The Effect of Inflammatory Phase in Mechanobiological Modeling on Bone Fracture Healing

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Bone fractures are commonplace in our fast-paced society. Medicine has advanced so much that people take for granted how intricate recovery is. The healing process at the cellular level is complex and involves a cascade of reactions that occur over the course of recovery. This complexity makes it difficult to simulate the bone fracture's progression as it heals. A successful simulation model would allow care providers to accurately track healing outcomes for their patients and catch any deviations in a timely manner. The issue is that the current framework for bone healing models is incomplete because these models fail to account for all four stages of healing (inflammatory phase, soft callus formation, hard callus formation and bone remodeling). In particular, the inflammatory stage is the most neglected stage in these models and so our team, using data collected from healthy rats , focused on this issue by constructing a computational model that simulates healing from the earliest stages of healing to bone reformation. The team created a biological expression map incorporating new RNA data to model the different growth factors that are present at the fracture site during recovery. We also updated an existing mechanical model that describes the optimal conditions of a bone fracture during recovery. It is the combination of these two models that are used to construct the new mechanobiological computational model that will simulate bone healing. This model will hopefully set a foundation for bone healing models that can be easily implemented in healthcare in the future.