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Bone regeneration, Bone Morphogenetic Protein-2 and Heparan Sulfate-3

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Host: Dr Deepak Choudhury

Seminar Abstract

Critical-size bone defects are difficult to treat, require either autologous bone grafts (ABG) or biological agents to stimulate significant amount of bone regeneration. Bone morphogenetic protein-2 (BMP2) is a revolutionary therapy, replacing the ABG, capable of achieving a high level of bone formation in complex cases. However, increasing evidence of "frequent and occasionally catastrophic complications with the use of BMP2" raises the need for safer yet effective bone graft substitutes. Heparan sulfates (HS) are extracellular matrix glycosaminoglycans that naturally bind to soluble growth factors and regulate their activities involving cell growth and differentiation. We previously isolated a BMP2-binding-HS fraction (HS3) from a commercial crude HS mixture. When crosslinked to a collagen scaffold, HS3 was able to retain up to 60% of the loaded BMP2 over 27 days *in vitro*, 3-times higher than scaffolds without HS3. Moreover, when implanted *in vivo* in several bone defect models, the HS3-incorporated scaffolds, even without BMP2, were able to induce a significantly better bone regeneration than the controls, presumably due to the availability of endogenous BMP2 at the defect site. This highlights the potential of HS3-funtionalized scaffolds as a safe and effect bone graft substitutes for the treatment of orthopaedic-related injuries.

About the Speaker

Bach obtained his BSc (Hons) Biomedical Sciences (2010) from the University of Sunderland, UK, and PhD in Biomedical Engineering (2018) from the University of Maastricht, The Netherlands. During his PhD, he tackled bone regeneration from multiple approaches: high-throughput-screening to stimulate collagen production, culturing hypertrophic cartilage in vitro to mimic endochondral ossification, modifying material topography to enhance osteogenic response, and generating a reporter cell line using CRISPR to study the growth factor BMP2. He joined the Glycotherapeutic group, IMB (2015) and focused on developing heparan sulfate-incorporated medical devices for orthopaedic procedures such as cranioplasty and spinal fusion. Bach recently joined the Biomanufacturing Technology group in BTI and is working on the AMBM program, developing collagen fabrication and crosslinking process for the manufacturing of skin wound dermal template. He was recently awarded with a CDF grant for the project "A bioengineered orthopaedic membrane for enhanced fracture healing", which aims to manufacture large tissue membranes *in vitro* using stem cells and utilize them to stabilize and enhance bone fracture healing *in vivo*.

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