University of Basel
Department of Biomedical Engineering

Selected research topics in Biomedical Engineering:
The Future of Personalized Medicine: 3D Printing and Patient-Specific Technologies
Location: Biozentrum, Spitalstrasse 41, Basel, Seminar Room U1.191
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Taming Biofabrication Technologies for Regenearative Medicine and 3D in vitro models

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Abstract

Organs are complex systems, comprised of different tissues, proteins, and cells, which communicate to orchestrate a myriad of functions in our bodies. In the pursuit of developing functional strategies for organ regeneration, the fundamental question whether form follows function or function follows form has been a mainstay in the field of regenerative medicine. Whether from a developmental biology perspective it is hypotesized that function follows form through morphogenetic processes dictated by cell-cell and cell-ECM communication and self-organization, from a bioengineering perspective the principle of form follows function has been a mainstay in designing 3D porous biological constructs for functional tissue regeneration. In this context, biofabrication technologies can play a key role in further dissecting whether form follows function or function follows form, as they allow to impart spatiotemporal control over cell-cell and cell-ECM communication, often through control over cell and material deposition and placement.

Here, we introduce several examples of instructive scaffolds and bioprinted constructs aimed at steering funcional tissue regeneration. To achieve these targets, the spatiotemporal control over biological signals at the interface between cells and materials is often aimed for. Alternatively, biological activity can be triggered through the control of mechanical cues, harnessing more fundamental know-how in mechanobiology that could be combined with biofabrication strategies. Some of the most recent advancements in merging mechanobiology with biofabrication that enabled the control of cell activity are presented, moving towards enhanced tissue regeneration as well as the possibility to create more complex 3D in vitro models to study biological processes. Ultimately, I will show that biofabrication technologies could be a powerful tool to replicate these structures towards the development of new therapies for tissue and organ repair, as well as for 3D in vitro models to better understand the morphogenetic biological processes that drive organogenesis.

Biosketch

Prof. Dr. Lorenzo Moroni received his Ph.D. cum laude in 2006 at University of Twente on 3D scaffolds for osteochondral regeneration, for which he was awarded the European doctorate award in Biomaterials and Tissue Engineering from the European Society of Biomaterials (ESB). Since 2014 he works at Maastricht University, where he is a founding member of the MERLN Institute for Technology-Inspired Regenerative Medicine. In 2016, he became full professor in biofabrication for regenerative medicine. Since 2019, he is chair of the Complex Tissue Regeneration department. He was vice-director of MERLN from 2019 till 2022. Since 2022, he is director of MERLN.

In 2014, he received the Jean Leray award from the ESB and an ERC starting grant. In 2016, he also received the Robert Brown Award from TERMIS. In 2017, he was elected as faculty of the Young Academy of Europe and in the top 100 Italian scientists within 40 worldwide by the European Institute of Italian Culture. In 2022, he was elected as member of the European Academy of Science. In 2023, he received the Merck Lecture Award in Materials Science. In 2024, he was elected as International Fellow of Biomaterials Science and Engineering.

His research group interests aim at developing biofabrication technologies to generate libraries of 3D scaffolds able to control cell fate, with applications spanning from skeletal to vascular, neural, and organ regeneration. From his research efforts, 3 products have already reached the market.