



Growing valves inside the heart

Speaker: Carlijn Bouten, Professor of Cell-Matrix Interaction in Cardiovascular Regeneration, Department of Biomedical Engineering
Eindhoven University of Technology

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Where: B2.73, Trinity Biomedical Sciences Institute

We investigate and design *in situ* heart valve tissue engineering technologies using cell-free biodegradable synthetic scaffolds as an approach to create living valves inside the human heart. While this would constitute a simple procedure, starting from the implantation of a biomaterial ‘device’, it requires the development of advanced materials and a detailed understanding of the interactions between endogenous cells, scaffold, and tissue formation under hemodynamic conditions.

This lecture addresses the challenges to develop instructive biodegradable scaffolds that i) function upon implantation and with time of tissue formation and scaffold degradation, ii) are capable of harnessing the natural host response, and iii) provide the necessary cues for a stable and organized load-bearing extracellular matrix *in vivo*. We will show how biomimetic *in vitro* models and computational analyses were used in direct comparison with *in vivo* small-animal experiments (orthotopic aorta implantations) to optimize scaffold biochemical, biophysical, and degradation properties. The resulting scaffold demonstrated sustained mechanical and biological functionality during long-term orthotopic (12 month FU) and transcatheter (6 month FU) implantations as pulmonary valve in sheep. These results offer new perspectives for endogenous heart valve replacement starting from readily-available synthetic grafts.

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Carlijn Bouten is full professor of Cell-Matrix Interaction in Cardiovascular Regeneration at the Department of Biomedical Engineering of the Eindhoven University of Technology (TU/e). Her research concentrates on new engineering approaches to regenerate the tissues of the cardiovascular system. A particular example is the development of a synthetic, bio-degradable heart valve prosthesis that ‘seduces’ the body to create a new, living heart valve at the site of implantation. The research is performed in close collaboration with material scientists, life scientists and clinicians, and mainly executed within public-private partnerships. Prof Bouten is recipient of the prestigious Aspasia (2002) and VICI (2003) career development awards of the Dutch National Science Foundation and theme-leader ‘Regenerative Medicine’ of the strategic area Health at TU/e. From 2007-2009 she was visiting professor at the dept. of Cardiothoracic Surgery, UMC Utrecht; and in 2013 she was visiting professor at Harvard Medical School to further the translational aspects of her research. Since 2017 she spearheads the national gravitation program Materials-Driven Regeneration.

Prof. Bouten serves on the board of directors of the international Heart Valve Society, the International Society of Applied Cardiovascular Biology, and the Scientific Advisory Board of the Dutch Heart Foundation. She was member of the Young Academy of the Royal Netherlands Academy of Arts and Sciences (KNAW, 2005-2010) and is elected member of AcademiaNet for Outstanding Female Scientists and Scholars in Europe as well as elected member of the KNAW.