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Development of Biomimetic Scaffolds for Controlled Release of Bioactive Agent

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Osteogenic factors are a must have feature of bone regeneration scaffolds. Here we present a biomimetic delivery scaffold that is directly translatable to clinical applications, integrating multiple intricate factors in an orthopaedic implant that is easy to fabricate and adopt in the surgical setting. The straightforward preparation of a microporous bio-active scaffold designed for sustained bio-agent release is presented. Chitosan, combined with osteoconductive bio-ceramics form the basis of the scaffold architecture. The sustained release of growth factors (GF) for bone repair after trauma or non- union fractures is demonstrated. An in situ crosslinking step provides a unique route to overcome the low GF stability and short half-life challenges under physiological conditions. High initial burst release is prevented with effective prolonged delivery demonstrated. The scaffold crosslinking reaction, mechanical properties and degradation profile characterization will be described. The bioactive bone regeneration implant presents a substantial list of essential criteria including biocompatibility, biodegradability, micro/nano-architectural physical cues and holds a great promise for therapeutic bone tissue repair.

Recent Publications:

1. Declan M. Devine, Eilish Hoctor, Jessica S. Hayes, Eoin Sheehan, Christopher H. Evans, "Extended release of proteins following encapsulation in hydroxyapatite/chitosan composite scaffolds for bone tissue engineering applications", Materials Science & Engineering C, 1, 84, 281-28 (2018)
2. C.J.D. Bergmann, J.C.E. Odekerken, T.J.M. Welting, F. Jungwirth, D. Devine, L. Bouré, S. Zeiter,
3. L.W. Van Rhijn, R. Telle, H. Fischer, P.J. Emans. Calcium phosphate based three-dimensional cold plotted bone scaffolds for critical size bone defects. BioMed Res Intern. 201, (2014)
4. J.A., Killion, S., Kehoe, L.M., Geever, D.M., Devine, E., Sheehan, D., Boyd, C.L., Higginbotham. Hydrogel/bioactive glass composites for bone regeneration applications: synthesis and characterisation. Mat. Sci & Eng. C, 33(7), 2013, 4203-12.
5. M Canillas, GG de Lima, MA Rodríguez, MJD Nugent, DM Devine, 2016. Bioactive composites fabricated by freezing-thawing method for bone regeneration applications. J Polym Sci Part B: Polym Phys. 54(7):761-773.

Biography

The research team has extensive experience and participates in a number of international collaborator research activities in the bone tissue regeneration field. In particular the team is focused on the development of variety of biomaterials which may be used to treat different ailments related to bone including, biomimetic bone graft substitutes and biodegradable polymers with tailored properties and degradation profiles.

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