Bone and Cartilage Engineering

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With 95 Figures and 55 Tables

With a Contribution by Thomas Meyer

Springer

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Dedicated to
Janine and Andrea

Preface

Bone and cartilage tissue engineering is a multidisciplinary, young and emerging field in biotechnology, which is expected to change medical practice profoundly, regenerating skeletal tissues and organs instead of just repairing them. This new medical discipline holds the promise of improved treatment possibilities, enhanced quality of the patient´s life and the ability to overcome, in the future, the need for major grafting procedures. It is expected that this biotechnology will also have a strong economical impact on clinical medicine. To fulfil these expectations several challenges concerning scientific, technological, clinical, ethical and also social issues need to be met. Basic research still requires the evaluation and elaboration of fundamental processes and procedures in multiple research fields. However, the first tissue engineered bone and cartilage products have already been introduced to the market, and many more are in the preclinical stage, and many companies are involved in this area.

Extracorporal bone and cartilage tissue engineering is a narrower definition of bone and cartilage reconstruction and regeneration by means of the implantation of a cell/scaffold complex. This kind of tissue engineering approach is a multidisciplinary subject bringing together various scientific fields, including material science, cell biology and clinical disciplines. The promising biotechnology, now introduced as a new clinical tool in the restoration of bone or joint defects, is expected to change treatment regimes and to contribute significantly to clinical medicine in future decades. Current limitations in tissue engineering seem most likely be overcome in the near future, suggesting that generating bone or cartilage tissue ex vivo will replace other therapies in routine clinical practice.

One of the reasons for the fast growth of tissue engineering is the large number of excellent research papers covering all aspects of bone and cartilage tissue engineering. Additionally, numerous high quality books are available describing in detail different aspects of bone and cartilage tissue engineering. Despite the fact that such literature is already available, we decided to write a book on bone and cartilage tissue engineering for two reasons. First, during the experimental and clinical work on tissue engineering carried out over more than 10 years in our clinic as well as in our biomineralisation and tissue engineering research group, we observed that many specialists from the different fields involved in tissue engineering had difficulties in overviewing the complexity of the field. We therefore intended to write a comprehensive book covering all aspects of bone and cartilage tissue engineering. Second, as tissue engineering brings together basic researchers, mainly having a biological, biophysical or material science oriented background, with clinically oriented physicians, we found that they differed in the language used. To overcome this problem, the demanding and complex aspects of tissue engineering were divided into the dif-

ferent aspects of tissue engineering on a level that provides extended information for specialist, but also gives usable access to non-specialists. The text of this book is therefore augmented by numerous tables, schematic illustrations and photographs in order to provide a better understanding of the information provided.

We hope this book will add further stimulus for all basic researchers and clinicians who are involved in investigating and applying tissue engineering and will contribute to making bone and cartilage tissue engineering an attractive and reliable alternative treatment option in reconstructive surgery.

Ulrich Meyer
Hans Peter Wiesman

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The outcome of this research was based on cooperation with a variety of commited colleagues (namely Prof. Dr. W. Schlegel, Department of Gynecology; Prof. Dr. K.-D. Richter, Department of Animal Studies; Prof. Dr. H. Arlinghaus, Prof. Dr. H. Kohl, Prof. Dr. L. Chi and Prof. Dr. H. Fuchs, Department of Physics; Prof. Dr. P. Bruckner, PD Dr. C. Runte and PD Dr. D. Dirksen, Institute of Biophysics, Prosthetic Department; PD Dr. T. Stamm, Orthodontic Department; Dr. E. Krefting and Prof. Dr. R. Reichelt, Department of Medical Physics and Biophysics; Dr. J. Libera, co.don AG, Teltow; Prof. Dr. Dr. D. Weingart, Katharienhospital, Stuttgart). We specially thank Dr. K. Reichenmiller of the Department of Conservative Dentistry, University Tübingen for many helpful discussions and for leaving the PCR images to us and we thank PD Dr. Meffert and Prof. Dr. Raschke of the Department of Reconstructive Surgery, who supported us with their scientific knowledge and who gave us the photographs on joint surgery. We thank Dr. Dr. J. Handschel and Prof. Dr. Dr. N.R. Kübler for their excellent scientific work in embryonic stem cell research at the University of Düsseldorf. Mister Sailer and Dipl.-Ing. N. Huda provided us with excellent schematic drawings. We are also very greatful to Dieter Sommer who supported us in the realisation of the book. Moreover we would like to express our gratitude to Springer, especially Ms. Irmela Bohn, for the professional accompaniment to this project.

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Ulrich Meyer
Hans Peter Wiesmann

Contents

1 Introduction 1

2 Bone and Cartilage 7

2.1 Bone Structure and Function 7
2.2 Matrix Mineralisation. 10
2.3 Osteoblast Structure and Function 17
2.4 Osteoclast Structure and Function 19
2.5 Bone Regeneration 20
2.6 Cartilage Structure and Function 25
2.7 Chondrocyte Structure and Function 30
2.8 Cartilage Regeneration 33
2.9 Skeletal Biomechanics 35
2.10 Bone Biomechanics. 38
2.11 Cartilage Biomechanic. 43

3 Principles of Bone and Cartilage Reconstruction 47

3.1 Bone Repair Strategies. 48
3.2 Cartilage Repair Strategies 55
3.3 Extracorporal Strategies. 62

4 Cell Development, Cell Sources 65

4.1 Cell Development. 65
4.2 Cell Sources. 66
4.3 Genetically Modified Cell Lines 70

5 Harvesting and Cultivation 73

5.1 Marrow-derived Stem Cells 73
5.2 Determined Bone Cells 78
5.3 Determined Chondrogenic Cells 83
5.4 Osteoclasts 83
5.5 Endothelial Cells 84
5.6 Co-cultures 85

6 Materials 121

6.1 Synthetic Organic Materials 122
6.2 Synthetic Inorganic Materials 124
6.3 Natural Organic Materials 125
6.4 Natural Inorganic Materials 128

7 Cells/Surface Interactions 131

7.1 Protein Adsorption 133
7.2 Cell Adhesion 133
7.3 Surface Topography 137
7.4 Surface Chemistry 139
7.5 Induction of Mineralisation at Materials 141
7.6 Functional Aspects of Biomaterial/Cell Interactions 143
7.7 Surface Structuring 143
7.8 Surface Patterning 144
7.9 Peptide Adhesion 145
7.10 Protein Coatings 146

8 Bioreactors and Cell Stimulation 149

8.1 Bioreactors 149
8.2 Stimulation in Bioreactors 156
8.3 Biomagnetic and Bioelectric Stimulation in Bioreactors 159
8.4 Hormones and Cytokines 161

9 Scaffold Structure and Fabrication 163

9.1 Scaffold Structure 163
9.2 Scaffold Fabrication 167
9.3 Scaffold-free Micromass Units 173

10 Tissue Reconstruction in vivo 179

10.1 Animal Models used for Bone Tissue Engineering 181
10.2 Animal Models used for Cartilage Tissue Engineering 186
10.3 Clinical Applications 187
10.4 Immunological Aspects 196

11 Clinical Handling and Control 199

11.1 Regulatory Issues 201

12 Ethical Considerations in Bone and Cartilage Tissue Engineering 203

13 Future Prospects 207

13.1 Customised Tissue Reconstruction 207
13.2 Vascularisation 208
13.3 Genetic Engineering 209

References 213

Subject Index 255