Materials for tissue engineering

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According to the most known definition by Langer and Vacanti tissue engineering is defined as "...an interdisciplinary field that applies the principles of engineering and the life sciences toward the development of biological substitutes that restore, maintain, or improve tissue function...". The most classical tissue engineering product consists of two critical components, i.e. biomaterial– usually in the form of the scaffold – which is the filler of the void in tissue and a support for the transplanted cells, and the cells which are to initiate tissue (re)generation after donation in vivo. In this combination, the role of the biomaterial is extremely demanding. Since it serves as a support for cell transplantation, it must offer superior cytocompatibility in vitro. At the same time, it is expected to play the role of a tissue filler in vivo – with a high surgical handling, appropriate mechanical competence and, preferably, well controlled resorbability so that it could be finally replaced with the regenerated host tissue. Such requirements open space for both biomaterials which are already in clinical use and new materials designed specifically for tissue engineering applications. The number of scientific articles which could be found in the PubMed database under the query: "scaffold and tissue engineering" has increased from two in 1993 to much over a thousand in 2012. Materials from all groups, i.e. metals, ceramics and polymers – both man-made and of natural origin are represented in tissue engineering. Due to the complex requirements, research and engineering in this area is fascinating, especially those involving the interaction of the material with cells.

This presentation will briefly discuss the materials used in tissue engineering. Particular emphasis will be placed on interaction between materials and cells – based on available knowledge and especially the results obtained in our laboratory. The following aspects will be underlined and illustrated with specific examples: impact of materials characteristics (including chemistry, mechanical properties, surface topography) on cell fate, difficulties in biocompatibility studies, extracellular matrix produced in vitro as a material in tissue engineering. The examples are intended to illustrate the unique role of material as a player in new systems designed for regenerative medicine. The perspective for the further interdisciplinary research will be proposed.