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Modeling the effects of the immune system on the fracture healing process

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Modeling the effects of the immune system on the fracture healing process

Abstract:

Immune system cells play a key role in the fracture healing process. At the early stage of the process, they clean the injury site, regulate the inflammation and help to reestablish the vascular supply. Moreover, cytokines and growth factors promote and accelerate the osteogenic activities. However, the mechanisms and functions of immune cells present at the fracture site is not clearly understood. In this work, we present a mathematical model for the bone healing process incorporating both immune and bone cells. Our model consists of a system of nonlinear ordinary differential equations which represents the interactions among the macrophages, fibroblasts, chondrocytes, and osteoblast and osteoclast cells in the repairing process. We use the model to simulate the progression of bone healing for different types of fractures. A set of numerical simulations is also presented to examine the effects of the cytokines and growth factors involved in the healing process.