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Dynamic remodeling of extracellular matrix instructs regenerative cell behavior

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The ability to functionally repair tissues damaged by disease or injury remains a significant challenge for regenerative medicine. While tissue repair is limited in higher vertebrates, particular in humans, regeneration of complex tissues occurs widely throughout the animal kingdom. Employing multiple regeneration-competent species in a comparative and complementing manner is currently providing a blueprint for regeneration at the cellular and molecular levels. Using new t and zebrafish model organisms, we are investigating the underlying principles that control the differentiated state of the cell and regulate regenerative processes. Performing multi-tissue microarray analyses, we have recently discovered concerted gene activities in different tissue types indicative of a molecular signature of regeneration. We have demonstrated a key role for the extracellular matrix (ECM) at the wound site, revealing that the transition from a stiff structural ECM environment to a softer, regulatory matrix and then back to the default stiff matrix of differentiated tissues is a critical driving force for regeneration. Employing novel 3D-imaging techniques to regenerating skeletal and cardiac muscle and explanting muscle cells into defined environments, we generated experimental evidence for distinct ECM components providing biochemical and mechanical signals that cooperatively regulate muscle regeneration. Using a cross-disciplinary approach incorporating developmental biology, cell signaling, and material sciences, we are now leveraging the gained knowledge towards engineering artificial matrices as a mimetic of the natural regeneration-specific ECM. We will discuss our progress towards deciphering the matrix code to unlock dormant regenerative abilities in mammals and develop new strategic opportunities in regenerative medicine.

Biography

Hans-Georg Simon has completed his PhD at the University of Freiburg, Germany and after Post-doctoral training at Harvard Medical School, USA, he has research experiences in “academic and industrial settings”. Being a Developmental Biologist for over two decades, he is investigating the reactivation of developmental programs as a mechanism to restore damaged or missing tissues and/or organs. He has won Marcus Singer Award for excellence in Regeneration Research.

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