11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

BONE REMODELING BASED ON CELL CULTURE

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Key Words: *Mathematical model, Bone remodelling, Osteoblasts, Osteoclasts, Mechanobiology.*

Bone is a living tissue characterized by an adaptive behavior due to the biomechanical stimuli, such as external loading, molecular signalization and pharmacological actions. This dynamical response is known as bone remodeling and results of a complex interactions between cells groups which are able to adapt form, shape and bone microstructure continuously.

The aim of this work is to analyze the bone remodeling model which takes into account the cells activities as proposed by Lemaire (2004) using the finite element method. The model describes the coupling between osteoblasts and osteoclasts and four types of signaling molecules (the catabolic effect induced by PTH, osteoclasts apoptosis induced by TGF-beta, catabolic action of RANKL and the reversal effect of OPG).

The method was implemented in a Python script using the platform SALOMÉ-MÉCA, an open–source platform which integrates a pre and post-processing (SALOMÉ) and numerical software codes for Finite element Application (CODE_ASTER). The method allows analyzing the qualitative response of a bone structure when subjected to a certain mechanical loadings. Two numerical examples are presented. The first example is a proximal humerus with a loading simulating a professional tennis player in action, according to Taylor et al. (2009) and the second explores a proximal femur with a standard walking gait, see Carter and Beaupré (2001). Obtained results are in accordance with expected bone remodeling behavior and offer a good correlation with experimental data available in the literature.

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