Model-guided bone tissue engineering: from bench to bedside via in silico modeling

Liesbet Geris [1-3]

[1]Biomechanics Research Unit, University of Liège, Belgium, [2]Prometheus, Division of Skeletal Tissue Engineering, KU Leuven, Belgium, [3]Biomechanics Section, KU Leuven, Belgium,

Correspondence: liesbet.geris@ulg.ac.be, +32 16372690, Chemin des Chevreuils 1 B52/3, 4000 Liège, Belgium

The creation of man-made living implants is the holy grail of tissue engineering (TE). As basic science advances, one of the major challenges in TE is the translation of the increasing biological knowledge on complex cell and tissue behavior into a predictive and robust engineering process. Mastering this complexity is an essential step towards clinical applications of TE. Computational modeling allows to study the biological complexity in a more integrative and quantitative way. Specifically, computational tools can help in quantifying and optimizing the TE product and process but also in assessing the influence of the in vivo environment on the behavior of the TE product after implantation.

In this talk, I will use the example of bone tissue engineering to demonstrate how computational modeling can contribute in all aspects of the TE product development cycle: cells, carriers, culture conditions and clinics (figure 1 and 2). Depending on the specific question that needs to be answered the optimal model systems can vary from single scale to multiscale. Furthermore, depending on the available information, model systems can be purely data-driven or more hypothesis-driven in nature. The talk makes the case for in silico models receiving proper recognition, besides the in vitro and in vivo work in the TE field.

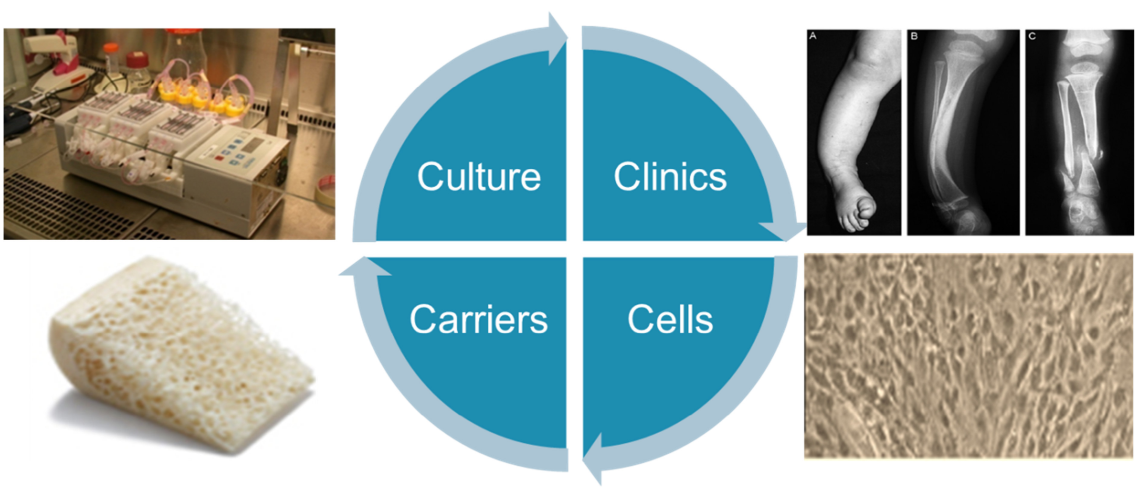

Figure 1: overview of the 4 important components in bone tissue engineering: cells, carriers, culture and clinics.

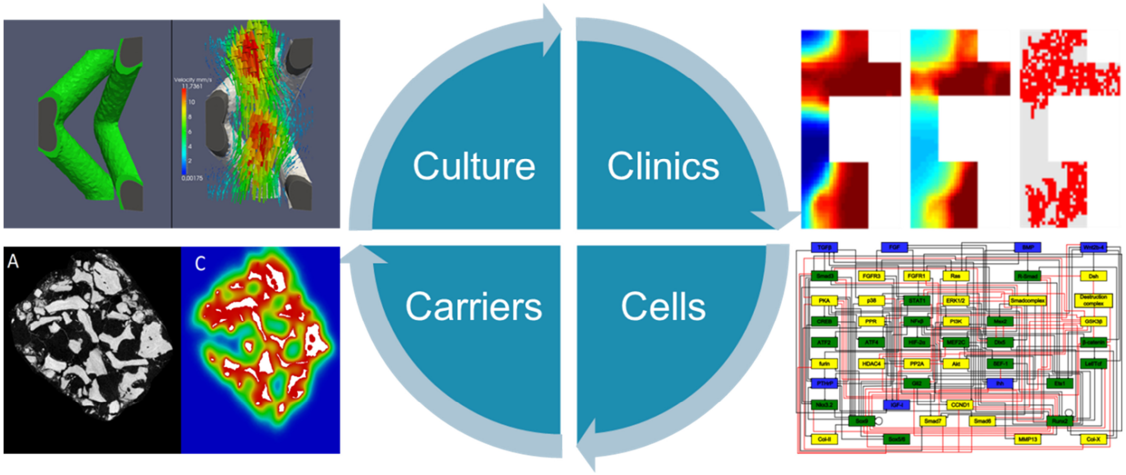

Figure 2: overview of in silico contributions to the 4 important components in bone tissue engineering: cells [1], carriers, culture [3] and clinics [4].

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