SEMINAR SERIES

February 20th, 2020 1pm – 2pm

Shriners Hospitals for Children - Room 2.30

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New insight in the physico-chemical and osteoinductive properties of undoped and doped b-tricalcium phosphate

β-tricalcium phosphate (β-Ca3(PO4)2; β-TCP) is one of the most used material for bone regeneration. Accordingly, it is highly studied, either in its pure form, or as doped material. Doping agents include more or less all atoms of the periodic table of elements, with a particular focus on Cu, K, Li, Mg, Mn, Na, Si, Sr, and Zn. Generally, all doping agents are reported to improve the biological properties of β-TCP, but the exact mechanism is unclear. Is it due to the effect of the doping agent on cells or due to the effect of the doping agent on β-TCP material properties, which itself influence cells through a change of calcium and phosphate release?

β-TCP is considered to be osteoconductive (conduce bone formation in contact with bone), but unfortunately not osteoinductive (induce bone formation away from bone, e.g. in soft tissues). However, a number of studies show that β-TCP, undoped or doped, is sometimes osteoinductive, which is the "Holy Grail" in bone regeneration. The mechanism by which a material (polymer, metal, ceramic) triggers an osteogenic response has remained elusive for 50 years.

My group has tried in the past 4 years to understand by which mechanism doping agents affect β-TCP biological properties and by which mechanism materials in general, and β-TCP in particular, trigger an osteogenic response. The aim of my presentation is to highlight some of our findings such as: (i) β-TCP crystalline parameters vary with tiny changes of the Ca/P molar ratio which affect β-TCP osteoclastic resorption; (ii) grain boundaries of doped β-TCP have a different composition than the bulk; (iii) the resorption pattern of β-TCP is affected by doping agents [1]; (iv) material-induced osteoinduction is most likely due to a transient decrease of calcium and/or phosphate concentration [2]; (v) the chemical composition occurring within a scaffold may be very different from the conditions occurring outside the scaffold [3].

[1] M. Gallo et al. "Resorption of calcium phosphate materials: a crystallography-driven process?", Acta Biomaterialia 2019;89:391-402; [2] M. Bohner, R. Miron. "A proposed-mechanism for material-induced heterotopic ossification", Mater Today 2019;22:132-141; [3] Y. Maazouz et al. "In vitro measurement of the chemical changes occurring within β-tricalcium phosphate bone graft substitutes". Acta Biomaterialia, 2020;102:440-457.

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