Modeling of cartilage growth on bidegrabile scaffold under mechanical loading

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In the present work we study modeling of hyaline cartilage growth. We start with exploration of the background of the problem, i.e. histology and physiology of hyaline cartilage, possibilities of cartilage healing and methods of tissue engineering. Then biothermodynamical principles follow. They lead to expression of modified mass action law, which provides possibility to include influences of chemical reactions and mechanical stimuli into the model. We use this equation for mathematical formulation of the cartilage growth model, which has the form of reaction-diffusion equations. This model and its simplifications are analyzed and one of the simplifications serves for comparison with the experiments. The parameters (reaction rates) are the main result which allows us to quantitatively describe cartilage growth.

We have developed new approach to cartilage modeling. The introduced mathematical model is able to quantitatively describe the cartilage growth via few parameters such as reaction rates. These parameters also reveal the quality of scaffold used for cartilage growing.

Similar work was submitted as a master thesis at Charles University in Prague, Faculty of Mathematics and Physics in 2010.