BILATERAL WORKSHOP "AGE OF REGENERATIVE MEDICINE"

on Proliferation and Differentiation of Neural Crest-Derived Stem Cells (NCSCs) Evaluated in vitro and ex vivo


Program and Abstract Leaflet

Tomsk
Hosting organization:
Goldberg Research Institute of Pharmacology and Regenerative Medicine,
Tomsk National Research Medical Center of the Russian Academy of Sciences, Russia

Organizing Committee of Bilateral Workshop "Age of Regenerative Medicine":
Prof. Dr. V.V. Zhdanov
Full member of RAS A.M. Dygai
Prof. Dr. E.G. Skurikhin
Dr. O.V. Pershina
Dr. M.Yu. Minakova

e-mail: amdygay@gmail.com

Executive Chairs:
Prof. Dr. W.-D. Grimm
Prof. Dr. E.G. Skurikhin

Session Chairs and Presidium:
Full member of RAS A.M. Dygai
Prof. Dr. W.D. Grimm
Prof. Dr. Fritsch
Prof. Dr. B. Giesenhagen
Prof. Dr. E.G. Skurikhin
Prof. Dr. D. Widera
Prof. Dr. F. Witte
Prof. Dr. V.V. Zhdanov

Working languages:
English, Russian
Regenerative medicine and stem cells are current subjects in today’s life sciences and provide many promising options for future treatment of degenerative disorders.

It is a pleasure to host this bilateral workshop in the Goldberg Research Institute of Pharmacology and Regenerative Medicine, and hopefully this event will become a new tradition. This forum aims at widening the international collaboration in this dynamically developing sector of medicine. In addition to presentations delivered at our institute, video bridge linking institutions in Russia, Germany and other countries will allow internationally leading scientists to present and discuss their ideas.

Notably, a substantial investment of money, knowledge and time is a pre-requisite for development of novel and worthwhile methods and their translation them into practice.

Definitely, the program of the bilateral will is highly interesting and timely, and will be useful for the professional development of all participants.

Wish you enjoy the Bilateral workshop
Sincerely Yours
Alexander Dygai
Welcome message
Prof. Dr. Grimm, Program committee

On behalf of the Program Committee of the Bilateral Workshop for Regenerative Medicine, it is a great honor to welcome you from all over the world. I am honored to announce that the Bilateral Workshop for Regenerative Medicine will be held in Tomsk (Russian Federation) from October 13th – October 15st, 2016. Regenerative medicine and stem cell technology offer many opportunities in basic sciences, technology development, and clinical translation. In terms of translation, stem cells and regenerative medicine rise the hope for future treatment of major “global killers” such as cancer, neurodegenerative diseases and chronic inflammatory diseases. In addition, there is a high demand for effective and cost efficient bone regeneration therapy. Importantly, the current “gold standard” including autologous and allogeneic bone grafts may result in severe complications and safety considerations of biomaterials and cell-based treatment still to be resolved. Thus, developing new therapies with stronger osteogenic potential and a lower incidence of complications is worthwhile. It has a perspective to form a biotechnology industry chain with the development of regenerative medicine industry as the center, which will be one of the high-tech industries the 21st century.

Our event in Tomsk focuses on building a bridge between the researchers in Russian Federation and abroad and will provide all participants with resources, information and advice they might need to aid their research and to benefit their professional developments.

Wish you enjoy the Bilateral workshop
Sincerely Yours
Wolf-Dieter Grimm
Program of the Bilateral Workshop

13.10.16

9.00–14.00 Registration of participants.
Hall of the Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, central building, Lenin str. 3, Tomsk

14:00 Opening of the Bilateral workshop
Welcome message acting Director, Professor V.V. Zhdanov
Welcome message A.M. Dygai, full member of the RAS

14.30–17.00 First section
Hall «1» of the Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, central building, Lenin str. 3, Tomsk

SECTION I
Bilateral Workshop / Round Table Discussion

Participants of the Bilateral Workshop

Full member of RAS A.M. Dygai, Tomsk, Russia; Prof. Dr. W.-D. Grimm, Witten/Herdecke, Germany; Prof. Dr. S.V. Sirak, Stavropol, Russia; Prof. Dr. D. Widera, Reading, UK; Prof. Dr. B. Giesenhagen, Frankfurt/M., Germany; Prof. Dr. E.G. Skurikhin, Tomsk, Russia; Prof. Dr. Witte, Berlin, Germany, Prof. Dr. Fritsch, Luzern, Switzerland; Prof. Dr. V.V. Zhdanov, Tomsk, Russia; Ph. D. O.V. Pershina, Tomsk, Russia; Dr. A.V. Pakhomova, Tomsk, Russia; Dr. Marie-Th. Zeuner, Reading, UK; Dr. E.A. Gubareva MD, PhD, Krasnodar, Russia; Dr. M.G. Danilets, Tomsk, Russia; Prof. Dr. S. Philippou, Bochum, Germany; Dr. M.A. Vukovic, Witten/Herdecke

Per Video-translation: Prof. Dr. W. Duncan, Dunedin, New Zealand; Prof. Dr. Sema S. Hakki, DDS, PhD, Konya, Turkey, Prof. Dr. G. Varga, Budapest, Hungary
Evaluation of the potential of different human craniofacial stem cells in mediating bone regeneration in large and small animal models

Topic 1: Neural Crest-Derived Stem Cells as a Tool in Regenerative Medicine
Introduction: Prof. Widera, University of Reading, UK

Topic 2: Extracellular Vesicles from Neural Crest-Derived Stem Cells as a Novel Approach to Stimulate Bone Regeneration through Regulation of Osteogenesis and Angiogenesis
Introduction: Prof. Grimm, Witten/Herdecke University, Germany, Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia

Topic 3: Osteoporotic Animal Models as a Novel Approach to Investigate Bone Regeneration through Regulation of Osteogenesis and Angiogenesis
Introduction: Prof. Skurikhin, Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia

Topic 4: Novel Scaffolds to Investigate Bone Regeneration through Regulation of Osteogenesis and Angiogenesis
Introduction: Prof. Witte, Julius Wolff Institute and Center for Musculoskeletal Surgery, Berlin-Brandenburg Center for Regenerative Therapies Charité - Universitätsmedizin Berlin, Germany

Topic 5: Animal models in Regenerative Medicine-Prospects from Pathology
Introduction: Prof. Dr. S. Philippou, Institute for Pathology and Cytology, Ruhr University Bochum, Germany
14.10.16  9:30–17:00

SECTION II

Hall «1»

Presidium
The full member of RAS A.M. Dygai, Prof. Dr. W.D. Grimm, Prof. Dr. Fritsch, Prof. Dr. B. Giesenhagen, Prof. Dr. S.V. Sirak, Prof. Dr. E.G. Skurikhin, Prof. Dr. D. Widera, Prof. Dr. V.V. Zhdanov

9.30–10.30  Neural Crest-Derived Stem Cells as a Tool in Regenerative Medicine

Prof. Dr. D. Widera
Lecturer in Stem Cell Biology and Regenerative Medicine, Head of the Stem Cell Biology and Regenerative Medicine Group, Reading School of Pharmacy, University of Reading, United Kingdom

10.30–11.00  Translational Research: Neural Crest-Derived Stem Cells as a Tool in Regenerative Dentistry

Prof. Dr. Grimm
Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia, Stavropol State Medical University, Stavropol, Russia, Witten/Herdecke University, Germany

11.00–11.15  Investigation of Mesenchymal Multipotent Stromal Cells in Experimental Fibrosis. Possible Ways of Regulation of the Differentiation of Mesenchymal Multipotent Stromal Cells

Prof. E.G. Skurikhin, Dr. O.V. Pershina
Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia

11.15–11.30  In vitro and in vivo evaluation of biodegradable, open-porous scaffolds made of sintered magnesium W4 short fibres.

Prof. Dr. F. Witte
Julius Wolff Institute and Center for Musculoskeletal Surgery, Berlin-Brandenburg Center for Regenerative Therapies Charité - Universitätsmedizin Berlin, Germany

11.30–11.45  Inflammatory Priming Increases Anti-inflammatory and Immunomodulatory Potential of Stem Cell-derived Extracellular Vesicles

Dr. Marie-Th. Zeuner, Prof. Dr. D. Widera
University of Reading, United Kingdom
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<tr>
<th>Time</th>
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<td>11.45–12.00</td>
<td>Animal models for investigation of mesenchymal stem cells</td>
<td>Dr. O.V. Pershina, Prof. Dr. E.G. Skurikhin, Ph.D., N.N. Ermakova, Ph.D., A.V. Pakhomova</td>
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<td>Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia</td>
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<td>12.00–12.15</td>
<td>Prospects of the tissue engineering lung development with the methods of regenerative medicine</td>
<td>Dr. E.A. Gubareva MD, PhD</td>
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<td>Laboratory Head, Kuban State Medical University, Krasnodar · International Research, Clinical and Education Center of Regenerative Medicine, Krasnodar, Russia</td>
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<td>12.15–12.30</td>
<td>Experimental Animals for Regenerative Medicine</td>
<td>Dr. M.G. Danilets</td>
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<td>DISCUSSION</td>
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<td>12–40</td>
<td>Coffee-break</td>
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<td>13.00</td>
<td>SECTION III</td>
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<td>13.00–13.45</td>
<td>Human allogenic bone substitutes – Clinical Results of the Bone-Ring Method</td>
<td>Prof. Dr. B. Giesenhagen</td>
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<td>University of Frankfurt/M., Germany, Implant Center Kassel, Germany</td>
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<td>13.45–14.15</td>
<td>Research Project: Osteoporotic Sheep mandibular model for comparative alveolar bone healing research. A proof of principle study. - Initial Results-</td>
<td>Grimm W.-D.¹,², Sirak S.V.¹, Adamchik A.A.³, Aybazov M.M.⁴, Fritsch T.⁵, Giesenhagen B.⁶, Hakki S.S.⁷, Koshel I.V.¹, Pershina O.V.⁸, Petrosyan G.G.¹, Philippou S.⁹</td>
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14.15–14.30 Sheep model for comparative dental implant research
Online presentation

Prof. Dr. W. Duncan
School of Dentistry, Dunedin, New Zealand

14.30–14.45 The influence of porous titanium for the osteogenic potential of bone marrow cells
in vitro and in vivo

Prof. Dr. S.V. Sirak
Stavropol State Medical University, Stavropol, Russia

Prof. Dr. A.A. Sletov, Prof. W.-D. Grimm
Stavropol State Medical University, Stavropol, Russia,
Witten/Herdecke University, Germany

14.45–15.00 TaqMan real-time PCR assay for Desulfovibrio orale in chronic periodontal lesions

Prof. Dr. Tilman Fritsch
Gesundheitscampus Luzern, St. Elisabethen University
Bratislava, Switzerland
<table>
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<th>Time</th>
<th>Session Description</th>
<th>Speakers</th>
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| 15.15–15.30  | Comparison of Mesenchymal Stem Cells Isolated From Pulp and Periodontal Ligament, online presentation | Prof. Dr. Sema S. Hakki  
        DDS, PhD, Selcuk University, Faculty of Dentistry, Department of Periodontology, Konya, Turkey |
| 15.30–15.45  | Mesenchymal stem cells of dental origin as promising tool for neuroregeneration, online presentation | Prof. Dr. G. Varga  
        Semmelweis University Budapest, Hungary |
| 15.45–16.00  | 3D reconstruction of non-removable implant supraconstructions in ceramics           | Dr. M.A. Vukovic  
        Witten/Herdecke University, Praxisteam Hasslinghausen, Germany,  
        W.-D. Grimm  
        Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia, Stavropol State Medical University, Stavropol, Russia, Witten/Herdecke University, Germany |
| 16.00–16.30  | DISCUSSION                                                                          |                                                                          |

**15.10.16**

**Presidium**

The full member of RAS A.M. Dygai,  
Prof. Dr. W.D. Grimm, Prof. Dr. Fritsch, Prof. Dr. B. Giesenhagen, Prof. Dr. S.V. Sirak, Prof. Dr. E.G. Skurikhin, Prof. Dr. D. Widera, Prof. Dr. V.V. Zhdanov

**9.30–11.00**

**SECTION IV: Poster session**

Hall «1»

**11.00–12.00**

**SECTION V: Summary of the bilateral workshop**

The full member of RAS A.M. Dygai, Prof. W.-D. Grimm,  
Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia, Stavropol State Medical University, Stavropol, Russia, Witten/Herdecke University, Germany,  
Prof. Dr. Skurikhin, Prof. Dr. V.V. Zhdanov
End of the Bilateral workshop Speakers (in alphabetical order):

Dr. M.G. Danilets, Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia

Prof. Dr. W. Duncan, School of Dentistry, Dunedin, New Zealand

Prof. Dr. Fritsch, Gesundheitscampus Luzern, St. Elisabethen University Bratislava, Switzerland

Prof. Dr. B. Giesenhausen, University of Frankfurt/M., Germany, Implant Center Kassel, Germany

Prof. Dr. W. Grimm, Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia, Stavropol State Medical University, Stavropol, Russia, Witten/Herdecke University, Germany

Dr. E.A. Gubareva MD, PhD, International Research, Clinical and Education Center of Regenerative Medicine, Kuban State Medical University, Krasnodar, Russia

Prof. Dr. Sema S. Hakki, DDS, PhD, Selcuk University, Faculty of Dentistry, Department of Periodontology, Campus, 42079, Konya, Turkiye

Dr. O.V. Pershina, Doctor of Medicine, Goldberg Research Institute of Pharmacology and Regenerative Medicine Tomsk NRMC, Russia

Prof. Dr. S. Philippou, Institute for Pathology and Cytology, Ruhr University Bochum, Germany,

Prof. Dr. S.V. Sirak, Stavropol State Medical University, Stavropol, Russia

Prof. E.G. Skurikhin, Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia

Prof. Dr. G. Varga, Semmelweis University Budapest, Hungary

Dr. M.A. Vukovic, Witten/Herdecke University, Praxisteam Hasslinghausen, Germany

Prof. Dr. Witte, Julius Wolff Institute and Center for Musculoskeletal Surgery, Berlin-Brandenburg Center for Regenerative Therapies, Charité – Universitätsmedizin Berlin, Germany

Prof. Dr. D. Widera, Stem Cell Biology and Regenerative Medicine, Stem Cell Biology and Regenerative Medicine Group, Reading School of Pharmacy, University of Reading, United Kingdom

Dr. Marie-Th. Zeuner, Stem Cell Biology and Regenerative Medicine, Stem Cell Biology and Regenerative Medicine Group, Reading School of Pharmacy, University of Reading, United Kingdom
Abstracts
Bilateral Workshop «Age of Regenerative Medicine»

Neural Crest-Derived Stem Cells as a Tool in Regenerative Medicine

Prof. Dr. D. Widera
Lecturer in Stem Cell Biology and Regenerative Medicine, Head of the Stem Cell Biology and Regenerative Medicine Group, Reading School of Pharmacy, University of Reading, United Kingdom

Abstract

The embryonic neural crest appears during development of mammals including humans as a transient structure between the newly formed ectoderm and the neural tube. Due to their intrinsic ability to give rise to mesenchymal and ectodermal derivatives neural crest stem cells possess an extraordinarily high developmental potential surpassed only by totipotent cells of the zygote and pluripotent embryonic stem cells. Adult neural crest-derived stem cells (NCSCs) were long term believed to be an in vitro phenomenon similar to embryonic stem cells derived from the inner cell mass of a blastocyst. During the last 15 years, however, an emerging line of evidence supported the hypothesis that at least a limited number of adult NCSCs may exist in the human body even in adulthood. Remarkably, such adult NCSCs perform self-renewal and exhibit a differentiation potential comparable to their embryonic counterparts. In particular they can give rise to neurons, melanocytes, bone cells and cartilage in addition to many other cell types associated with tooth development and homeostasis. Notably, despite the undisputed therapeutic effects, the level of engraftment and differentiation after transplantation of human NCSCs in experimental animal models is unusually low. This talk will introduce the developmental background and current biological concepts from our and other labs dealing with NCSCs within regenerative medicine. Finally, translational aspects of...
NCSCs including alternative explanations for their efficacy will be discussed.

**Biography**

Dr. Widera is currently an Assistant Professor/ Lecturer at the University of Reading, United Kingdom. His lab is mainly interested in neural crest-derived stem cell populations, which are promising candidates for the development of autologous stem cell-based therapies. He further works on the influence of injury and inflammation on stem cells and somatic cells (injury-induced cellular reprogramming) and develops novel approaches for clinical grade 3D-cultivation of human stem cells.

He graduated in Biochemistry (Witten/Herdecke University, Germany) and received his PhD in Neurobiochemistry from the Witten/Herdecke University in Germany. Since 2013 he served as a Principal Investigator and Adjunct Professor at the Department of Cell Biology, University of Bielefeld (Germany). In February 2015 he was appointed Assistant Professor/ Lecturer in Stem Cell Biology and Regenerative Medicine at the University of Reading (United Kingdom), where his lab is currently based. Since May 2015 he also serves as a Visiting Professor at the Stavropol State Medical University (Russian Federation). Dr Widera is member of the Physiological Society and acts as an Associate Editor for the journal Frontiers in Stem Cell Research.

He has published over 40 PubMed-listed publications (h-index: 16, i10-index:25, 1337 citations) in addition to several book chapters and has presented his research outcomes at numerous international conferences in the UK, Germany, USA, Malaysia, Singapore, Russia, Brazil, and China.
TRANSLATIONAL RESEARCH: NEURAL CREST-DERIVED STEM CELLS AS A TOOL IN REGENERATIVE DENTISTRY

Prof. Dr. W.-D. Grimm
Goldberg Research Institute of Pharmacology and Regenerative Medicine Tomsk NRMC, Russia
Stavropol State Medical University, Stavropol, Russia
Witten/Herdecke University, Germany

Abstract
Neural crest cells (NCC) are migratory multipotent cells that give rise to diverse derivatives. NCC respond to various environmental factors throughout their development, and differentiate into many cell types, including neurons and glial cells of the peripheral sensory and autonomic ganglia, Schwann cells, melanocytes, endocrine cells, smooth muscle, and skeletal and connective tissue cells of the craniofacial complex (Le Douarin & Kalcheim, 1999).

Notably, some NCC maintain their multipotency in the adulthood. However, a major limitation in the study of neural crest stem cells has been the inability to identify them prospectively in vivo. This is due to the lack of markers to isolate them or to distinguish them from restricted progenitors in vivo. In addition, multipotent, self-renewing neural crest stem cells have all been isolated after a period of growth in culture that could have changed their properties. It is therefore not yet clear whether such cells derive from cells with similar properties in vivo.

In our studies we identified cells positive for the neural crest-specific intermediate filament nestin adjacent to Meissner corpuscles and Merkel cell-neurite complexes within palatal ridges (palatal rugae/rugaepalatinae). In addition, we were able to show that palatal NCSCs express Sox2, Twist and Snail which all together represent characteristic hallmarks of NCCs.

In addition to the palate, NCSC-like cells have also been identified in the periodontal ligament and expanded through a sphere-forming culture system that was originally utilized to isolate neuronal stem cells (Widera et al., 2007, 2009, Grimm et al. 2011, 2014, 2015, Keeve et al. 2012).
Biography

Wolf-Dieter Grimm, clinical periodontist, graduated from dentistry, St. Petersburg State University in 1968. He worked for Technical University Dresden, for Academy of Postgraduate Programs in Dentistry Schwerin, and Witten/Herdecke University, Faculty of Health, Germany since 1991 to date. Since 1992, he became the Chairman of Department of Periodontology, Faculty of Dental Medicine, University of Witten and the director of Dental clinics 1993-97. From 1997-2005, he worked in USA as an Adjunct Professor in the Department of Periodontology, University of North Carolina at Chapel Hill. As Professor of Periodontology he has decades of experience with the diagnostic and treatment of periodontal diseases.

As a PI, Prof. Grimm has developed rodent (rat and mice) animal models including animal experimental surgery (titanium chamber model); histological techniques (organ/tissue/cell isolation, fixation, processing for light/scanning electron microscopy, embedding, sectioning, specific/differential staining) and radioactive labeling in vivo/in vitro, autoradiography for the investigation of periodontal regeneration. Since 2006 his research is focused on the use of stem cells in advanced regenerative periodontology and dental implantology. As a standardized animal model, he investigated periodontal and alveolar bone regeneration in nude rat. Nowadays, he and his clinical team are developing new techniques for vertical and horizontal augmentations of alveolar bone defects using human allogenic bone substitutes as carrier material for human ecto-mesenchymal stem cell-enriched palatal tissues in patients. Prof. Grimm has been awarded three times with the Colgate-Research Award. He is specialist in periodontology, graduated from the European Association of Periodontology and from the German Society of Periodontology, and has published more than 105 papers in reputed journals and serves as a member on numerous editorial boards. Since 2010 Prof. Grimm is also running a private practice “PraxisteamHasslinghausen” specialized in advanced periodontology and dental implantology in cooperation with Dr. M.A. Vukovic. Since September 2014 Prof. Grimm is additionally working as Distinguished Gottfried Herder Exchange Program Professor of Stomatology (Germany) at Stavropol State Medical University (Russian Federation).
INVESTIGATION OF MESENCHYMAL MULTIPOTENT STROMAL CELLS IN EXPERIMENTAL FIBROSIS. POSSIBLE WAYS OF REGULATION OF THE DIFFERENTIATION OF MESENCHYMAL MULTIPOTENT STROMAL CELLS

Prof. E.G. Skurikhin, Dr. O.V. Pershina
Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia

Abstract
The use of stem cells has given rise to many hopes in regenerative medicine, especially in diseases without efficient therapies. Clinical trials on the use of stem cells are underway for a wide variety of conditions and there is an emphasis on the use of bone marrow, hematopoietic and mesenchymal stem cells. The attention is focused on using of stem cells for tissue regeneration. According to modern concepts stem and progenitor cells are localized in many organs and tissues of an adult organism, and have a high potential to self-renew. Depending on the localization they differentiate into cells of hematopoietic, mesenchymal lines or other specialized cells. From our point of view, pharmacological modulation of adult stem cells may be effective. Thus, the search for compounds that modify the function of endogenous stem and progenitor cells is very important for regenerative medicine.

We investigated the effect of neurotropic drugs, enzymes altering the extracellular matrix, plant products, and pharmacologically active molecules on carriers on stem and progenitor cells derived from bone marrow, lung, pancreas and mammary gland in experimental models of leukopenia, diabetes mellitus, fibrosis and emphysema. Each disease is accompanied by a specific activity of endogenous stem cells. From our point of view, chronic diseases can be treated through influencing endogenous stem cells and progenitor cells. In this talk, we will present data from our studies dealing with different compounds in models of the pneumofibrosis, diabetes, myelosuppression and emphysema. In summary, we identified target-cells for each group of pharmacologically active molecules. We propose new approaches for inhibition of inflammation and fibrosis along with stimulation of tissue regeneration. We will discuss how these approaches can be implied in regenerative medicine.
Biography
Evgenii Skurikhin got his Medicine Doctor’s degree (PhD) from the Institute of Pharmacology of RAMS SD (2004). He is a professor of Pathological Physiology. He is the head of the research group of Department of Pathophysiology and Regenerative Medicine at the ED Goldberg Research Institute of Pharmacology and Regenerative Medicine (Tomsk). He is specialist in regenerative medicine and degenerative disorders, such as emphysema, idiopathic fibrosis of lung, diabetes, neurosis, and has published more than 95 papers in reputed journals and serves as a member on numerous editorial boards. In total, he supervised 10 major research projects.
IN VITRO AND IN VIVO EVALUATION OF BIODEGRADABLE, OPEN-POURS SCAFFOLDS MADE OF SINTERED MAGNESIUM W4 SHORT FIBRES

Prof. Dr. F. Witte
Julius Wolff Institute and Center for Musculoskeletal Surgery, Berlin-Brandenburg Center for Regenerative Therapies Charité - Universitätsmedizin Berlin, Germany

Abstract
A cytocompatible and biocompatible, degradable, open-porous, mechanically adaptable metal scaffold made of magnesium alloy W4 melt-extracted short fibres was fabricated by liquid phase sintering. Cylindrical samples (3 × 5 mm) of sintered W4 short fibres were evaluated under in vitro (L929, HOB, eudiometer, weight loss) and in vivo conditions (rabbits: 6 and 12 weeks). The in vitro corrosion environment (e.g., temperature, flow, composition of corrosion solution, exposure time) significantly influenced the corrosion rates of W4 scaffolds compared with corrosion in vivo. Corrosion rates under cell culture conditions for 72 h varied from 1.05 to 3.43 mm y⁻¹ depending on the media composition. Corrosion rates measured in eudiometric systems for 24 h were rv 24–27 times higher (3.88–4.43 mm y⁻¹) than corrosion in vivo after 6 weeks (0.16 mm y⁻¹). Moreover, it was found that the cell culture media composition significantly influences the ionic composition of the extract by selectively dissolving ions from W4 samples or their corrosion products. A pilot in vivo study for 6 and 12 weeks demonstrated active bone remodelling, no foreign body reaction and no clinical observation of gas formation during W4 scaffold implantation. Long-term in vivo studies need to be conducted to prove complete degradation of the W4 scaffold and total replacement by the host tissue.

Principal Investigator: Bioactive Implants
Biology of Bone
Degradable Biomaterials and Biodegradable Magnesium Alloys
Synchrotron-radiation based Microtomography
Immune Response to Biomaterials (in vitro and in vivo)
In vivo Fluorescence Imaging for Biomaterial-Host-Interactions
INFLAMMATORY PRIMING INCREASES ANTI-INFLAMMATORY AND IMMUNOMODULATORY POTENTIAL OF STEM CELL-DERIVED EXTRACELLULAR VESICLES

Dr. Marie-Th. Zeuner, Prof. Dr. D. Widera
University of Reading, United Kingdom

Abstract
Adult multipotent stem cells can be easily isolated from a variety of adult human tissues and organs including bone marrow and adipose tissue. Especially mesenchymal stromal cells (MSCs) possess immunomodulatory capabilities affecting the majority of immune cells. As of November 2015, more than 540 clinical trials utilising MSCs have been registered in the database clinicaltrials.org. Notably, the therapeutic benefit of MSC-administration revealed in different proof of concept and clinical studies is frequently connected to paracrine/endocrine effects rather than to effects driven by the engraftment of MSCs into affected tissues and differentiation towards lost cell types. Related to their proposed paracrine mode of action, several preclinical reports and a clinical treatment attempt of a Graft-versus-host disease (GvHD) patient provided evidence that MSCs exert their therapeutic functions via extracellular vesicles (EVs), such as exosomes and microvesicles.

Possible mechanisms by which MSCs contribute to regeneration include reduction of inflammation along with immunomodulation. Notably, exposure of MSCs to pro-inflammatory signals including TLR3, TLR4 and TNFR ligands has been reported to improve their anti-inflammatory and regenerative potential. We hypothesised that priming of adipose-tissue-derived MSCs (AdMSCs) could increase the anti-inflammatory potential of EVs. AdMSCs were exposed to LPS, Poly(I:C) and tumour necrosis factor alpha followed by assessment of the anti-inflammatory potential in a reporter gene-based, standardised potency assay. Here, we show that priming of MSCs significantly elevates the anti-inflammatory potential of the released EVs.

Despite its high promise, current stem cell therapies are still experimental, expensive and harbour several risks including immunological issues, risk of tumour formation or transmission
of pathogens in an allogenic setup. Thus, cell-free approaches including EV-based therapies, potentially involving inflammatory priming, could be considered as an alternative, more cost effective and safer therapeutic option for numerous degenerative disorders and associated symptoms and complications.
ANIMAL MODELS FOR INVESTIGATION OF MESENCHYMAL STEM CELLS

Dr. O.V. Pershina, Prof. Dr. E.G. Skurikhin, Ph.D., N.N. Ermakova, Ph.D., A.V. Pakhomova
Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia

Abstract
We used at the experimental models of leukopenia, diabetes mellitus, fibrosis, emphysema and breast cancer. Experiments were performed on C57BL/6, BALB/C and CBA mice. All our experimental procedures with animals were performed in accordance with the European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes. We investigated the effect of neurotropic drugs, enzymes altering the extracellular matrix, plant product and pharmacologically active molecules on carriers on stem and progenitor cells derived from blood, bone marrow, lung, pancreas and mammary gland. Our investigations were performed with a strict methodology and compliance with world standards. In our research we used the histological methods for investigation of tissues. We evaluated by flow cytometry content of HSCs, pan-hematopoietic cells, hematopoietic progenitor cells and MSCs derived from different tissues. We evaluated the mobilization, migration, engraftment after transplantation, proliferation, differentiation and regenerative potential of endogenous stem and progenitor cells. New search algorithm for potential medication targets (stem and progenitor cells) was tested in the several experimental models in mice.

Biography
Dr. Olga Pershina is a senior researcher of Department of Pathophysiology and Regenerative Medicine in the Research Institute of Pharmacology and Regenerative Medicine named after E.D. Goldberg (Tomsk). She got her Medicine Doctor’s degree (Ph.D.) from the Institute of Pharmacology of RAMS SB (2006). She is a specialist in regenerative medicine and cytometry. She studies the role of endogenous stem cells and progenitor cells in the pathogenesis of myelosuppression, idiopathic fibrosis of lung, neurosis, diabetes and breast cancer, monoamines and system of blood. She published 5 books (2 on English), 93 articles, has 24 Patent RU.
HUMAN ALLOGENIC BONE SUBSTITUTE – CLINICAL RESULTS OF THE BONE-RING METHOD

Prof. Dr. B. Giesenhagen
University of Frankfurt/M., Germany, Implant Center Kassel, Germany

Abstract
In the case of advanced atrophy or jaw defects, extensive vertical bone augmentation is often unavoidable to enable patients to be fitted with implants. These implantological procedures are usually two-stage and are very time-consuming for patients. The method of grafting bone rings developed by Bernhard Giesenhagen in 2004 makes it possible to augment the bone and insert implants in one single session. There are virtually no limitations to the indications for applying this technique. Compared with the classic, two-stage augmentation using bone blocks, the bone ring technique shortens the overall treatment time by several months. The method will be clearly and graphically presented in a multiple-part series of individual patient cases with the aid of various case studies. If the recommended treatment protocol is followed and the anatomically risk-prone regions are respected, bone grafting and implant placement can be safely performed by the ring technique.

As well as the chin, the palate, the retromolar region and human allogenic ring grafts may be considered as donor sites for the ring technique.

Harvesting from these regions and using human allogenic ring grafts as well as risks in soft tissue management (incision direction, suturing techniques) will be presented and discussed in the presentation.

The conditions required for successful application of the bone ring technique, in terms of achieving a restoration with long-term stability, will also be explained.

Biography
1996 – Medical Director PRO-IMPLANT, Institute for Implantology and Education: Academic partner of Johann Wolfgang Goethe University Frankfurt/Main.
Since many years involved in different educational programs in Germany and abroad.
– Developer of the Bone Ring Technique.
– Well known specialist for augmentation of hard and soft tissue around the world.
– Numerous publications about augmentation and Bone Ring Technique.
2012 – Private Clinics for Implantology in Kassel
RESEARCH PROJECT: OSTEOPOROTIC SHEEP
MANDIBULAR MODEL FOR COMPARATIVE
ALVEOLAR BONE HEALING RESEARCH. A PROOF OF
PRINCIPLE STUDY – INITIAL RESULTS

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Abstract

Aim

It is a clinical challenge to obtain a sufficient dental implant stability in weak osteoporotic bone. Reproducible and suitable animal models are required for in vivo experiments. The aim of the present study was to investigate the suitability of the mandibular ridge in osteoporotic sheep for comparative dental implant
research, to establish histological protocols for this model, to generate baseline histomorphometric data in this model, to study the effect of variations in healing of tooth extraction sockets and of critical-size bone defects. The hypothesis tested was the post-extraction osteoporotic sheep mandible and the critical-size bone defect in osteoporotic sheep is a suitable model for comparative dental implant research.

**Material and methods**

Six young female sheep with an average body weight of 30 kg have been used in this *proof of principle* study. Animal handling and surgical procedures has been conducted according the rules of the local ethical committee at the Stavropol State Medical University School (number 98/4, 10/03/2011). Six months prior to the studies start, animals had been neutered by ovariectomy to induce osteoporosis. The study was performed in two surgical phases. In the first phase, extraction of the incisors was performed bilaterally in each osteoporotic sheep. Following tooth extraction, in accordance with the literature two standardized box-shaped defects (12 mm critical-size defect, CSD) were surgically created at the buccal aspect of the alveolar ridge in the frontal sextant in a split-mouth design. After 12 weeks, block sections were obtained from the experimental sites. Qualitative histological analysis on decalcified sections was carried out. Bone density (BMD) was measured using radiographic images and initial morphometric analysis was provided to study the bone architecture of our Osteoporotic Sheep Model.

**Results**

All animals tolerated surgery well and regained full weight-bearing mobility by postoperative day 3. The Hounsfield units we have found clearly support the hypothesis of Osteoporotic Sheep model used in our *proof of principle* study. Significant microstructural evolutions were measured on the periodontal/bone compartment biopsies. The bone volume fraction (BV/TV) decreased by approximately 25% at six months post-ovariectomy. Histologic analysis of the periodontal/bone compartment sections stained with different stains revealed typical changes in the periodontal/bone compartments of the osteoporotic sheep. At 12 weeks, defect healing was characterized by an assessment of ongoing bone formation and mineralization.
**Conclusion**

The total ovariectomy resulted in an osteoporotic bone deficit not adversely affecting the general health of the sheep. Bone loss at both investigated anatomical sites was in excess of 25% which is sufficient to categorize these animals as osteoporotic supporting the stated hypothesis and suggests that the mechanism of bone loss could differ temporally as well as anatomically.

In general, it was observed that both of treatment procedures resulted in considerable histological values typically for osteoporotic changes during the entire healing period of 30 days, 60 days, and 120 days for the periodontal/bone compartment and for 12 weeks after creation of a 12mm critical size defect (12 mm CSD) in the osteoporotic sheep pairs. Within the limits of the present study, it was concluded that both of used models, the tooth extraction site model and the critical-size defect model of osteoporotic sheep have shown efficacy for being used in comparative alveolar bone healing research studies. This experimental animal model provides an excellent basis for testing new biomaterials for their suitability as bone augmentation materials.

**Key words:** Osteoporotic sheep, animal models, comparative regenerative alveolar bone studies, tooth extraction site model, 12 mm critical size defect, bone densification, bone quality, bone density measurements, qualitative histology
SHEEP MODEL FOR COMPARATIVE DENTAL IMPLANT RESEARCH

Prof. Dr. W. Duncan  
*School of Dentistry, Dunedin, New Zealand*  

**Abstract**  
This inquiry investigated the suitability of the jaw of domestic sheep as an animal model for dental implantology research. Initially, parameters for osseous healing of critical size defects (CSD) in the sheep mandible were established. Pilot studies were conducted using machined-surface implants and a surgical protocol established for dental implant placement in ovine mandibular sites. Subsequent experiments examined the utility of this animal model for examination of techniques designed to enhance osseointegration. Hydroxyapatite-coated implants were compared with titanium plasma-sprayed (TPS) implants, either alone or combined with autogenous bone grafts or a bone graft/collagen vehicle loaded with transforming growth factor-beta (TGF-β). Immunofluorescent bone labelling yielded information on the mineral apposition rate (MAR). Implant survival and success and histomorphometric analysis of percent bone-implant contact (% BIC) and percent peri-implant bone density (% density) were the main output variables. Naturally occurring “broken-mouth” periodontitis in sheep was identified as a potential confounder. Subsequent experiments considered implants with a variety of surface preparations. The model was also extended from a two-stage surgical protocol to include single-stage implants and the effect of pre-existing ovine periodontitis was also examined. A systematic review and meta-analysis of published animal implant experiments was then conducted in order to validate the sheep model.

Major findings were as follows. The size of non-healing sheep mandibular unicortical CSD is > 12 mm. Attempts to establish a chronic non-healing CSD were unsuccessful. The sheep diastema proved unsuitable for implant placement. The model system was therefore modified to a post-extraction protocol. Implant success rates after 3 months integration in the sheep mandible (defined as implant survival with % bone-implant contact >10%) ranged
from 50% to 100% for different implant surface treatments and placement protocols. Histomorphometric analyses revealed that % BIC ranged from 11±17% to 81±29% for different titanium surfaces and up to 85±11% for hydroxyapatite surfaces. Implants with TGF-β plus autogenous bone grafts had around 36±30% compared with 43±30% for implants with grafts alone. The percentage of bone (%density) adjacent to, but outside of the implant threads ranged from 63±16% to 86±3 and was markedly lower for titanium plasma-sprayed surfaces and for one-stage implants. Within the implant threads, % density varied from 31±33% to 73.4±8.3%, and was markedly lower for machined titanium surfaces. Sheep periodontitis had little effect on the protocols investigated. The sheep mandibular model was found to be comparable to similar models in other species and merits further development.
The search for osteoinductive as well as osteoconductive materials has led to the novel idea of using titanium in bone augmentations of the alveolar crest. Due to its excellent biocompatibility and favourable osteogenic properties, highly porous TiO₂ granules has been proposed as a promising material for non-resorbable synthetic bone grafts in the restoration of large bone defects, and for bone augmentation in dental applications.

Objectives: The aim of this study was to investigate the osteoconductive properties and biological performance of porous titanium granules used in osseous defects adjacent to the sinus maxillaris in sheep. The experimental animal study involved 15 yearling sheep with a focus on the osteogenic potential of porous titanium used for subantral augmentation.

Material and methods
Calibrated defects were prepared in the subantral region of sheep. The defects were randomized into tests and control group. The test defects were grafted with porous titanium granules (PTG), whereas control defects were left empty (sham). Defects were left for healing for 30, 60, and 90 days. After healing, the grafted areas were removed and finally osteoconductivity was analysed by OPG and histology.

Results
Significantly more new bone formed in PTG grafted defects compared with sham. The control group showed significantly less expression of key inflammation cells, but with no significant difference in key inflammation cells compared with the experimental groups.

Conclusion
Porous titanium can offer as an effective alternative to calcium phosphate and bone collagen based materials used for
subantral augmentation of the maxillary bone in cases of dental implantation.

**Keywords:** porous titanium granules, subantral augmentation, standardized sheep model, x-ray, histology, histomorphometric assessment, statistics.
TAQMAN REAL-TIME PCR ASSAY FOR DESULFOMICROBIUMORALE IN CHRONIC PERIODONTAL LESIONS

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Abstract:
Introduction
Sulfate-reducing bacteria as well as Desulfomicrobi umorale (D. or ale) have both been shown to play a potential etiopathogenetic role for periodontal disease.

Material and Methods
From 15 treated periodontitis patients 45 subgingival biofilm isolates (SBIs) were obtained from residual periodontal pockets > 5mm. Real-time PCR was performed using species-specific primers and a TaqMan probe. Absolute quantification was achieved by an external recombinant DNA-standard. Sign alignment of the 16S rRNA gene was performed using commercial algorithm. Furthermore the correlation between probing depth (PD) or clinical attachment level (CAL) and the quantity of the target gene of D. or ale were analyzed.

Results
The prevalence of D. or ale within the SBIs was 100%. The mean target gene amount was 7.2E+04. Sign alignment of the sequence of the 16S rRNA gene showed high similarities to further Desulfomicrobi um strains. The correlation of CAL and PD with the target gene count of D. or ale was not significant (p > 0.05).

Conclusion
For the first time the absolute amount of subgingival D. or ale was measured using real-time PCR technology in chronic periodontal lesions. This assay provides a culture independent risk monitoring of patients suffering from periodontitis by qualitative and quantitative analysis of D. or ale.
COMPARISON OF MESENCHYMAL STEM CELLS ISOLATED FROM PULP AND PERIODONTAL LIGAMENT (ONLINE PRESENTATION)

Prof. Dr. Sema S. Hakki, DDS, PhD
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Abstract
Cell-based therapy using mesenchymal stem cells (MSCs) seems promising to achieve regeneration of dental tissues. A comparison of tissue sources, including periodontal ligament (PDL) and pulp (P), could provide critical information to select an appropriate MSC population for designing predictable regenerative therapies. The purpose of this study is to compare the proliferation, stemness, and the MSC-specific and mineralized tissue-specific gene expression of P-MSCs and PDL-MSCs.

Material and Methods
MSCs were obtained from PDL and P tissue of premolars (n = 3) extracted for orthodontic reasons. MSC proliferation was evaluated using a real-time cell analyser for 160 hours. Telomerase activity was evaluated by a telomeric repeat amplification protocol assay based on enzyme-linked immunosorbent assay. Total RNA was isolated from the MSCs on day 3. A polymerase chain reaction (PCR) array was used to compare the expression of MSC-specific genes. The expression of mineralized tissue-associated genes, including Type I collagen (COL I), runt-related transcription factor 2 (RunX2), bone sialoprotein (BSP), and osteocalcin (OCN) messenger RNA (mRNA), was evaluated using quantitative real-time PCR.

Results
Higher proliferation potential and telomerase activity were observed in the P-MSCs compared to PDL-MSCs of premolar teeth. Fourteen of 84 genes related to MSCs were expressed differently in the PDL-MSCs versus the P-MSCs. The expressions of bone morphogenetic protein 2 (BMP2) and BMP6; sex-determining region Y-box 9 (SOX9); integrin, alpha 6 (ITGA6); melanoma cell adhesion molecule (MCAM); phosphatidylinositol glycan anchor biosynthesis, class S (PIGS);
prominin 1 (PROM1); ribosomal protein L13A (RPL13A); and microphthalmia-associated transcription factor (MITF) were higher in the P-MSCs compared to the PDL-MSCs, and higher expression of matrix metalloproteinase 2 (MMP2), interleukin (IL)-6, insulin (INS), alanyl (membrane) aminopeptidase (ANPEP), and IL-10 were observed in the PDL-MSCs. However, there was no statistically significant difference in the expression of mineralized tissue-associated genes, including BSP and RunX2, between the P-MSCs and the PDL-MSCs. Higher expression of COL I and lower expression of OCN mRNA transcripts were noted in the PDL-MSCs compared to the P-MSCs.

**Conclusions**

The results of this study suggest that MSCs isolated from P and PDL tissues show different cellular behaviour. To increase the predictability of MSC-based regenerative treatment, differences in dental tissue-derived MSCs and favourable aspects of cell sources should be further clarified.

**Biography**

May 2002–present: Professor (Full), Selcuk University, Faculty of Dentistry, Department of Periodontology, Turkey, Konya

Research Experience: Periodontics, Cell Adhesion, Cell Biology, Cell Culture, PCR, Gingivitis, Molecular Biology, Periodontal Surgery, Fibroblast, Cell Migration, Periodontal Regeneration, Chronic Periodontitis
MESENCHYMAL STEM CELLS OF DENTAL ORIGIN AS PROMISING TOOL FOR NEUROREGENERATION
(ONLINE PRESENTATION)

Prof. Dr. G. Varga
Semmelweis University Budapest, Hungary

Abstract
Periodontitis is a chronic inflammatory disease leading to alveolar bone destruction, and eventually tooth loss. In genetically or environmentally predisposed individuals periodontopathogenic bacteria trigger an inflammatory immune response where activated macrophages secrete inflammatory cytokines and T helper 17 cells produce interleukin-17, receptor activator of nuclear factor kappa B ligand (RANKL) and tumor necrosis factor-a. Inflammation and the production of RANKL, the key cytokine responsible for osteoclast activation, cause excessive activation of osteoclasts.

This results in a decoupling between bone formation and resorption, leading to bone loss. As conventional treatment does not target the inflammatory response and osteoclast activation, its effectiveness is limited. Novel treatments are thus required if we are to cure this disease. Mesenchymal stem cells (MSCs), including those of dental origin, are potent immunomodulators and are known to be suitable for tissue regeneration. MSCs can inhibit the immune response by suppressing T cells, inducing regulatory T cells and converting dendritic cells and macrophages into a regulatory phenotype. Additionally, genetic modulation may enhance the therapeutic potential of MSCs. In the present review the authors describe the potential use of MSCs, either unmodified or engineered for therapeutic purposes in periodontitis, with special emphasis on MSCs from dental pulp and periodontal ligament. The paper envisions that multiple targeting of this inflammatory disease by modulating the immune response, promoting bone regeneration and inhibiting bone resorption might yield significantly improved treatment outcomes when combined with conventional treatment modalities.
Biography

Director. Professor Gábor Varga, Ph.D., D.Sc.

The Department of Oral Biology is the only theoretical/pre-clinical institute of the Faculty of Dentistry. Founded in 1989, the Department was preceded by the Oral Biology Group of the Faculty of Dentistry, which had been formed by staff members of the Department of Pathophysiology with doctoral degrees in dentistry.

Profile: Oral biology deals with the function and interactions of organs functionally related to the oral cavity, and the relationship of these organs with other parts of the organism both in health and disease.

Education: The Department teaches two subjects and several special courses to 3rd, 4th and 5th year dental students: General and Oral Pathophysiology, a pre-clinical subject with special attention to topics important for dental students, and Oral Biology, which provides knowledge at the pre-clinical level. This latter subject started to be introduced as part of dental education in Hungarian medical schools at the end of the 1970s (1982 at Semmelweis University). The theoretical and practical components of the subjects were developed by the Department’s faculty members, based on the British and Scandinavian approach. Oral biology has been taught in a partial credit-point system since 1994.


Research: The Department’s main focus is on topics related to the interface between modern biology and clinical dentistry. Some of these include:

Postnatal stem cells of dental origin.

We isolate cells from human dental pulp and periodontal ligament, to develop in vitro model systems and processes for identification of stem cells, which have the potential for full or partial regeneration of dental tissues. Cultures containing pluripotent postnatal stem cells from the dental pulp (DPSC), from deciduous pulp (SHED) and periodontal ligament (PDLSC)
are prepared. We determine their proliferative capacity and clonogenity, and study the effect of BMPs and extracellular matrix components on proliferation and (trans) differentiation of these cultures.

Human salivary gland model for exploring the molecular mechanisms of epithelial secretion and for developing gene delivery techniques.

Primary cultures are prepared of human submandibular gland to provide optimal conditions for the formation of either ductal- or acinar-like polarised epithelia. We use cell lines as reference systems. The HSG cells are capable of ductal-lacinar transdifferentiation but it does not form a tight epithelial monolayer. Par-C10, Capan-1, Panc-1 and HPAF can form high-resistance epithelia capable of transepithelial electrolyte and water transport. The work helps to establish the basis for future gene therapeutic interventions by pinpointing possible target genes to correct salivary gland dysfunction. Polymorphism studies of genes potentially involved in periodontitis and hypodontia. The purpose is to map single nucleotide polymorphisms (SNP) related to these disorders in the Hungarian population. Besides polymorphism of genes that are already implicated as factors involved in periodontitis and hypodontia, new SNPs are identified that have not been previously considered as hazards for oral health. These observations may lead to the development of new diagnostic strategies and provide novel tools for early detection and primary control.
3D RECONSTRUCTION OF NON-REMOVABLE IMPLANT SUPRACONSTRUCTIONS IN CERAMICS

Dr. M.A. Vukovic
Witten/Herdecke University, Praxisteam Hasslinghausen, Germany

Univ.-Prof. Dr. W.-D. Grimm
Goldberg Research Institute of Pharmacology and Regenerative Medicine, Tomsk NRMC, Russia
Stavropol State Medical University, Stavropol, Russia
Witten/Herdecke University, Germany

Abstract
Background and Overview
Since the early years of the XXI century it has been conducted studies and developed the clinical concept of 3D reconstruction of non-removable implant supraconstructions in ceramic, at the same time raising the issue of the fast fabrication of the ceramic restorations. We are using in-office computer-aided design/computer-aided manufacturing (CAD/CAM) fabrication of ceramic restorations specifically to complete multiple ceramic restorations for implant patients. CEREC (Sirona Dental Systems GmbH, Bensheim, Germany) divided the system into an acquisition/design unit and a separate machining unit. Three-dimensional software makes the handling illustrative and easy both in the office and in the laboratory.

Clinical Implications
The process of planning and manufacturing of non-removable implant supraconstructions in ceramics will be shown in the presentation.

Conclusions
Sound knowledge of diligent planning is essential for the successful integration of CAD/CAM into advanced implant dentistry. It appears that the CEREC CAD/CAM concept is becoming a significant part of regenerative dentistry.

Biography
Dental technician apprenticeship with degree 1987–1991
Studied dentistry at the Witten/Herdecke University 1995–2001, state examination, approval
Dental work: 2001-2005: Assistant Dentist, Department of Oral Surgery Faculty of Dentistry, Witten/Herdecke University
Since December 2005: own privat practice in Sprockhövel, practice team Hasslinghausen
Certified Practice Areas (Dental Association Westphalia-Lippe), since 2010:
• Aesthetic Dentistry
• Laser Dentistry
• Implantology