METHODOLOGY FOR NUMERICAL SIMULATION OF THE DEGRADATION PROCESS OF 3D PRINTED BIOPOLYMERIC SCAFFOLDS

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Abstract: Scaffolds are porous implants manufactured by additive manufacturing of biomaterials, with hierarchical structure, which enables the tissue regeneration process [1]. The durability of these implants mainly depends on the physical properties of the material used. In this work, a predictive model of the degradation process of the biopolymeric scaffold is presented, using open source tools. It consists of a numerical simulation to compute the dynamic degradation of the scaffold manufactured by additive manufacturing. The model consists of a chamber with an entrance duct (as well as an outlet pipe) [2,3] where the fluid goes through a cylindrical scaffold. Once the geometric model is done, a mesh of both fluid and solid domains is generated [4]. Afterwards, it simulates the fluid flow with transient Navier Stokes to obtain the velocity field using a Finite Element software [5]. Once the velocity is calculated, it allows the determination of the shear stress field over the surface. Then, a threshold shear stress value is defined to remove the elements that exceeds this limit value. The removed elements are assigned to the fluid domain by means of the advanced management tools of FreeFem++ [6], in 3D. The threshold value decreases at the time that the scaffold is being degraded. This tool allows the prediction of the durability and suitability of the scaffold before the experimental degradation test, previous to in vitro or in vivo test.

Keywords: Fluid Mechanics, Tissue engineering, Degradation, Direct Numerical simulation, Mechanical properties.

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