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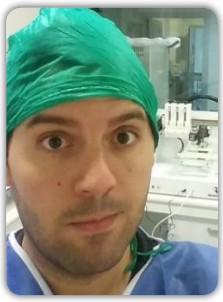

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Manufacturing of functional tissues *in vitro* using bioprinting and bioreactors: Application in knee cartilage regeneration

Introduction: A lot of efforts have been directed to the creation of functional knee cartilage tissue in the lab. The lack of tissue regeneration in human beings and the deficiency of allogenic transplants in addition to the increasing of life expectancy make this problem to be considered as one of the most important ones of humanity in the current era.

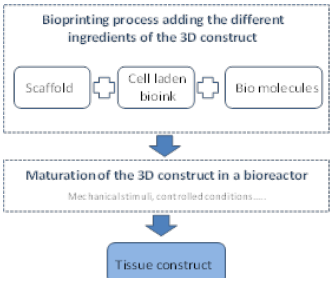
Joint cartilage is a connective tissue that lacks vascularization and innervation and is composed of a specific extracellular matrix. The healing process of cartilage tissue is slow and results in a fibrous scar-like tissue that lacks the functional properties of the hyaline cartilage leading to further tissue degeneration.

However, the results obtained are still far away from the desired. For the creation of a living tissue it is crucial the bioprinting process but also the maturation of the construct. Replicating the human being adult conditions *in vivo* in the lab or the stimuli that occur in embryogenesis could improve the results of tissue engineering towards the clinical application of the technology.

Materials and methods: Here, we propose a unique approach to create functional knee cartilage tissue starting from bio printed constructs (fabricated using bioprinting) and a device that mimic the physiology and apply the right mechanical conditions of the structure to be replaced and through the maturation procedure, applying the right stimuli, creates a functional tissue. We think that the best stress distribution is the real one and other approaches fail as do not mimic the real conditions happening in nature.

Results and discussion: In the present work, we show a method that helps to create functional knee cartilage tissue after bioprinting. For the creation of a living tissue it is crucial the bioprinting process and the ingredients selected to achieve the objective to create a functional specific tissue (first block of the image). But also, the maturation procedure applied to the 3D cell laden constructs, that is even more important (second block of the image). If we think about bioprinting as a technology to recreate all the structure in the same form as shown in a living knee cartilage tissue, we are going to fail. We have to think on bioprinting as a way of creating cell laden 3D constructs as a precursor of a functional tissue. The maturation and tissue formation process will be as important or even more than the bioprinting one. Considering the strategies of both blocks in the diagram will be crucial to obtain the desired functional knee cartilage tissue.

Conclusion: The stress distribution is crucial as stimuli to create the right tissue. Also, the scaffold architecture as it will affect the stimuli distribution and other important parameters as the biodegradation time. The selection of the right ingredients and the bioprinting procedure is very important in the success of the creation of functional knee cartilage tissue, as well as the maturation procedure applied to the 3D cell laden constructs is even more important. This approach opens a wide research area for tissue engineers to develop protocols with different stimuli to create functional knee cartilage tissue after bioprinting.



Speaker Biography

Jose Manuel Baena completed his PhD in Biomedicine from the University of Granada, Spain, MSc Engineering from Polytechnic University of Valencia, Spain and TU Braunschweig, Germany and MSc from Oxford Brookes University, UK. He serves as scientific coordinator of the tissue engineering and 3D printing platform (PITI3D), IDIPAZ, Hospital Universitario de La Paz, Madrid, Spain and he is research associate in the group "Advanced therapies: Differentiation, regeneration and cancer" IBIMER, CIBM, University of Granada, Spain. He has published several research papers and 1 book. He has presented his work in dozens of congresses around the globe. As a biotech entrepreneur, he founded BRECA Health Care, pioneer in 3D printed custom-made implants for orthopaedic surgery and REGEMAT 3D, a leader in the bioprinting industry. He is an expert in innovation, business development and internationalization, lecturer in some business schools and also, he is passionate about biomedicine and technology.

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