

The Preparation of Multifunctional Nanocomposite Scaffolds for use in Bone Tissue Engineering

Eilish Hctor, Athlone Institute of Technology, Ireland

Abstract. Every year millions of people suffer with bone defects which can arise from injuries, oncological resection and progressive degenerative diseases. When these problems arise bone can normally repair itself, however, if the damage is beyond natural repair by the body either an autograft or allograft must be carried out. An autograft, also known as autologous bone graft involves taking non-essential bone from another part of that patient's body and using it to bridge the gap in the damaged area. An allograft also known as an allogenic bone graft is an alternative method which involves using bone which is harvested from a donor. Both of the above methods have drawbacks, these include an increased risk of infection, limited supply of non-essential bone, risk of disease transmission not to mention another surgery procedure which results in increased pain and healing time for the patient.

Synthetic bone substitutes have recently become an alternative method of choice as opposed to the above procedures for surgeons around the world. These substitutes are synthetic biomaterials that have been developed for use in bone defects which are beyond self-repair. Examples of bone substitutes that have been used in the past and ones that are currently on the market include metal and alloys and more recently ceramics and polymers. As with all materials the above substitutes have their disadvantages. While metals and alloys are both strong and ductile, they are also quite dense and can corrode. Ceramics are bioactive and bioresorbable but they are also brittle and lack resilience. Polymers are a better option as they are flexible, resilient and there is a wide range to choose from. They can however, be weak and have toxic effects on the body.

In recent times nanocomposites have come to the fore as an alternative bone substitute material due to their high surface reactivity, larger surface area and enhanced mechanical strength. In this study a proposed alternative to the above mentioned materials is a novel nanocomposite scaffold. This scaffold involves the use of both a polymer (Chitosan) and a nanocomposite (Hydroxyapatite). The two materials combined would make for a more biocompatible, resilient and flexible bone substitute material as opposed to bone grafting.

Chitosan is a flexible polymer which exhibits antimicrobial properties and is also biocompatible. It is produced from chitin, a long chain polymer present in the exoskeleton of crustaceans and insects. Hydroxyapatite is a close match to the natural mineral composition present in bone and teeth; its role is to both increase the mechanical strength of the end product and also to help promote cellular bone growth where the defect occurs. If this scaffold is successful it would mean the elimination of a second surgical procedure as it would prevent infection occurring at the site of the bone defect. In turn this means less pain and healing time for the patient, a more cost effective surgical method and also less complicated surgical procedures.