PhD position

The Julius Wolff Institute, Charité - Universitätsmedizin Berlin, has an opening for a PhD position in the topic of **Mechanically driven cellular self-organization and soft tissue patterning in bone healing**.

Background

Although bone is able to self-repair, in many situations its regeneration potential is impaired leading to delayed functional restoration or even non-unions. One of those situations concerns large bone defects which, if left untreated, results in limited bone tissue formation and unsuccessful healing. A peculiarity of this healing situation is that natural bone tissue patterning results in the formation of a bone capsule enclosing the medullary cavity. We have previously observed that this bone formation pattern follows collagen fiber organization that occurs much earlier during healing. The reason for this soft tissue patterning was found in cellular self-organization based on the traction forces generated by the individual cells. We have also observed that in large compared to small defects, there is a significant reduction in the levels of limb-loading induced mechanical strain under which the regeneration process takes place. Such local strains are also known to influence the structural organization of the tissue. However, it remains unknown to what extend both, traction force induced patterning and local mechanical strains within the healing region, interfere or synergistically contribute to soft tissue patterning with consequences for bone regeneration.

The aim of this project is to investigate how the two above-described mechanical aspects influence cellular and soft tissue organization representing different clinically relevant bone defect sizes. In particular, we will investigate how the mechanical/geometrical constrains in a large bone defect influence the spatial distribution of mechanical signals within the regenerating region and how those signals dictate cellular organization and soft tissue formation. We will also investigate potential ways to manipulate the mechanical environment of the healing region to influence cellular and tissue organization and prevent marrow encapsulation.

We will use an existing in vitro clamp setup to investigate cellular organization under controlled mechanical conditions which aim to replicate the physical/geometrical constrains in a large bone defect. Bioreactors will be used to apply in vivo-like cyclic mechanical loading signals and the influence of load magnitude and frequency on tissue patterning will be investigated. In vitro experiments will be coupled to computer models that determine the local mechanical strains surrounding individual cells and to better understand the dynamics of cellular self-organization and soft tissue formation under load.

Profile

- A degree in Mechanical Engineering/Physics/Biophysics or a related discipline
- Knowledge of Finite Element Modelling
- Experience in Programming (e.g. C/C++, Matlab)
- Previous experience in *in vitro* cell culture experiments will be advantageous
- High motivation and strong interest in research