Decellularized Matrices (DCMs) for Material Sciences and Tissue Engineering

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Our university in Erlangen-Nuremberg together with other German universities has recently been awarded a grant from the German Science Foundation on the bio-fabrication, i.e. the use of 3D printing techniques to simultaneously process living cells and biomaterials (hydrogels) to mimic complex tissue and organ-like 3D structures. The goal of this long-term research funding is to investigate how decellularized biological tissue, such as the microarchitecture and protein content of the matrix, are conserved. Research will focus on particular organs (e.g. bone, heart, etc.) to apply the knowledge gained to matrices that ideally preserves the structure and composition of the native extracellular matrix (ECM). Following biochemical, histological, mechanical and structural analyses to identify the best procedure to ensure complete cell removal, while preserving most of the native ECM structure and composition, the researchers plan to develop a bioactive product. In all research efforts, biocompatibility, biodegradability and bioinductivity of DCMs are important factors, which need to be considered in surgical practice (implantation) and research (tissue engineering and material sciences).

After establishing the use of the appropriate matrices, the 3D fabrication process will be started and different techniques such as prototype printing or conventional mold or stereo-lithographic methods will be employed. A mixture of hydrogel and specific cells will be used to coat the scaffold made from synthetic biomaterials, which are now commonly used in the field of bioengineering and regenerative medicine. In some specific cases, stem cells will be tested as these have the tendency to differentiate into cell types suitable for DCMs. Thus, all forms of DCMs will be used and studied to reveal their potential role in regenerating functional tissue.

The utilization and naturalisation of delivered factors and natural growth of cells without any host immune response are the main concern for successful tissue engineering. Researchers are confident that an ideal 3D DCM scaffold can be generated for functional tissue regeneration and restoration of a functional organ after grafting in the near future. For further reading on this topic, see references [1-8].

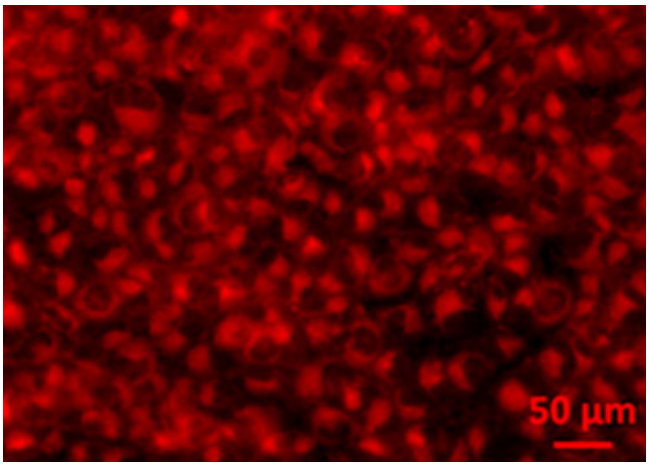

Figure 1: *Cu-releasing bioactive glass/polycaprolactone coatings on human osteosarcoma cells (MG-63; Sigma-Aldrich) used for in vitro cell biocompatibility assessments and bone tissue engineering. Vybrant®Dil stained cells are shown here after 72 h of cultivation. Note, bioactive glass nanoparticles containing copper (Cu-BGNs) were introduced into polycaprolactone coating systems to improve the bioactivity, antibacterial properties, and corrosion resistance of vulnerable magnesium matrices under physiological conditions [9]. The image was taken with the permission of IOP Publishing.*

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Although many disease models have been described, cancer cell invasion, progression, and their survival and establishing metastases in a microenvironment is currently not well understood and remains one of the most challenging topics in cancer treatment. Therefore, to closely mimic the tumour microenvironment, studies are geared to developing a 3D bioengineered in vitro bone model for the study of bone metastasis [9]. The editor, in a timely way, had introduced this topic in the last issue of Oncology News [10].