José Manuel Baena, J Biotechnol Biomater 2017, 7:2 (Suppl)
http://dx.doi.org/10.4172/2155-952X.C1.072

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An improved biofabrication process to enhance cell survival and distribution in bioprinted scaffolds for cartilage regeneration

Tissue regeneration (TR) is currently one of the most challenging biotechnology unsolved problems. Tissue engineering (TE) is a multidisciplinary science that aims at solving the problems of TR. TE could solve pathologies and improve the quality of life of billions of people around the world suffering from tissue damages. New advances in stem cell (SC) research for the regeneration of tissue injuries have opened a new promising research field. However, research carried out nowadays with two-dimensional (2D) cell cultures do not provide the expected results, as 2D cultures do not mimic the 3D structure of a living tissue. Some of the commonly used polymers for cartilage regeneration are Poly-lactic acid (PLA) and its derivates as Poly-L-lactic acid (PLLA), Poly(glycolic acids) (PGAs) and derivates as Poly(lactic-co-glycolic acids) (PLGAs) and Poly caprolactone (PCL). All these materials can be printed using fused deposition modelling (FDM), a process in which a heated nozzle melts a thermoplastic filament and deposits it in a surface, drawing the outline and the internal filling of every layer. All these procedures uses melting temperatures that decrease viability and cell survival. Research groups around the world are focusing their efforts in finding low temperature printing thermoplastics or restricted geometries that avoid the contact of the thermoplastic and cells at a higher temperature than the physiologically viable. This mainly has 2 problems; new biomaterials need a long procedure of clearance before they can be used in clinical applications, and restrictions in geometries will limit the clinical application of 3D printing in TE. We have developed an enhanced printing process named Injection Volume Filling (IVF) to increase the viability and survival of the cells when working with high temperature thermoplastics without the limitation of the geometry. We have demonstrated the viability of the printing process using chondrocytes for cartilage regeneration. This development will accelerate the clinical uptake of the technology and overcome the current limitation when using thermoplastics as scaffolds.

Biography

José Manuel Baena, MSc is a Research Associate. He is the Founder of BRECA Health Care, pioneer in 3D printed custom made implants for orthopedic surgery, and REGEMAT 3D, the first Spanish bioprinting company. He is an expert in innovation, business development and internationalization. He is a Lecturer in some business schools, and is passionate about Biomedicine and Technology. In his free time, he also works as a Researcher at the Biopathology and Regenerative Medicine Institute (IBIMER).

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