

**Title: Biomaterials and adipose-derived stem cells for osteo-chondral regeneration *in vitro* and *in vivo***

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Bone and cartilage repair represent an important challenge in the field of regenerative medicine, either for bone healing or for treating joint lesions and diseases. Traumatic injury or surgical excision of diseased bone tissue usually require the reconstruction of large bone defects unable to heal spontaneously, especially in older individuals. Similarly, current therapies for osteoarthritis are unable to promote a complete restoration. The most recent tissue engineering approaches use 3D scaffolds to stimulate tissue repair and functional regeneration providing specific micro-environmental conditions.

We propose a new model for osteo-chondral regeneration based on adipose tissue-derived mesenchymal stem cells (ADSCs) and biomimetic scaffolds. These cells are considered the better candidate for autologous cell transplantation, due to their plasticity, safety and ease of withdrawal and propagation. Our data show that ADSCs can promote both osteo- and chondro-genesis either *in vitro* or *in vivo*. Moreover, the data demonstrate that the use of cell-free collagen-hydroxyapatite scaffolds could promote tissue repair by recruiting host cells, but the use of ADSCs along with this biomaterial can strongly increase this repairing process. Although further preclinical and clinical studies are necessary, we believe that a combined approach, using specific cells and/or 3D scaffolds, could help in the treatment of either small or large bone/cartilage defects. The proposed model could be suitable for the production of medical devices for osteo-chondral engineering, thus improving the efficacy of the current therapeutic options.