Bone is constantly undergoing microfracturing and repair in response to everyday loading. The development of innovative strategies for the treatment of bone defects caused by trauma, tumor, degenerative disease, congenital skeletal defects, periprosthetic fracture around prosthetic joint or bone defects resulting from loosening of prostheses, so it is now a prerequisite to help patients suffering from diseases of the skeletal system [1]. When bones cannot heal themselves in cases of severe injury or disease, bone grafts are usually necessary. The most commonly used in orthopedic therapy are autologous bone grafts. However, there are a number of limitations of this method, for example: poor access to autologous material, death of the donor site related to pain, infections or subsequent fractures [2]. Alternative technique is implantation of allogenic tissue, usually isolated from the femoral head of patients that are undergoing hip replacement procedure. Unfortunately, in this case, the treatment could result in failure to approx. 30% [2], due to the rejection of the transplanted material or the transfer of contagious disease [3]. Due to so many limitations of bone grafts, there are searched and developed effective and safe alternative methods. Especially promising seems to be the usage of tissue engineering methods, that primary objective is to develop a suitable scaffolds: a biocompatible construct with specially design architecture and appropriate mechanical properties, which carries bioregulating factors (growth factors) and/or appropriate repair cells - in this case the osteogenic cells [3].

The main objective of the project is to develop bioactive substrates with growth factors (bone morphogenetic proteins, BMPs) attached to their surfaces (**Fig. 1A**). The substrates will be mainly made out of biopolymers (polysaccharides) and synthetic polycation. A key step in the research will be the stabilization of multilayer polymeric films with BMPs (**Fig. 1B**). This will be achieved by photochemical crosslinking, which means the formation of stable covalent bonds between polycations, polyanions and proteins. Sequentially physicochemical properties of multilayers will be investigated with and without immobilized proteins such as rigidity, wettability, topography, surface charge density and the type exposed to the surface functional groups. These parameters are crucial in relation to the further interactions of these polymeric films with human mesenchymal stem cells isolated from umbilical cord (hUC-MSC) cultured on their surface (**Fig. 1C**). Biological studies will include determination of the efficiency of growth and differentiation of hUC-MSC on growth factors functionalized substrates. The proliferation, vitality, adhesion and migration of cells will be determined. Additionally, to explore the potential of substrates to inducing hUC-MSC differentiation towards bone and cartilage cells the special tests on a molecular level will be carried out.

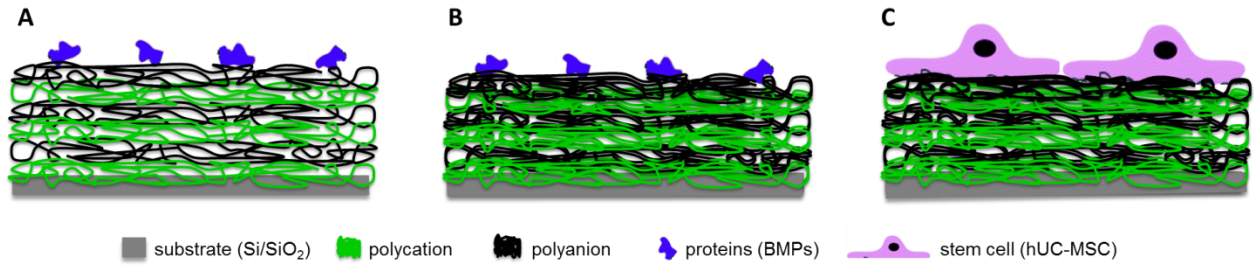

Fig. 1. Scheme of the main experimental stages in the project. **A** – Preparation of polymeric multilayers and proteins adhesion onto their surface; **B** – photochemical crosslinking of obtained systems; **C** – study of biological activity and differentiation of hUC-MSC towards the bone cells.

The results obtained in this project will enable the development of functionalized substrates with immobilized BMPs. The use of covalent binding of various type of BMPs to surface makes the proposed investigation novel. The surfaces of these substrates enable quick proliferation and much more effective differentiation of hUC-MSC into bone cells at the *in vitro* conditions, for subsequent transplantation of such tissues. The proposed systems can be used as coatings of scaffolds and implants for treatment of bone defects. Conducting of proposed studies is justified both in terms of basic research of such systems, and also in the context of their perspective applicability for biomedical applications, with a particular focus on the development of regenerative medicine.

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