Human macrophages and osteoclasts resorb β-tricalcium phosphate in vitro but not mouse macrophages

Titre	Human macrophages and osteoclasts resorb β-tricalcium phosphate in vitro but not mouse macrophages
Type de publication	Article de revue
Auteur	Arbez, Baptiste [1], Manero, Florence [2], Mabilleau, Guillaume [3], Marchand-Libouban, Hélène [4], Chappard, Daniel [5]
Editeur	Elsevier
Type	Article scientifique dans une revue à comité de lecture
Année	2019
Langue	Anglais
Date	Octobre 2019
Pagination	102730
Volume	125
Titre de la revue	Micron
ISSN	1878-4291
Mots-clés	Beta tricalcium phosphate [6], biomaterial [7], Carbonic anhydrase [8], macrophage [9], osteoclast [10], Raman [11]
Résumé en anglais	β-TCP is a resorbable bony biomaterial but its biodegradation mechanisms in vivo remains unclear. Osteoclast can resorb β-TCP but a role for macrophages has also been suggested by in vivo studies. However no in vitro study has clearly evidenced the action of macrophages in the resorption process. We prepared flat β-TCP tablets with a smooth surface to investigate the in vitro capability of murine (RAW 264.7) and human macrophage cells (PBMCs) to resorb the biomaterial. In parallel, these cells were differentiated into multinucleated osteoclasts with M-CSF and RANK-L. The action of these cells was evaluated by scanning electron microscopy and Raman microspectroscopy after a 21 day culture on the tablets. Human macrophages and osteoclasts derived from PBMCs appeared able to resorb β-TCP by forming resorption pits at the surface of the flat tablets. RAW macrophages were unable to resorb β-TCP but they exhibited this possibility when they have been differentiated into osteoclasts. These cells can engulf β-TCP grains in their cytoplasm as evidenced by light and TEM microscopy with production of carbonic anhydrase (revealed by the immunogold technique in TEM). The resorbed areas were characterized by severe degradation of the grains showing speckled and stick-like aspects indicating a chemical corrosion. The effect was maximal at the grain boundaries which have a slightly different chemical composition. Changes in the Raman spectrum were observed between the resorbed and un-resorbed β-TCP suggesting crystal modifications. In contrast, un-differentiated murine macrophages were not able to chemically attack β-TCP and no resorption pit was observed. RAW cell is not a representative model of the macrophage-biomaterial interactions that occur in human. This in vitro study evidences that both human osteoclasts and macrophages represent active cell populations capable to resorb β-TCP.

URL de la notice	http://okina.univ-angers.fr/publications/ua20302 [12]
DOI	10.1016/j.micron.2019.102730 [13]
Lien vers le document	https://www.sciencedirect.com/science/article/pii/S0968432819300976?via%... [14]
Autre titre	Micron
Identifiant (ID) PubMed	31415983 [15]

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