

maGO-CaP: a novel graphene-based nanotool for bone regeneration

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Abstract

One of the innovative advantages of graphene in biomedical application is its promising use for bone regeneration therapy [1]. However, it is well known how also the immune system play an important role guiding the differentiation of human mesenchymal stem cells (hMSCs) in osteoblasts [2]. Here, we combined the intrinsic characteristics of a particular Graphene Oxide able to induce specific stimuli on monocytes (maGO) [3] with the well-recognized osteoinductivity capacity of calcium phosphates (CaP) in a novel unique biocompatible nanomaterial called maGO-CaP (Monocytes Activator Graphene Oxide conjugated with Calcium Phosphates). maGO-CaP was found able to activate monocytes *in vitro* enhancing the hMSCs differentiation into osteoblasts, without any evidence of toxicity. maGO-CaP shown bone-anabolic effects *in vivo* stimulating the bone formation without any adverse inflammatory reactions [Figure 1]. From a public health perspective, maGO-CaP could become a promising therapeutic material able to support and accelerate the bone regeneration therapy.

References

- [1] Dubey N, Bentini R, Islam I, Cao T, Castro Neto AH, Rosa V. Stem Cells Int. (2015) Graphene: A Versatile Carbon-Based Material for Bone Tissue Engineering. 804213.
- [2] Nicolaidou V, Wong MM, Redpath AN, Ersek A, Baban DF, Williams LM, Cope AP, Horwood NJ. PLoS One. (2012), Monocytes Induce Stat3 Activation In Human Mesenchymal Stem Cells To Promote Osteoblast Formation. 7(7):e39871.
- [3] Orecchioni M, Jasim DA, Pescatori M, Manetti R, Fozza C, Sgarrella F, Bedognetti D, Bianco A, Kostarelou K, Delogu LG. Adv Healthc Mater. (2016) Molecular and Genomic Impact of Large and Small Lateral Dimension Graphene Oxide Sheets on Human Immune Cells from Healthy Donors. 21;5(2):276-87.

Figures

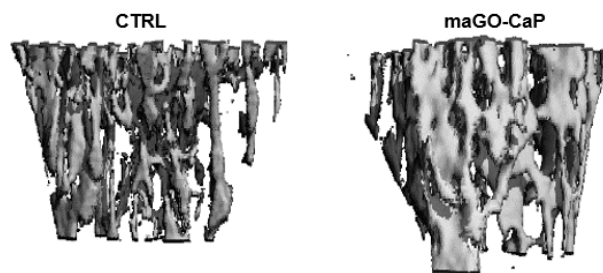


Figure 1: Microcomputed tomography image of untreated tibia (CTRL) and after one month of maGO-CaP treatment