Stevens Institute of Technology

Nanotechnology Graduate Program

Cell adhesion to biomaterials are governed by molecular interactions at the nano-scale

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Theo G. van Kooten, PhD.

Department of Biomedical Eng., University Medical Center Groningen (Netherlands)

Research in BioMedical Engineering, within the academic, clinical setting of the University Medical Center Groningen, is performed within three sections: Bioadhesion, Biomaterials & Biocompatibility, and Artificial Organs. Within Biomaterials & Biocompatibility, mechanisms governing the interaction of cells with biomaterial surfaces are studied, as well as tissue response upon implantation in animal models. Special attention is directed to the use of biodegradable materials used in regenerative medicine. An important aspect of degradation is the issue of the fate of the degradation products and particles. Degradation kinetics and mechanisms are studied in both *in vitro* and *in vivo* models. Macrophages are the prime cellular candidates to remove particulate debris from the tissues, thus *in vitro* models involving stimulation/activation of macrophages by degradation products may give insight in processes occurring in the body. These models may also predict the behavior of newly designed, degradable polymers *in vivo*. Fundamental interactions between cells and materials are studied at the level of adhesion and cell cycle with cell biological methods, in relation to the physico-chemical properties of the biomaterial surface. These properties are determined in terms of chemical composition, wettability and roughness and can be modified using different coating methods such as wet chemistry (e.g. covalently-coupled silanes) or glow discharge treatments. Roughness is an interesting parameter as it relates to the topographical makeup of a surface. Here we are seeing a paradigm shift from micrometer size to nanometer size when it comes to surface design. In performing this shift we are moving towards more biomimetic surfaces mimicking the macromolecular interactions that take place when a cell meets and modifies its environment. Finally, the issue of biocompatibility of biomaterials will be addressed. This relates to the absence of adverse cellular reactions and modulation of cell adhesion and subsequent responses. Most currently developed materials need to evoke cell adhesion and spreading, while potentially displaying differential cell function. Study of the cell biological basis of differential behavior will provide detailed insight governing cell–material interactions.

Dr. Theo G. van Kooten is currently heading the section Biomaterials and Biocompatibility of the Department of Biomedical Engineering within the University Medical Center Groningen (UMCG) in The Netherlands. Besides research, Theo van Kooten is involved in several educational programs at the bachelor and masters level concerning Biomedical Technology and Tissue Engineering. Research has always been concentrated on the interface between cells and biomaterials. Being trained as a medical biologist, it will not be a surprise that this interface is mainly approached from the cell biological side. Theo van Kooten did his PhD at the University of Groningen. Subsequently he was assistant professor at Clemson University, working with Dr. Andreas von Recum, prior to joining the Institute of Pathology within the Johannes Gutenberg University Clinic in Mainz (Germany), at that time already led by James Kirkpatrick. In 1999 Theo joined the Biomedical Engineering department in Groningen.

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