



- Institute of Fundamental Technological Research •
- Polish Academy of Sciences •
- Warsaw • Poland •

LECTURE NOTES 5

Biomaterials in Orthopaedic Practice

Workshop BMAT 2005
Warsaw, May 13–15, 2005

edited by
Tomasz Lekszycki
Paweł Małyk



abiomed

WARSAW 2005

© Copyright by | Institute of Fundamental Technological Research
Świętokrzyska 21, 00-049 Warsaw, Poland

ABIOMED LECTURE NOTES

Series Editors:

Executive Committee of ABIOMED:

Tomasz A. Kowalewski (*Scientific Coordinator*)

Tomasz Lekszycki

Andrzej Nowicki

Executive Editor:

Maciej Stańczyk

INSTYTUT PODSTAWOWYCH PROBLEMÓW TECHNIKI PAN
BIBLIOTEKA
02-106 Warszawa, ul. Pawińskiego 5B
Tel. (0-22) 826-01-29

*Edition of this volume has been partially supported
by the European Commission*



56173

ISSN 1733-0874

Skład: Maciej Stańczyk

Papier offset. kl. III, 70 g, B1

Oddano do druku: IX 2005; druk ukończono: X 2005

Druk i oprawa: Drukarnia Braci Grodzickich, Piaseczno, ul. Geodetów 47a

Contents

Invited Lectures	7
M. LEWANDOWSKA-SZUMIEL, <i>Tissue Engineering as a Tool in Reconstructive Surgery of Skeletal Tissues</i>	9
J. KLEIN-NULEND ET AL., <i>Cell Biology of Mechano-Adaptive Bone Remodeling</i>	31
D.J. KELLY, <i>Mechanobiological Models of Skeletal Tissue Differentiation</i>	49
R. CADOSSO ET AL., <i>Physical Regulation of Bone Growth with PEMF-Biostim</i>	69
Contributed Papers	95
W. ŚWIĘSZKOWSKI ET AL., <i>In Vivo Degradation and Wear of Biomaterials in Total Joint Replacements</i>	97
W. KUKWA ET AL., <i>Cartilage and Bone Tissue Engineering in the Head and Neck Surgery—Clinical Expectations</i>	117
W. CHRZANOWSKI, <i>Evaluation of the Usefulness of Oxide Layer in the Intramedullary Nail Surfaces</i>	135

Preface

The volume *Biomaterials in Orthopaedic Practice* collects selected papers presented during a workshop BMAT2005 on biomaterials held in May 13–15, 2005 in Warsaw. This workshop was one of the series of events organised within the activity of the Centre of Excellence for Applied Biomedical Modelling and Diagnostics ABIOMED created in 2002 in the Institute of Fundamental Technological Research of Polish Academy of Sciences and supported by the 5th Framework Programme of European Commission and Polish Committee for Scientific Research. The workshop gathered researchers of different specialities among the others engineers, medical doctors, biologists and physicists. Several invited lectures were presented by leading scientists from research institutions in Poland, Europe and from USA.

This volume is devoted to the memory of Professor Józef Joachim Telega who played the leading role in ABIOMED organisation and next acted as the Coordinator of the Centre. His wide scientific interests and exceptional organisational talents determined to big extent the directions of Centre's activities. The idea of the workshop BMAT2005 was inspired by Professor Telega who suddenly passed away on January 2005.

In the first part of the volume some of the papers presented by invited lecturers are included. Tissue engineering in context of reconstructive surgery of skeletal tissues is discussed in the paper by Lewandowska-Szumiel. Several issues—among others—the scaffolds as new materials, cells culture systems and tissue cultivation, biologically active molecules and their role in implant-host connection, bio-reactors and their use are discussed. The paper by Klein-Nulend et al. covers the problems of bone cells biology with special attention to the mechanisms responsible for mechano-adaptive bone remodelling. The phenomena at the cellular level are discussed and the results of theoretical and experimental investigations to explain the fundamental effects contributing in bone remodelling are presented. In the paper by Kelly, the problem of modelling of mechano-regulated tissue differentiation is discussed. A wide review of different mechanobiological models with a special consideration of

fracture healing is presented. Paper by Cadossi et al. covers the theoretical, experimental and practical aspects of bone growth stimulation using PEMF (Pulsed Electromagnetic Field). This paper provides systematic insight into the problems of bone growth and healing stimulation with great attention to medical issues.

The second part of the volume contains some of the papers presented as short presentations during BMAT2005 workshop. Świążkowski et al. present the results of experimental investigations of degradation and wear of biomaterials in total joint replacements. Clinical aspects of cartilage and bone tissue engineering in the head and neck surgery are discussed in a paper by Kukwa et al. In a paper by Chrzanowski the results of experimental and computational investigations of oxide layer in the intramedullary nail surfaces are reported.

Tomasz Lekszycki,
Paweł Małdyk

Warsaw, September 2005