“Tissue Engineering Scaffolds and 3D Printing for Biomedical Applications”

Tissues or organ damage are major health problems worldwide which are due to trauma, disease or congenital abnormalities. Along with morbidity and mortality there is huge cost associated with these types of health care services. There are several treatment options like transplantation, artificial prostheses, mechanical devices, surgery and drug therapy. If there is major damage to tissue or organ, these procedures do not provide long term recovery and cure. In order to address this issue, tissue engineering is a solution as in this case natural, synthetic or semi-synthetic tissue or organ can be implanted to restore the function. This new paradigm requires scaffolds that balance temporary mechanical function with mass transport to aid biological delivery and tissue regeneration. Little is known quantitatively about this balance as early scaffolds were not fabricated with precise porous architecture (size, shape and mechanical properties). Recent advances in additive manufacturing (AM) have made it possible to create three dimensional structure of biomaterials with controlled architecture. Different AM approaches, for example, 3D printing (3DP), solid freeform fabrication (SFF), rapid prototyping (RP), are approaches that allow complex shapes for scaffolds’ fabrication directly from a computer aided design (CAD) file. Among all these techniques, fused deposition modeling (FDM) has attracted more attention due to its transportability, low overhead investment, low technical expertise needed to operate and maintain, and low maintenance costs. However, a pure scaffold is limited by its biological properties such as the absence of its biological properties, that limit cell-material interactions. Therefore, it is necessary to modify the surface properties by introducing various bioactive materials to enhance its cell-material interaction. Hence, the goal of this presentation is to describe the use of FDM technology to print polymer scaffold and then integrate it with bioactive materials for tissue engineering applications, with a focus on reported clinical and economic outcomes.