TISSUE BIOENGINEERING - APPLICATION OF NATURAL BioPOLYMERic MATERIALS

The classical approach of tissue bioengineering, (TE), is the combination of cellular elements with a biodegradable scaffold, that mimics the selected tissue's natural extracellular matrix. The designs being developed are intended to fill a tissue defect of a critical size. At the same time, the requirements for such a structure and materials are complete biocompatibility and biodegradability. To create scaffold structures, or TE-products, many different materials are used, from ceramics and metals to hydrogels, based on the biomechanical characteristics of tissues and its extracellular matrix structure. Polymeric materials have the widest range of performance characteristics, due to the great possibilities for controlling their structure.

Our professional competence is the development of artificial analogues of the extracellular matrix for various tissues, reconstructive regeneration and the creation of tissue-engineered analogues, as well as the modification and functionalization of medical materials and products with biodegradable compounds. We work with biopolymer materials, polyhydroxyalkanoates, PHA [1], and bacterial cellulose, BC [2], obtained by microbiological biosynthesis. The most studied directions for now are the replacement of defects in bones and skin, however, the field of application of these biopolymers is much wider. We develop tailor-made materials and designs for hard and soft tissues restoration, as well as various microparticle systems. It was found, that the chemical composition of the polymer affects the nano-structure of its surface, which is involved in the formation of biointerface. Biological events at the implant-organism interface during TE-construct implantation are realized through a system of mechanochemical signaling processes [3], while there is a possibility of directed functionalization of scaffold-surfaces to optimize cellular responses in the cells of the constructions and the recipient.

References

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[3] The effect of the chemical composition and structure of polymer films made from resorbable polyhydroxyalkanoates on blood cell response. E.Shishatskaya, N.Menzyanova, A.Shumilova. Int. J. of Biological Macromolecules. 2019. https://doi.org/10.1016/j.ijbiomac.2019.09.015.