

MECHANOREGULATION IN THE SKELETAL TISSUES

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The human body can be viewed as a machine; this has been recognised since the time of Borelli. What is not so well recognised that it is a machine that adapts to its mechanical environment, and these adaptation mechanisms are themselves subject to evolutionary pressures. In the research presented here the algorithms describing processes of repair and regeneration of skeletal tissues are presented. In particular an algorithm describing the mechanoregulation of the bone remodelling cycle is presented and it is used to predict biomechanical basis of bone loss in osteoporosis. Methods for somputational simulation of tissue differentiation are more complicated and involve algorithms for simulation cell migration, proliferation, and differentiation. It is shown how these algorithms may be

combined to simulate both long bone fracture healing and tissue regeneration in a scaffold for tissue engineering. In the concluding part of this lecture I will return to the issue of evolution of algorithms for mechanoregulation. It is shown that the evolution of mechanoregulation may not lead to optimal phenotypes; therefore it is unlikely that adaptation can be viewed as a process of optimization – rather we should expect variability of mechanoregulation of tissues in the population. The consequences of this for simulations of clinical relevance is discussed.

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