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## LECTURE NOTES **3**

# Tissue Remodelling

Advanced Course – ACTR'04

Warsaw, June 22-25, 2004

edited by

Jarosław Piekarski



**abiomed**

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## Preface

Lecture Notes of Advanced Course on Tissue Remodeling is the third volume published in the Lecture Notes series of the ABIOMED Centre of Excellence. This centre has been created in 2002 and its activity, mainly destined for promoting research and dissemination of knowledge in the field of biomechanics, is supported by the 5th Framework Programme of European Commission, as well as by Polish Committee for Scientific Research.

The establishment of ABIOMED has been inspired by Professor Joachim J. Telega. Educated as a mathematician, he worked on modeling of materials, first of all contributing to variational methods and to homogenization. In early 1990ties he took the interest in biomechanics. His extensive knowledge enabled him to make significant contributions to the field, mainly to constitutive modeling of soft and hard tissues. His personal skills allowed him to gather researchers interested in biomechanics, and to create the biomechanics research group within the Institute of Fundamental Technological Research. Rich of inventiveness, full of beans, he successfully led the ABIOMED Centre. Sadly, his body was not so strong as his spirit. He passed away on January 28th, 2005.

Advanced Course of Tissue Remodeling (ACTR) has been chaired by Professor Telega. He proposed the formula of the course and has invited leading Polish and foreign researchers, who have presented the modern state-of-the-art and main research topics related to tissue remodeling. The course was a successful event. It attracted over 40 participants, mainly from Poland, but also from other European countries. Eleven key-note lectures, and several contributed papers have been presented.

Topics related to the cascade of biochemical events, cell activity and their interaction with mechanical factors, that enjoy great interest nowadays, have been widely discussed. The role of biochemical factors during bone remodeling has been reviewed (A. Górecki and coworkers). Both experimental research on mechanoregulation and theories attempting to explain these phenomena in terms of mathematical models and numerical simula-

tions have been presented (S.C. Cowin, J. Klein-Nulend). Response of cells during bone fracture regeneration and theories of tissue differentiation have been outlined (P. Prendergast). Collagen remodeling, role of cells during this process, and applications to tissue engineering of heart valves have been discussed (F. Baaijens) as well as the function of cells in vascular remodeling (A. Rachev).

Another group of topics was related to recent advances in theories of tissue remodeling and numerical simulations of this process. Review of theories related to adaptive elasticity has been presented by S.C. Cowin. Theories and simulations taking into account the response of bone to microdamage (P. Prendergast) and also those based on the hypothesis of optimal response of bone (T. Lekszycki) have been considered as well. Theoretical models of volumetric and global growth applied to remodeling of ventricular wall, and application of mechanobiological principles to examination of the response of arteries have been provided (A. Rachev). Also the role of residual stresses and the way of accounting them for in mathematical models of soft and hard tissue adaptation (J.J. Telega) have been widely analysed. Trends in modeling of tissues, modern experimental methods of evaluation of structure and tissue material properties (P. Niederer, R. Będziński) have been discussed as well.

Clinical aspects of bone remodeling including pathologies have been reviewed by A. Górecki and coworkers. The ultrasound methods of evaluation of bone quality and detection of diseases were discussed at length by A. Nowicki and coworkers.

The present volume contains a set of review articles concerning the topics outlined above. With a wealth of experimental facts, theoretical insights and computational results, not to mention the exhaustive bibliography reference lists, these articles will certainly prove to be useful for all interested in studying tissue remodeling problems.

*Jarostaw Piekarski*