**Introduction**

Calcium phosphates (CaP) are used as biodegradable bone grafts. Their in-vivo degradation mechanism depends on their composition and structure.

1. Gypsum (CS) and biphasic α-TCP+CSD are soluble in extracellular fluid (ECF) and sustain spontaneous dissolution.
2. Hydroxyapatite, calcium deficient hydroxyapatite (CDHA), α- and β-TCP are insoluble in ECF, but undergo cell-mediated degradation: osteoclasts secrete HCl to locally decrease the pH to 3-5.
3. Grain boundaries are more disordered than bulk

⇒ Hypothesis n°1: insoluble CaP can incur preferential grain boundary dissolution, loose particles are phagocytized by macrophages and giant multinucleated cells.

⇒ Hypothesis n°2: impurities segregate to grain boundaries and modify their solubility.

**Aim**

Developing a method to evaluate the effect of impunity on the in-vivo dissolution behavior of β-TCP with the final aim to be able to control the in-vivo degradation of CaP by addition of diverse elements (Mg, Sr, Na, ...).

**Materials and methods**

Samples production: Uniaxial pressing and sintering of commercial amorphous tricalcium phosphate powder (with and without Mg$_2$(PO$_4$)$_2$ addition) to produce dense (95%) β-TCP (Ca$_3$(PO$_4$)$_2$) and Mg-β-TCP (Mg$_2$(Ca$_3$(PO$_4$)$_2$)) samples.

Dissolution tests:

- In simulated body fluid (SBF): mimic extracellular fluid = spontaneous dissolution
- In citric acid buffer solution, pH 3: mimic osteoclastic activity.

1. Incubation in SBF/ citric acid for diverse periods of time
2. Sample is weighed before and after incubation
3. ICP-MS analysis of 20 mL unfiltered
4. ICP-MS analysis of 20 mL filtered
5. Weighing of filter before and after filtration

⇒ Overall dissolution

**Results**

There was no apparent dissolution, neither in (Mg,Ca)$_2$(PO$_4$)$_2$ nor in Ca$_3$(PO$_4$)$_2$. The precipitates (red arrow) seems to originate from heterogeneous precipitation.

**Citric acid buffer**

There was an apparent preferential dissolution at grain boundaries in both MgCa$_3$(PO$_4$)$_2$ and Ca$_3$(PO$_4$)$_2$ samples.

**Discussion**

Dissolution and precipitation did not lead to a significant change of weight of any of the samples (1). Samples did not have any influence on precipitation compared to SBF free of sample (2). The increase in Mg/Ca ratio of the solutions containing samples compared to sample-free SBF is an indication of dissolution (3). As expected, the increase of Mg/Ca was bigger in the case of (Mg,Ca)$_2$(PO$_4$)$_2$ than in Ca$_3$(PO$_4$)$_2$.

**Conclusion**

A method to observe the effect of grain boundaries composition on the dissolution behavior of a CaP was developed. Due the thinness of grain boundaries, there is a need for another way to observe segregation of impurities. Mg was observed to decrease the solubility of CaP in acid conditions, and no dissolution or bioactivity (beneficial effect of CaP on HA precipitation) could be observed during incubation in SBF. The next step would be to add elements likely to decrease stability of grain boundaries (Sr, Na), to observe spontaneous dissolution of CaP grain boundaries in SBF.