family. Hydroxyapatite (HA) and tricalcium phosphate (TCP) are among the most favourable bioceramics from the calcium phosphate family. In fact, inside the human body, HA is the main mineral phase that exists in bones and teeth. Due to this reason, HA is used extensively in artificial bone graft application. On the contrary, studies have proven that HA is not suitable to be applied in our bone because of its low degradability compared to TCP which degrades within 6 weeks of its application [2]. β-TCP, especially, has high solubility and biodegradation rate compare to α- and α`-TCP, making it suitable for bone implant, which helps to accelerate the formation of new bone [3].

There are several methods of producing porous artificial bone which includes porosifier [4], freeze-casting [5], gel-casting [6], gas foaming [7], solid free-form fabrication [8] and replica of porous structure [9]. The foam impregnation method however, provides a