World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:18, No:05, 2024

Characterization and Degradation of 3D Printed Polycaprolactone-Freeze Dried Bone Matrix Constructs for Use in Critical Sized Bone Defects

Authors : Samantha Meyr, Eman Mirdamadi, Martha Wang, Tao Lowe, Ryan Smith, Quinn Burke

Abstract : Critical-sized bone defects (CSD) treatment options remain a major clinical orthopedic challenge. They are uniquely contoured diseased or damaged bones and can be defined as those that will not heal spontaneously and require surgical intervention. Autografts are the current gold standard CSD treatment, which are histocompatible and provoke a minimal immunogenic response; however, they can cause donor site morbidity and will not suffice for the size required for replacement. As an alternative to traditional surgical methods, bone tissue engineering will be implemented via 3D printing methods. A freeze-dried bone matrix (FDBM) is a type of graft material available but will only function as desired when in the presence of bone growth factors. Polycaprolactone (PCL) is a known biodegradable material with good biocompatibility that has been proven manageable in 3D printing as a medical device. A 3D-extrusion printing strategy is introduced to print these materials into scaffolds for bone grafting purposes, which could be more accessible and rapid than the current standard. Mechanical, thermal, cytotoxic, and physical properties were investigated throughout a degradation period of 6 months using fibroblasts and dental pulp stem cells. PCL-FDBM scaffolds were successfully printed with high print fidelity in their respective pore sizes and allograft content. Additionally, we have created a method for evaluating PCL using differential scanning calorimetry (DSC) and have evaluated PCL degradation over roughly 6 months.

Keywords : 3D printing, bone tissue engineering, cytotoxicity, degradation, scaffolds
Conference Title : ICABBTE 2024 : International Conference on Advanced Biomaterials for Bone Tissue Engineering
Conference Location : Sydney, Australia
Conference Dates : May 16-17, 2024