3rd INTERNATIONAL SYMPOSIUM ON BIOMATERIALS, October 16-17, 2019

Program

Abstract booklet

Prof.Dr. Drago Dolinar-3 ISB chair

Scientific committee and Organizing committee
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Organized by
Institute of Metals and Technology, IMT

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Faculty of Medicine, University of Ljubljana

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IUVSTA

3. MEDNARODNI SIMPOZIJ O BIOMATERIALIH
3rd INTERNATIOAL SYMPOSIUM ON BIOMATERIALS

PROGRAM IN KNJIGA POVZETKOV/ PROGRAM AND BOOK OF ABSTRACTS

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27th International Conference on Materials and Technology

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Welcome to ISB 2019 Portorož

The Scientific and Organizing Committees are delighted to welcome you in Portoroz on Slovenian Adriatic coast at the 3rd International Symposium on Biomaterials October 16-17, 2019.

The symposium promises a diverse and interesting program and international forum for the presentation and discussion of cutting-edge research related to the interactions of biological systems with engineered, synthetic and natural materials. The Institute of Metals and Technology Ljubljana organize annually International Conference on Materials and Technology since 2000 and three years ago was upgraded with the International Symposium on Biomaterials . The experts, scientists, researchers, and clinicians from the Faculty of Medicine, University Medical Centre will promote the very unique collaboration among different specialties involved in many research fields with a very strong aim to bring contemporary knowledge in the field of biotechnology and biomaterials technology for the high quality standards of treatment to our patients. It is an occasion to meet, to listen, to discuss, to share knowledge and bring together inspired biomaterials people.

We particularly welcome our young researchers, and will facilitate interactions with prominent senior investigators in the field, as well as scientists from leading biomedical institutions.

The Symposium will provide a forum to exchange scientific ideas, inspire new research, and new contacts for closer collaboration, so that we can, together, define the future for our young (and not so young) researchers who are today's reality and tomorrow's future.

Biomaterials 2019 Symposium is a platform for filling the gap between Academia and Industry through discussion on innovative research methods in Biomaterial science.

Biomaterials as a field have seen steady growth over its approximately half-century of existence and use ideas from medicine, biology, chemistry, materials science and engineering. There is also a powerful human side to biomaterials that considers ethics, law and the health care delivery system. The biomaterials market is expected to reach 167 Billion EURO by 2021 from an assessed 79.40 Billion EURO in 2016. The developments of the overall biomaterials market (Metallic, Ceramic, Polymers, and Natural) we hope attribute increased funds & grants by government bodies worldwide.

We wish you a very fruitful scientific event and we are sure that you will experience the beautiful Adriatic–Mediterranean city of Portorož, located on the Slovenian coast in the municipality of the historical Venetian-style town of Piran. The symposium is held in the Congress Centre Bernardin, a part of the prestigious St. Bernardin hotel complex, situated between Piran and Portorož.

Prof.Dr.Drago Dolinar
Prof.Dr Monika Jenko

Scientific and Organizing Commitee

PROGRAM 3.MEDNARODNEGA SIMPOZIJA O BIOMATERIALIH
3rd INTERNATIONAL SYMPOSIUM ON BIOMATERIAL: PROGRAM

Wednesday October 16, 2019

9:15 **PLENARY**

New micro-and nanostructured biomaterial surfaces based on colloidal crystals

Peter Kingshott
Department of Chemistry and Biotechnology, Polymer Nanointerface Engineering Group, Swinburne University of Technology, Melbourne, VIC, Australia

Chair: Drago Dolinar, Monika Jenko

10:00 **INVITED**

Complex tissue defect reconstruction after rhinectomy using 3d planning

Uroš Ahčan [1], Vojko Didanović [2], Aleš Porčnik [1]
[1] Department of Plastic Surgery and Burns, University Medical Centre, Ljubljana, Slovenia,
[2]Department of Maxillofacial and Oral Surgery, University Medical Centre, Ljubljana, Slovenia

10:15 **PLENARY**

The complex interactions between biomaterial, microbe and host

Andrej Trampuž,
Infectious Diseases Research Laboratory Charité –University Medicine in Berlin, Germany

10:45 **PLENARY**

Study of surface phenomena and osteointegration of cementless Ti6Al7Nb hip endoprostheses

Drago Dolinar[1], Matevž Gorenšek[2]
[1] Department of Orthopedic Surgery, University Medical Center Ljubljana, Slovenia,
[2]MD Medicina Ljubljana, Slovenia

11:15 **Coffe break**

Chair: Veronika Kralj Iglič, Aleš Iglič, Blaž Mavčič

11:45 **INVITED**

Different approaches to achieving biodegradability with an Fe-Mn alloy

Matjaž Godec[1], Irena Paulin[1], Črtomir Donik[1], Matej Hočevar[1], Jaka Burja[1], Peter Gregorčič[2]
Aleksandra Kocijan[1]
[1]Institute of Metals and Technology, Ljubljana, Slovenia
[2]Faculty of Mechanical Engineering, University of Ljubljana, Slovenia

12:00 **INVITED**

Comparison of bearing surfaces in cementless primary hip arthroplasty - ceramic on metal versus metal on metal

S. Manojlović, S.Palija, D.Dragičević-Cvjetković
University of Banjaluka, Faculty of Medicine, Bosnia and Herzegovina

12:15 **INVITED**

Spontaneous curvature of healthy human spine as a parameter of bipodal stance contour

V Kralj Iglič [1] , M .Drab [1,2], V. Rehakova [3], J .Leban[3], R. Vengust [2], M.Daniel [4], Š. Bračun

[1]Laboratory of Clinical Biophysics, Faculty of Health Sciences, University of Ljubljana, , Slovenia, [2]Laboratory of Biomechanics, Czech Technical University in Prague, Prague, Czech Republic, [3]Department of Orthopaedic Surgery, University Clinical Centre Ljubljana, Ljubljana, Slovenia, [4]Physiotherapeutica, Medvode, Slovenia

12:30 **INVITED**

Titanium nanostructures for modification of vessel stents

Ita Junkar[1], Metka Benčina[1], Janez Kovač[1], Katjuša Mrak-Poljšak[2], Katja Lakota[2], Snežna Sodin-Šemrl[2], Veronika Kralj-Iglič[3,4], Miran Mozetič[1], Aleš Iglič[4,5*]

[1]Jožef Stefan Institute, [2]University Medical Centre Ljubljana, [3]Biophysics, Faculty of Health Sciences, UNI-LJ , [4]Laboratory of Clinical Biophysics, Faculty of Medicine, University of Ljubljana, Slovenia, [5]Laboratory of Physics, FE University of Ljubljana Slovenia

12:45 **LUNCH**

Chair: Maja Ovsenik, Čedomir Oblak, Rihard Trebše, Igor Kopač

14:30 **INVITED**

IT applications in orthopaedic surgery

Rihard Trebše, Rene Mihalič, Bogdan Ambrožič, Janez Mohar, Jurij Štalc, Benjamin Marjanovič.

Valdoltra Orthopaedic Hospital, Ankaran, Slovenia

14:45 **INVITED**

Corrosion phenomenon of modular hip implants

Ingrid Milošev[1,2] , Vesna Levašič[2], Andrej Cör[2,3], Rihard Trebše[2]

[1]Jožef Stefan Institute, Ljubljana, Slovenia

[2]Valdoltra Orthopaedic Hospital, Ankaran, Slovenia

[3]University of Primorska, Faculty of Health Sciences, Izola, Slovenia

15:00 **INVITED**

Biophysical propertis of super elastic NiTi archwires

M. Ovsenik[1,2], D.Dolinar[3,2], R.Ovsenik[1], M.Godec[4], T. Kosec[5], J.Kovač[6], Č. Oblak[7,2] M. Jenko[4,2]

[1]Dept of Orthodontics and Jaw Orthopaedics Faculty of Medicine, University of Ljubljana, Slovenia , [2]MD-RI Institute for Materials Research in Medicine, Ljubljana, Slovenia, [3]Dept of Orthopedic Surgery; University Medical Center Ljubljana, Slovenia ,[4]Institute of Metals and Technology, Ljubljana, Slovenia, [5]Slovenian National Building and Civil Engineering Institute, Ljubljana, Slovenia, [6]Jozef Stefan Institute,Ljubljana, Slovenia, [7] Dept of Prosthodontics, Faculty of Medicine, Dental Division, University of Ljubljana, Slovenia

15:15 **INVITED**

Modern digital technology for post and core fabrication: an in-vitro measuring of cement thickness

Domen Kanduti, Igor Kopač

Faculty of Medicine, University of Ljubljana,Slovenia

15:30 **INVITED**

Qualitative analysis of 3D printed CoC for proshtodontic applications

Amir Čatič, Zdravko Schauperl[2], Sanja Šolić, Črtomir Donik[3], Irena Paulin[3], Aleksandra Kocijan[3], Matjaž Godec[3]

[1]UNIZG, School of Dental Medicine, Department of Fixed Prosthodontics, Zagreb Croatia

[2]UNIZG, Faculty of Engineering and Naval Architecture, Laboratory for materials, Zagreb Croatia

[3]IMT, Institute of Metals and Technology, Ljubljana , Slovenia

15:45 Mechanical properties and ageing of different zirconia ceramics for monolithic fixed dental prostheses
Nina Grguraš Lestan, Čedomir Oblak
University of Ljubljana, Department of Prosthodontics, Faculty of Medicine, Dental clinic Ljubljana, Slovenia

16:00 **INVITED**
Clinical outcomes of titanium alloy SL-PLUS® femoral stem (Zweymüller): 2,013 Total Hip Arthroplasty cases with up to 25 years of follow-up
Blaž Mavčič
Dept. of Orthopaedic Surgery, University Medical Centre Ljubljana, Slovenia

16: 15 **Coffee break**

16:40 **INVITED**
Wear particles and lymphocytes in tissue around failed joint prostheses
Andrej Cör,
Valdoltra Orthopaedic Hospital, Ankaran, Slovenia

16:45 **INVITED**
Behaviour of human osteoblast-like cells on nanosecond laser-textured 316L surfaces
Matej Hočevar[1], Peter Gregorčič[1,2], Barbara Šetina Batič[1], Veno Kononenko[3], Damjana Drobne[3], Matjaž Godec[1]
[1]Institute of Metals and Technology, Ljubljana, Slovenia
[2]Faculty of Mechanical Engineering, University of Ljubljana, Ljubljana, Slovenia
[3]Department of Biology, Biotechnical Faculty, University of Ljubljana, Slovenia

YOUNG RESEARCHERS, PhD STUDENTS, YRS 17:10 -18:20

YRS Commission: Maja Ovsenik, Peter Jevnikar, Čedomir Oblak, Igor Kopač, Boris Gašpirc, Damjana Drobne, Drago Dolinar, Monika Jenko

17:10 **YRS**
Detection of aluminum oxide in periprosthetic tissue in patients which required revision surgery after aseptic joint failure
Maja Lončar[1], Drago Dolinar[2], Damjana Drobne[1], Sara Novak[4], Gregor Marolt[4], Andrej Cör[5], Monika Jenko[3]
[1]Deapartment of Biollogy, Biotechnical Faculty, Ljubljana, Slovenia
[2]Dept for Orthopeadic Surgery, University Medical Centre Ljubljana, Slovenia
[3]Institute of Metals and Technology, Ljubljana, Slovenia
[4]Faculty of Chemistry and Chemical Technology , Ljubljana, Slovenia
[5]Valdoltra Orthopaedic Hospital, Ankaran, Slovenia

17:20 **YRS**
Adhesion to zirconia ceramics: a problem solved?
Tine Malgaj[1], Andraž Kocjan[2], Peter Jevnikar[1]
[1]Department of Prosthodontics, Faculty of Medicine, University of Ljubljana, Slovenia,
[2] Department for Nanostructured Materials, Jožef Stefan Institute, Ljubljana, Slovenia

17:30 **YRS**
Characterization of new and retrieved titanium dental implants materials
Sonja Žarković Gjurin[1], Monika Jenko [2,3], Črt Donik[2], Čedomir Oblak[1],
[1]Department for Prosthetic Dentistry,Medical Faculty, Dental Division, University of Ljubljana, Slovenia, [2]Institute for Metals and Technology, IMTLjubljana Slovenia, [3]MD-RI Institute for Materials Research in Medicine, Ljubljana, Slovenia

17:40 **YRS**

Evaluation of microbial flora in patients with gingival enlargement during treatment with fixed orthodontic appliance

Rok Ovsenik[1] , Miha Pirc[2,] Jasmina Primožič[3], Rok Schara[1], Boris Gašpirc[1]

[1]Department of Orthodontics and Dentofacial orthopaedics, Faculty of Medicine, University of Ljubljana, Slovenia, [2]Department of Oral Medicine and Periodontology, Faculty of Medicine, University of Ljubljana, [3]Community health center Piran, Portorož, Slovenia

17:50 **YRS**

Soldering of periodontal tissues by a diode laser-activated indocyanine green chitosan membrane

Mojca Trost[1], Boris Gašpirc[2]

[1]Community Health Centre Lenart, Slovenia

[2]Department of Oral Medicine and Periodontology, Faculty of Medicine, University of Ljubljana, Slovenia

18:00 **YRS**

Three dimensional assesement of jaw's morphology

A.Golež, A.Arhar, J.Primožič, M.Ovsenik,

[1]Department of Orthodontics and Dentofacial Orthopaedics, Faculty of Medicine, University of Ljubljana, Slovenija, [2]Orthos Institute, Ljubljana, Slovenia

18:10 **YRS**

Three-dimensional assessment of back asymmetry

J.Primožič [1], M.Ovsenik[2], A.Zhurov[3], S.Richmond[3], V.Antolič[4], J.Primožič[2],

[1]Community health center Piran, Portorož, Slovenia

[2]Department of Orthodontics and Dentofacial orthopaedics, Faculty of Medicine, University of Ljubljana, Slovenia

[3]University of Cardiff, Cardiff, United Kingdom

[4]Department of Orthopaedics, Faculty of Medicine, University of Ljubljana, Slovenia

Thursday, October 17, 2019

Chair: Boštjan Kocjančič, Špela Tadel Kocjančič

9:00 **INVITED**
Percutaneous implantation of self-expandable left atrial appendage occluders for prevention of thromboembolic complications of atrial fibrillation
Andrej Pernat
Cardiology department, University Medical Centre Ljubljana, Slovenia

9:15 **INVITED**
Extracorporeal membrane oxygenation (ecmo) in patients with acute respiratory failure
Špela Tadel Kocjančič,
Centre for intensive internal medicine, University Medical Centre Ljubljana, Slovenia

9:30 **INVITED**
Grit blasted surfaces of cementless hip endoprostheses
Drago Dolinar[1,3], Monika Jenko[2,3], Matjaž Godec [2], Bojan Črtalič[4], Mojca Andolšek Črtalič[4], Matevž Gorenšek[5,3] and Č edomir Oblak[6]
[1]Dept for Orthopaedic Surgery, University Medical Centre Ljubljana, Slovenia
[2]Institute for Metals and Technology, Ljubljana Slovenia
[3]MD-RI Institute for Materials Research in Medicine, Ljubljana, Slovenia
[4]FerroČrtalič, Dolenjske Toplice, Slovenia
[5]MD Medicina, Ljubljana, Slovenia, [6]Department for Prosthetic Dentistry,Medical Faculty, Dental Division, University of Ljubljana, Slovenia

9:45 **INVITED**
Using new designs of reverse shoulder arthroplasty for rotator cuff deficiency
Oskar Zupanc, Timon Zupanc, David Martinčič, Uroš Meglič
[1]University Medical Centre Ljubljana, 1000 Ljubljana, Slovenija
[2]University of Belgrade School of Medicine, Belgrade, Serbia

10:00 **INVITED**
New method to evaluate long term results of Perthes disease
Boštjan Kocjančič[1], Veronika Kralj Iglič[2], Drago Dolinar[1]
[1]University Medical Center Ljubljana, Department of Orthopaedic Surgery, Slovenia,
[2]Zdravstvena fakulteta, Univerza v Ljubljani, Ljubljana, Slovenia

10:15 **INVITED**
Coated spine implants - a risk factor for surgical site infection?
Mirza Biščević[1], Barbara Smrke[2],
[1]Hospital Prim.dr. Abdulah Nakaš Banja Luka, Bosnia and Herzegovina , [2]University Medical Centre Ljubljana, Slovenia

10:30 **INVITED**
Sonication for orthopaedic implant associated infection diagnostics - complication or solution?
Samo Jeverica
Institute of Microbiology and Immunology, Faculty of Medicine, University of Ljubljana, Slovenia

10:45 **Coffee break**

Chair Andrej Moličnik , Oskar Zupanc

11:15 **INVITED**
Secondary breast reconstruction using 3D template enhanced innervated free DIEP flap

Andrej Laposa
Department for Plastic Surgery and Burns, University Medical Centre Ljubljana, Slovenia

11:30 **INVITED**

Case report of ceramic acetabular fracture in total hip arthroplasty with ceramic-on-ceramic articulation

Borut Pompe[1], Darja Freizpur[2], Lenart Zore[1], Monika Jenko [2,3], Drago Dolinar [1,3]
[1]Department for Orthopedic Surgery, University Medical Center Ljubljana , Slovenia,
[2]Institute of Metals and Technology, Ljubljana, Slovenia, [3] MD-RI Institute for Materials Resarch in Medicine, Ljubljana, Slovenia

11:45 **INVITED**

Nano-characterization of wear debris of ceramic-on-ceramic bearing in total hip replacement

Darja Feizpour[1], Monika Jenko[1], Borut Pompe[2], Boštjan Kocjančič[2], Matjaž Godec[1], Drago Dolinar[2]
[1]Institute of Metals and Technology, Ljubljana, Slovenia
[2]Department for Orthopedic Surgery, University Medical Center Ljubljana, Slovenia, [3] MD-RI Institute for Materials Resarch in Medicine, Ljubljana, Slovenia

12:00 **INVITED**

3D printed acetabular endoprosthesis in major acetabular revisions

Andrej Moličnik[1], Urška Kostevšek[2], Tomaž Brajlih[2], Igor Drstvenšek[2]
[1]University Medical Centre Maribor, Slovenia, [2]University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia

12:15 **INVITED**

Thermodynamic effect on selective laser melted biomedical implants

Snehashis Pal[1], Tomaz Brajlih[1], Andrej Moličnik[2], Igor Drstvenšek[1]
[1]Faculty of Mechanical Engineering, University of Maribor, Maribor, Slovenia, [2]University Medical Centre Maribor, Slovenia

12:30 LUNCH

YOUNG RESEARCHERS 14:00 – 14:50

YRS Commission : Drago Dolinar, Monika Jenko, Matej Drobnič, Rok Vengust, Jadranka Buturović Ponikvar, Rafael Ponikvar

14:00 **YRS**

Effect of autoclave or plasma oxygen gaseous sterilization on surface properties of cementless Ti6Al7Nb hip endoprostheses

Klemen Avsec[1], Monika Jenko [2,3,] Marjetka Conradi[2], Alenka Vesel[4], Miran Mozetič [4] Boštjan Kocjančič,[1] Drago Dolinar [1,3]

[1]Department for Orthopaedic Surgery, University Medical Centre Ljubljana, Slovenia
[2]Institute of Metals and Technology, Ljubljana, Slovenia
[3]MD-RI Institute for Materials Research in Medicine, Ljubljana
[4]Jožef Stefan Institute, Ljubljana, Slovenia

14:10 **YRS**

Titanium coated peek for spinal interbody fusion: the best of both worlds?

Aljaž Merčun, Miha Vodičar
Department of Orthopaedic Surgery ,University Medical Center Ljubljana, Slovenia

14:20 **YRS**

Titan vs polyetheretherketone (peek) cages in interbody fusion: review

Klemen Bošnjak[1], Matevž Topolovec[1], Rok Vengust[2]
[1]Department of Orthopaedic Surgery, University Medical Centre Ljubljana, Slovenia,
[2]Department of Spine Surgery, Valdoltra Orthopaedic Hospital, Ankaran, Slovenia

14:30 **YRS**

Hemodialysis catheters: different locking solutions and biofilm

Bojan Medved, Rafael Ponikvar
Department of Nephrology, Center for Acute and Complicated Dialysis, University Medical Centre Ljubljana, Slovenia

14:40 **YRS**

New medium cut-off membrane for hemodialysis

Marija Malgaj, Jadranka Buturović Ponikvar
Department of Nephrology, Center for Acute and Complicated Dialysis, University Medical Centre Ljubljana, Slovenia

Chair: Aleksandra Kocijan, Igor Belič

14:50 **INVITED**

Ultrahigh molecular weight polyethylene (UHMWPE) with improved oxidation and wear resistance for use in arthroplasty

Monika Jenko[1], Jože Grdadolnik[2], Drago Dolinar[3], Matevž Gorenšek[4] Majda Žigon[5]
[1]Institute of Metals and Technology, Ljubljana, Slovenia
[2]Theoretical Department, National Institute of Chemistry, Ljubljana, Slovenia
[3]Dept. for Orthopedic Surgery University Medical Centre, Ljubljana, Slovenia
[4]MD Medicina, Ljubljana, Slovenia
[5]Faculty of Polymer Technology, Slovenj Gradec, Slovenia

15:05 **INVITED**

Structural changes of HDPE upon gamma irradiation

Jože Grdadolnik[1] Urban Novak[1], Majda Žigon[2], Luka Snoj[3], Monika Jenko[4] Drago Dolinar
[1]National Institute of Chemistry , Ljubljana, Slovenia [2]Faculty of Polymer Technology, Slovenj Gradec,Slovenia , Jožef Stefan Institute ,Reactor Podgorica,Slovenia [4]Institute of Metals and Technology, Ljubljana,Slovenia, [5]Dept. for Orthopedic Surgery University Medical Centre, Ljubljana, Slovenia

15:20 **INVITED**

Treatment of implant-associated infections

Lea Papst [1,2]
[1]Department of Infectious Diseases, University Medical Centre Ljubljana, Slovenia
[2]Faculty of Medicine, University of Ljubljana, Slovenia

15:35 **INVITED**

Bio polymeric composite membranes for guided tissue regeneration

Selestina Gorgieva[1] , L. Verestiuc[2], M. Butnaru[2], S. Jeverica[3] and K. S. Kleinschek[1]
[1]Institute of Engineering Materials and Design, University of Maribor, Slovenia
[2]Department of Biomedical Sciences, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania, [3]Institut of Microbiology and Immunology, University of Ljubljana, Slovenia

15:50 **Coffee break**

16:20 **INVITED**
MAGEC growing rod system for early onset scoliosis
Miha Vodičar [1], Matevž Gorenšek[2],
[1]Orthopaedic Surgery, University Medical Centre Ljubljana, Slovenia, [2]MD Medicina Ljubljana, Slovenia

16:35 **INVITED**
The science and characteristics of hyaluronic acid soft-tissue fillers and their use in aesthetic medicine
Samo Gorenšek,
Skin dermatology, Ljubljana, Slovenia

16:50 **INVITED**
Mechanical resonnance of femoral part of hip prosthesis as possible cause of aseptic loosening
Igor Belič[1], Beno Klopčič[2], Andraž Logar[2], Monika Jenko[1,3], Drago Dolinar[4,3], Matevž Gorenšek[5,3], Boštjan Kocjančič[4]
[1]Institute of Metals and Technology, Ljubljana,Slovenia ; [2]BOSCH REXROTH d.o.o., Škofja Loka, Slovenia [3]MD-RI Institute for Materials Research in Medicine, Ljubljana, Slovenia
[4]Dept for Orthopedic Surgeon, University Medical Center Ljubljana, Slovenia , [5]MD-Medicina Ljubljana, Slovenia

17:05 High sensitive magnetoelectric composite sensors for biomagnetic field sensing applications
Matic Jovičević Klug[1], L. Thormählen[1], S. D. Toxværd[2], V. Röbisch[1], D. Meyners[1], R. Knöchel[2] , M. Höft[2], E. Quandt[1], J. McCord[1]
[1]Institute for Materials Science, Kiel University, Kiel, Germany,[2]Institute of Electrical and Information Engineering, Kiel University, Kiel, Germany,

Abstract Booklet

3rd International Symposium on Biomaterials

PLENARY

New Micro- and Nanostructured Biomaterial Surfaces based on Colloidal Crystals

Peter Kingshott
Department of Chemistry and Biotechnology, Polymer Nanointerface Engineering Group,
Swinburne University of Technology, Melbourne, VIC, Australia
pkingshott@swin.edu.au

Complex colloidal crystals are a promising material that is attracting interest in the areas of photonic band gap devices, electronics, displays, chemical sensors and biosensors, and biomaterials and tissue engineering. One of the challenges with decorating surfaces with colloidal crystals is to create ordered structures over large surface areas (cm^2). This presentation will discuss how using controlled solvent evaporation it is possible to surface engineer new types of patterns and structures on surfaces with a range of colloids of different size, chemistry and shape. Precise spatial control of chemistry on surfaces provides an essential platform for the directed attachment of bioactive molecules and control over cell and bacterial attachment and growth. In addition, the crystal layers can be used as masks against deposition of plasma polymers and/or metals such as gold to create complex patterns of dimensions ranging from □ms to sub 100 nms and are useful for post-modification with different chemistries for site-specific immobilisation of biomolecules. This includes using chemistries for preventing non-specific adsorption of proteins and attachment of cells, including new ways of generating high graft density polymer brushes. Also we demonstrate that the colloidal crystals can be sued to selectively graft cell adhesive or antimicrobial peptides that enhance the growth of mammalian cells or kill bacteria respectively. In terms of mammalian cells we are targeting using colloidal crystals to direct stem cell fate in specific cell types and even using them the generate induced pluripotent stem cells (iPSCs) from somatic cells such as fibroblasts. The presentation will also demonstrate the importance of using surface sensitive analytical tools to prove the presence of the different surface chemistries. These include x-ray photoelectron spectroscopy (XPS), SEM, and high resolution time-of-flight secondary mass spectrometry (ToF-SIMS) imaging. Finally, the presentation will provide details of cell and bacterial attachment results to polymers and biopolymer surfaces where the properties have a profound effect on the responses. The potential of these new materials in biointerface science is discussed.

Complex Tissue Defect Reconstruction After Rhinectomy Using 3D Planning

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Two patients, after total nasal defect, underwent a two-stage nose reconstruction using prefabricated free tissue transfer with the help of preoperative 3D planning.

In the first stage, an innervated osteocutaneous radial forearm flap was raised according to the preoperative markings with the help of a biocompatible 3D template. After an osteotomy of the radius, an L-shaped bone framework was reconstructed using a titanium micro-plate. A custom-made titanium coated cage was used as a template for the inner lining of the nose. The “neo-nose” was reattached to the forearm and healed by primary intention, retaining the exact and predicted shape of the titanium cage. In the same procedure a tissue expander was placed under the forehead skin to expand it for the second stage.

After five weeks the second stage was performed. The prefabricated, well-vascularised “neo-nose” was re-raised, including a lateral antebrachial cutaneous nerve, and transferred to the face. End-to-end anastomoses were performed on facial artery and vein; coaptation of the donor nerve was made to a branch of the infraorbital nerve. The bone framework was fixed to the facial skeleton using a titanium micro-plate. A pre-expanded paramedian forehead flap was used for the external coverage of the nose.

In both patients, careful preoperative 3D planning was performed enabling precise and predictable result. 3D planning of complex facial tissue reconstruction can drastically improve patient’s outcome and can facilitate physical and social rehabilitation. In these two patients a fully functional and aesthetically pleasing nose was reconstructed.

PLENARY

The complex interactions between biomaterial, microbe and host

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PLENARY

Surface Phenomena of Zweymüller Cementless Hip Endoprostheses

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Background: Cementless, Zweymüller, hip endoprostheses with SL-PLUS® and Alloclassic ZM or Variall femoral stem was introduced in 1970's, stem is nowadays made of wrought Ti6Al7Nb alloy with the grit blasted surface. It shows excellent secondary stability as proven by high rates of radiographic osseo-integration and often lower rates of revision for aseptic loosening than cemented stems. Since introduction it gaining in popularity with the average life time of 15 to 20 years. Last 20 years more than 2,000 Zweymüller endoprostheses was implanted in a single tertiary hospital in UMC Ljubljana. Our aim is to evaluate the impact of the grit blasted surface on the longevity of ZM cementless hip endoprostheses.

Materials and Methods: The retrieved and new Ti6Al7Nb stems were investigated (selected hip endoprostheses – premature failed due to: aseptic loosening -10; infection-10, latent infecition-10, new -5), using contact angle (water) measurements and profilometry for hydrophilicity, wetting properties and roughness (Bruker Alicona) respectively and scanning electron microscopy (SEM) with EDS, EBDS and FIB (Zeiss Gemini 2 Cross Beam 550), were used to examine surface chemical composition, and morphology and phase analysis. X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES) (Thermo Scientific-Microlab 310F) for surface analysis, Corrosion resistance of alumina grit-blasted and polished surface of Ti6Al7Nb alloy were investigated by the electrochemical experiments, carried out in a simulated physiological Hank´s solution at pH=7.8 and 37 °C. The potentiodynamic curves were recorded using a BioLogic® Modular Research Grade Potentiostat/Galvanostat/FRA Model SP-300 with an EC-Lab® software V11.10., after 1 h of sample stabilization at the open-circuit potential (OCP), starting the measurement at 250 mV vs SCE more negative than the OCP. The potential was then increased, using a scan rate of 1 mV/s.

Results: Sterilization effects the surface properties of Ti6Al7Nb alloy – hydrophilicity/ hydrophobicity [2,3]. We found Al_2O_3 corundum particles contamination on the grit-blasted surfaces of new and retrieved implants. These residues are potential problems -third body wear and probably induction for osteolysis and aseptic loosening. Microstructure of wrought Ti6Al7Nb alloy contains small grains, the majority alpha (hcp)Ti with a small amount of Ti beta grains (bcc) structure. The microstructures of the new and retrieved implants are similar [1]. The thicknesses of the thin oxide films on the Ti6Al7Nb (primarily of TiO_2) were estimated using AES and XPS depth profiling. The Ti, O and C Auger peaks were detected in the AES analysis. The estimated oxide thickness was about 7 nm, consisting primarily of TiO_2. The corrosion rate was calculated for 8.6 µm/year.

Conclusion We need to investigate in details the minimizing of the residual particles on grit blasted implant surface. The results of this study confirmed that the key role in corrosion performance of investigated materials the formation of compact outer oxide layer, which prevents the penetration of aggressive ions and therefore enhances anticorrosion performance of material. The surface-chemistry results showed that thin oxide films on the Ti alloys prevent further corrosion, improve the biocompatibility, and affect the osseointegration. It is obvious that we need to keep an optimal microstructure with regards to the corrosion and mechanical properties, which can be controlled through the production parameters and could be standardized in the near future.

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Different Approaches to Achieving Biodegradability with an Fe-Mn Alloy

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Metallic biomaterials can play an important role in the repair or replacement of bone tissue that has become diseased or damaged. However, the plates, screws and pins used to secure serious fractures must be removed by a second surgical procedure after the tissue has healed sufficiently. This repeated surgery increases the costs to the healthcare system and the risks to the patient. To overcome these problems, biodegradable materials can be used, which temporarily support the healing tissue, but then completely degrade over time. Where heavy loads are not required, poly-lactic acid materials are used today. Otherwise, intensive research is ongoing in the field of metal biodegradable implants based on magnesium, zinc and iron. Fe-Mn alloys are promising candidates for biodegradable metallic materials because of their excellent mechanical properties, which are usually obtained during a multi-stage forming process. However, the biodegradability rate is usually not sufficient and lasts too long. In order to speed up the corrosion rate we use different approaches: alloying elements, grain-boundary engineering and the surface laser texturing of conventionally produced Fe-Mn alloys. There are also possibilities to use an additive manufacturing process to make biodegradable Fe-Mn alloys by choosing the proper selective-laser-melting processing parameters, by mixing different nanoparticles with the Fe-Mn powder and to increase the surface area of the final product that leads to superior bone-tissue regeneration.

Comparison of Bearing Surfaces in Cementless Primary Hip Arthroplasty – Ceramic on Metal Versus Metal on Metal

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After 60 years of the hip arthroplasty, the aim is to construct the implant that is stable, resistant to shocks, inert to body fluids and long-lasting. Researches are conducted in the field of implant materials, design and new bearing surfaces.
The first goal of this study was to prove that CoM is not inferior bearing surface to MoM, using femoral heads larger than 38 mm.The second objective was to detect early complications in meaningful early periprosthetic osteolysis,loosening,and pseudotumors.
Prospective study included 51 patients (34 men, 17 women), mean age 56.5 years, during period April 2011-Jully 2019. All surgeries were performed by the same surgical team, following the same surgical protocol, in period April 2011-September 2011. The same acetabular cup and femoral stem were implanted to all patients, but the femoral head were metal (26 patients) and ceramic (25 patients), sizes 42-58 mm. Evaluation of functional outcome was done by HHS, and WOMAC index. The radiological outcome was done using postition of components, component stability, osteolysis by Gruen and Charnley-DeLey. The monitoring periods were: preoperativelly, immediately postoperative, 6 weeks, 6 months, 1 and 2 years postoperatively. CCS was defined. Today, all patient are in regular annual telephone contact. One patient was lost from study after 6 years because he had changed his country of residence.
During the early follow up period (first two years) stability of both components was satisfactory, acetabular or femoral osteolysis were not observed. Functional score values were at the level of good function after 6 months, and after 1 and 2 years it were maintained. No dislocations, infections and thromboembolic complications were observed. Trendelenburg sign was postoperatively positive in one patient. Heterotopic ossification Brooker I and II occured in 2 patients. Five years after surgery, we had one revision in one patient for an implant infection (MoM) that developed 8 month after biliary sepsis. Intraoperatively, there were no pseudotumors or any signs of metallosis in the patient. Today, all patients have no problems, good functional status and quality of life according to a telephone survey.
In this follow up we observed that CoM is not inferior bearing surface to MoM using femoral heads larger then 38 mm, and in some indicators is even better. We did not observe early osteolysis or pseudotumors in both groups of patient.

Spontaneous Curvature of Healthy Human Spine as a Parameter of Bipodal Stance Contour

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Sagittal equilibrium of bipodal posture imposes the development of the shape of the spine. It is indicated that non-local effects of the spine are of utmost importance for maintaining the equilibrium. In order to describe the effects of the local deformation of the spine constituents on the shape of the spine, we constructed a mathematical model in which the spine (from sacrum to the most exposed point on the thorax) was represented by a two dimensional curve with a given spontaneous curvature. The equilibrium shape of the curve was determined by minimization of its bending energy at relevant constraints and boundary conditions. A phase diagram of equilibrium shapes, determined by the curvature at the sacrum and the dimensionless spontaneous curvature (ζ_0) was elaborated. For some model parameters the shape predicted by the model agreed well with the shape of a contour of a healthy human spine in the sagittal plane of the body. The model was then used for fitting (with respect to ζ_0) the shapes of contours of 31 healthy human subjects in the standing position, obtained from X-ray pictures. It was found that the dimensionless spontaneous curvature strongly negatively correlated with the curvature at sacrum (Pearson coefficient 0.7, $p < 0.0001$). Also, it was found that the values of ζ_0 were obtained within a rather large range between -16.6 and -3.9. Dimensionless spontaneous curvature ζ_0 is a potential parameter reflecting the clinical status of the spine. Assessment of this parameter in cohorts with different pathologies is needed to validate the model.

Titanium Nanostructures for Modification of Vessel Stents

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Titanium and titanium alloys exhibit a unique combination of strength and biocompatibility, which enables their use in medical applications and accounts for their extensive use as implant materials. In cardiovascular applications, titanium stents are commonly employed to enlarge the lumen wall and to restore blood flow through the affected blood vessel. Although titanium alloys are extensively used for stent application they still lack desired biological responses. Namely, mostly due to restenosis. Therefore the long term success of stent implantation depends mainly on avoiding the aggregation of platelets as well as on appropriate proliferation of endothelial cells and controlled proliferation of smooth muscle cells. The presented work provides an elegant solution for prevention of platelet and smooth muscle cell adhesion and activation on stent surfaces, while obtaining surface conditions to support the growth of human coronary artery endothelial cells. This was achieved by surface nanostructuring and chemical activation of the surface. Specific nanostructured surfaces of titanium were obtained by electrochemical anodization, while appropriate chemical properties were attained by treatment of titanium oxide nanotubes by highly reactive oxygen plasma. Our results show that a combination of nanostructuring and plasma modification of the surfaces is an effective way to achieve desired biological responses necessary for implantable materials, such as stents.

Patient Specific Computer Aided Elective Orthopedic Procedures – State of the Art

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Among bone surgeries, 95 % is based on some sort of bone and joint angular analysis before and during surgery. To correctly perform this type of bone surgeries, it is necessary to analyse the preoperative bone geometry, and to perform either a surgical correction of the angles or reproduce the anatomy and fix it afterwards with one of the orthopaedic implants.

For example we may plan to implant an artificial knee implant in a degenerate knee with an important axial deformation, where angular correction is necessary as well as resurfacing of the degenerated joint surfaces. In contrary on an anatomically correct but degenerated hip joint, it is necessary to replace the surfaces but it is important to maintain the geometry and the angles.

Despite the recent technical achievements more than 90 % of bone and joint surgeries are performed freehand and only exceptionally with the aid of image intensifier, rulers and mechanical protractors. The precision is thus mostly dependent on surgeon's experience, insight, subjective intraoperative recognition of bony landmarks, patient position on the table, surgical approach and other less important factors. Only exceptionally and mostly for study purposes commercial computer aided navigation is adopted in the few centres where the technology is ready available.

There are two technical solution for the problem:

For the first the preoperative CT scan is mandatory for the acquisition of bony geometry. It is than necessary to apply the acquired anatomy to the actual bone within the surgical field. Only after this has been synchronized the device can guide our surgical procedure. During the process the patient is submitted to considerable dose of radiation, the surgical time is prolonged, increasing the incidence of complications. The solution is good for rarely performed complex osteotomies.

The other solution involves intraoperative acquisition of the important bony anatomy and the navigation of the surgical steps based on the acquire landmarks. The execution of the bone cuts during the osteotomy is best solved with the first technique. Osteotomies are still mostly freehand, or carried out with the prior installation of guidewires, which, however, cannot always be placed due to soft tissue that is in the way. The control of the execution of bone cuts is carried out by means of intraoperative x-rays producing always a two-dimensional display of three-dimensional problem. Particularly challenging are osteotomies, which require the simultaneous correction of angles in several planes or osteotomies, where it is necessary to simultaneously perform multiple bone cuts. Due to the limited control over the performance of bone osteotomies during surgery, the clinical results are worse than expected, the operation can be prolonged, cuts and corrections suboptimal and exposure to X-ray radiation high. Technical optimization of these procedures significantly improves the clinical output and repeatability of these procedures and shorten the length of the operations and reduce radiation exposure.

We are going to present the technical developments and application of computer aided technologies in: (i) Shoulder problems (ii) Spine pathologies (iii) Pelvic osteotomies (iv)Hip socket implantation (v)Lower limb corrections (vi)Foot and ankle surgeries.

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Corrosion Phenomenon of Modular HIP Implants

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The modular hip prostheses consist of a femoral stem, a femoral head, and an acetabular component. In orthopedic surgery modular prostheses were introduced in the 1990s and, unlike so called monolithic prostheses, allow the surgeon more options in selecting the femoral head material and, above all, the possibility of a change in the femoral offset, resulting in the length of the limb. In addition to these advantages, however, the modularity of the prosthesis represents an additional source of dissolution of the metal in the head/neck cavity. Since 2009, there have been many examples of corrosion revisions in the neck of modular prostheses in literature, which is clinically demonstrated as groin pain, swelling, and the operation of yellowish fluid and the occurrence of pseudotumor (1,2). Increased blood metal concentration, especially cobalt, was observed in patients. Histological analysis showed the presence of lymphocytes, metal particles, necrosis and granulation tissue (1,2).

At Valdoltra Orthopedic Hospital, dual modular prostheses with femoral neck were used extensively, in particular Profemur Z (Wright Medical) (3). Analysis of 32 explant prosthetic components with Profemur Z femoral component and femoral neck of titanium alloy and a femoral head of stainless steel or cobalt alloy will be presented. The revised components were evaluated with respect to the degree of corrosion, composition and morphology of corrosion products and impact on histological image of the periprosthetic tissue.

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Biophysical propertis of super elastic NiTi archwires

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New biomaterials are being constantly developed to respond to the need for better mechanical properties and biocompatibility. In the early 1960s, a nickel–titanium alloy was developed by W. F. Buehler, a metallurgist investigating nonmagnetic, salt resisting, waterproof alloys for the space program me at the Naval Ordnance Laboratory in Silver Springs, Maryland, USA (Buehler *et al*. 1963).

The thermodynamic properties of this intermetallic alloy were found to be capable of producing a shape memory effect when specific, controlled heat treatment was undertaken The alloy was named Nitinol, an acronym for the elements from which the material was composed; *ni* for nickel, *ti* for titanium and *nol* from the Naval Ordnance Laboratory. Nitinol is the name given to a family of intermetallic alloys of nickel and titanium which have been found to have unique properties of shape memory and super-elasticity. The super-elastic behavior of Nitinol wires means that on unloading they return to their original shape before deformation. As the alloy has greater strength and a lower modulus of elasticity compared with stainless steel, there may be an advantage in the use of NiTi in orthodontic treatment.

NiTi wires were first used in orthodontics by Andreasen& Hilleman (1971), who observed differences in the physical properties of Nitinol and stainless steel orthodontic wires that allowed lighter forces to be used.The strength and resilience of NiTi wires meant there was a reduction in the number of arch wire changes necessary to complete orthodontic treatment. Rotations of teeth could be accomplished in a shorter time, without increasing patient discomfort. Nitinol wires showed better resistance to corrosion so were felt more appropriate for intraoral use than stainless steel wires. Andreasen & Morrow (1978) observed the unique properties of Nitinol, including its outstanding elasticity (which allows it to be drawn into high-strength wires) and its ‘shape memory’ (which allows the wire when deformed, to ‘remember’ its shape and return to its original configuration). The most important benefits of Nitinol wire were its construction as a resilient, rectangular wire that allowed simultaneous rotation, leveling, and tipping and torqueing movements, to be accomplished early in treatment of malocclusion.

Contemporary Digital Technology for Post and Core Fabrication: a Pilot Study Measuring Cement Thickness

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Background. Fabrication of a custom cast metallic post and core with direct technique is an established clinical procedure for the treatment of endodontically treated teeth with extensive loss of hard dental tissue. Nowadays computer-assisted digital CAD/CAM technologies can be used in fabrication of post and core. Digital techniques shorten the necessary clinical and laboratory procedures and make fabrication easier, quicker and accurate.

Methods. Intact extracted single-rooted permanent maxillary incisors were used. For each tooth one metal post was fabricated with digital technique using SLM fabrication technology (group A) or one by casting (group B). All the posts were cemented with zinc phosphate cement. All teeth were sliced perpendicular to the axis of the post. The thickness of the cement layer was measured with an optical microscope with 60x and 100x magnification lens. The average cement thickness was compared between both groups.

Results. The average cement thickness for group A was 36.76 ± 17.29 µm in cross-section 1 62.38 ± 15.24 µm in cross section 2 129.42 ± 38.37 µm in cross-section 3 and 142.76 ± 36.35 µm in cross section 4. For group B the average cement thickness was 18,18 ± 4,6 µm in cross-section 1,. 15.36 ± 5.41 µm in cross-section 2 25.41 ± 13.42 µm in cross section 3 and 23.69 ± 13.44 µm in cross section 4.

Qualitative Analysis of 3D Printed CoCr for Metal-Ceramic Crowns and Bridges

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3D printed CoCr for metal-ceramic crowns and bridges have become a standard in prosthetic dentistry. Still, aesthetic and functional durability of metal-ceramic crowns and bridges with 3D printed metal-base in correlation to the production methods has not been extensively investigated, so it has been used without relevant data on material characteristics, nor evidence-based conclusions and clinical recommendations regarding the material. Production phases have significant influence on the final products' characteristics. However, there is no standard for 3D printed metal production workflow, no input atomized powder control, and SLS machine settings are often left to the laboratory technician to master and optimize for their own benefit. This results in unstandardized final product with questionable mechanical characteristics and ceramic bonding strength. 3D printed CoCr metal-base for metal-ceramic crowns and bridges in form of test tubes and actual crowns and bridges will be analyzed for its precision, volume definition, build-up parameters, surface chemistry characteristics and mechanical characteristics.

Objectives:

- Understand the production process of 3D printed CoCr and its influence on the quality of the final product,
- Learn the indications and limitations of 3D printed CoCr,
- Understand the importance of standardization and quality control in 3D printed CoCr from both the raw material and the production process aspects.

Mechanical Properties and Ageing of Different Zirconia Ceramics for Monolithic Fixed Dental Prostheses

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Objective: The development of dental ceramics follows the introduction of new mainly computer-controlled dental laboratory technologies and new clinical indications. The aim of the study was to evaluate the performance of multi-unit posterior monolithic zirconia fixed dental prostheses (FDPs).

Methods: After a mean observation period of 39.8 ± 16.7 months a total of 20 patients received 33 monolithic posterior zirconia FDPs with minimally invasive preparations of the abutment teeth. Three to six unit FDPs were bilaterally supported, had uniform connector diameter of 9 mm^2 and were luted with resin-modified glass ionomer cement. Clinical evaluations were performed one week, 6 months and thereafter annually after completed treatment. Caries and periodontal status of the abutment teeth were evaluated by assessing pocket depth, attachment level, plaque control, bleeding on probing and tooth vitality. Aesthetic qualities and functional performance of FDPs were evaluated according to the rating scales represented by Cvar and Ryge. Using Kaplan-Meier survival analysis, survival rate was assessed.

Results: The survival rate of posterior multi-unit monolithic zirconia FDPs after a mean observation period of more than 3 years was 93.9 %. No chipping or debonding was observed, two FDPs had to be replaced, first due to an endodontic complication of the abutment teeth and second due to fracture in the connector area of five-unit maxillary FDP.

Conclusions: Considering short observation time, the monolithic zirconia FDPs are an appropriate treatment option for prosthetic rehabilitation in the posterior region of dental arches. If the integrity of the surface is well polished, intact and without microscopic surface defects, they exhibit excellent mechanical properties, good marginal stability and good clinical survival.

Clinical Outcomes of Titanium Alloy SL-PLUS® Femoral Stem (Zweymüller): 2,013 Total Hip Arthroplasty Cases with up to 25 years of Follow-up

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Zweymüller uncemented hip endoprosthesis with SL-PLUS® femoral stem has been used for the last 25 years with unchanged design, made of forged titanium alloy Ti-6Al-7Nb with double-taper straight stem of rectangular cross-section. Its grit-blasted 4-8 µm surface roughness enhances bone ingrowth. So far, there has been no report on >2,000 Zweymüller endoprostheses from a single center with >20 years of follow-up. Our aim was to evaluate the impact of surgeon, season of the year and patients age/gender on clinical outcomes of hip arthroplasty in 2,013 consecutive SL-PLUS® femoral stems from a single tertiary hospital.

Retrospective implant survival analysis included all patients who received SL-PLUS® between 1. 1. 1993 and 31. 05. 2017 with Kaplan-Meier and Cox regression (for covariables: age, gender, operated side, season of the year, surgeon). In the cohort of 2,013 primary Zweymüller SL-PLUS® femoral stems (1,042 female / 971 male) implanted at mean 58 ± 11 years of age and 21,335 observed component-years, 154 (7.7 %) femoral stems required at least one surgical revision (0.72 revisions per 100 component-years, 30 retained, 129 removed), 50 (2.5 %) were lost for follow-up and 280 (13.9 %) died unrevised. Survival without SL-PLUS® removal at 5/10/15/20 years after the primary operation was 96/94/93/88 % respectively. Cox regression found statistically significant reduction in implant removal risk if the primary implantation was performed in winter (odds ratio 0.51 in comparison to spring, 95 % confidence interval 0.31-0.83, $p < 0.01$) and by particular surgeons ($p = 0.02$).

Presented data corroborate excellent results of the Zweymüller SL-PLUS® femoral stem from arthroplasty registries. In terms of observed component years, this is the largest single-center study of this implant so far and the first to show a statistically significant impact of the season at primary operation and the surgeon on the risk for subsequent revision surgery.

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Wear Particles and Lymphocytes in Tissue Around Failed Joint Prostheses

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The longevity of total joint prosthesis is limited by the generation of wear debris and its subsequent biologic response in periprosthetic tissue. Histological examination provides essential information about size; shape and types of wear particles and also biological response of periprosthetic tissue to wear particles. Host response to wear particles deposition in periprosthetic tissue is fundamentally similar, whatever the nature of the implant-derived foreign material. Innate, non-specific foreign body response is mediated by macrophages which are specialised phagocytic cells. Beyond the role of macrophages and innate non-specific foreign body response, the mechanisms of interaction between lymphocytes and wear particles are not completely understood.

Wear particles induce an adaptive immune response, histologically demonstrated by the presence of lymphocytes within periprosthetic tissue. Diffuse lymphocytes in periprosthetic tissue around different types of joint prostheses have been described; however no specific attention has been given to this infiltration since lymphocytes are well-known to be a player in the periprosthetic cellular immune response in aseptic loosening. Immunohistochemically most of lymphocytes were determined as T cells, however, no correlation between metallosis and the extent of T lymphocyte infiltration in periprosthetic tissue was found.

A pronounced perivascular lymphocyte accumulation, termed aseptic lymphocyte-dominated vasculitis-associated lesion (ALVAL) is commonly seen in periprosthetic tissue in response to the deposition of Co-Cr wear particles derived from metal-on-metal (MoM) articulation. A cell-mediated immune response occurs when sensitised T lymphocytes recognise an antigen on macrophages and proliferate and release lymphokines which attract and activate macrophages and other lymphoid cells. In most cases the extend of perivascular lymphocyte reaction correlate with the amount of wear, however, it was noted that in a small number of cases relatively low wear had heavy ALVAL response and that a few had high wear with a minimal ALVAL response. Morphology of this reaction is similar to the Type IV hypersensitivity reaction. However, not all patients with failed metal on metal implants have demonstrated an immune response when challenged by metal ions that compose these implants, suggesting other non-allergic mechanism may exist by which metal ions more directly affect implant loosening. Perivascular accumulation of lymphocytes has also been observed following metal on polyethylene articulation. It has been proposed that endothelium is a central regulatory component in trans-endothelial lymphocytes migration.

Histopathological findings in periprosthetic tissue reflect the pathobiology of the host innate and adaptive immune response to wear particle deposition but should always be interpreted in the context of all clinical, radiological, microbiological and allergological data.

Behaviour of Human Osteoblast-Like Cells on Nanosecond Laser-Textured 316L Surfaces

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Considerable effort is being devoted to the surface engineering of biomaterials in order to improve and understand the material-cell interactions in various applications. Within this context, laser surface texturing presents an excellent alternative to other surface modification technologies, due to its flexibility, simplicity, precise control over the morphology and wettability of the modified surface, without affecting the properties of bulk material. **The main idea** of this study is to employ nanosecond Nd:YAG laser pulses at high fluences for texturing AISI 316L stainless steel aiming at improving and controlling material-cell interactions.

Scanning electron microscopy (SEM), X-ray diffraction (XPS), optical 3D surface measuring system and contact angle goniometer were employed for surface characterization of non-treated and laser-textured samples.

Results show that laser texturing greatly modifies surface morphology, topography, roughness, wetting properties, thickness and chemistry of the surface oxide layer.

Subsequently we studied the effect of laser-texturing on human osteoblast-like cells (MG63) and their behaviour *in vitro* after 1, 3 and 7 days of exposure using fluorescence (viable staining) microscopy, cell cytotoxicity assays (Resazurin, NRU and CBB assay) and SEM microscopy for cell distribution and morphology evaluations.

We observed higher number of attached viable cells on laser-textured surfaces in majority of samples. There was only one exception where surface exhibited cytotoxic effect already after 1 day, as seen by lower cell density (fluorescence and SEM microscopy) and by lower cell metabolic activity, the amount of cellular proteins and lysosomal integrity, based on cytotoxicity assessment test.

SEM microscopy proved to be a very good method to study subtitle difference among samples in cell-surface interactions in terms of cell distribution, orientation, cell surface morphology and cell shape. Nanosecond laser surface texturing presents flexible, simple and chemical free approach that can be applied to most metallic materials without affecting the properties of bulk material.

Detection of Aluminum Oxide in Periprosthetic Tissue in Patients which Required Revision Surgery after Aseptic Joint Failure

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Total joint replacement surgery is a common, generally successful and cost-effective procedure in all of surgery. The problem is that all arthroplasty cases implants evoke an initial inflammatory reaction, which generally subsides over few weeks. The finally outcome of the operation is depended on the characteristics of the implant, the precision of the surgical technique and the biological age of the host. However, prosthetic failures occur in approximately 1-2 % of arthroplasty cases due to aseptic loosening. One of the reasons for revision surgery can be wear implant particles (Pajarinen J., Lin T-H., Sato T., Yao Z., Goodman B. S., 2014; Rao J. A., Gibon E., Ma T., Yao Z, Smith R. L. and Goodman B. S., 2012). Particles, which are part of implant, are phagocytosed by macrophages. Activated macrophages produce pro-inflammatory factors and cytokines that induce an inflammatory reaction that activates osteoclast leading to aseptic loosening (Abu-Amer Y., Darwech I. and Clohisy C.J., 2007). The aim of our research was to develop a method to evaluate the chronic inflammatory reaction and elemental distribution in histological sections of periprosthetic tissue. We hypothesize that surface of the implant after blasting residues a large degree of Al_2O_3 particles which are found in the surrounding tissue of the implant. With different histology approaches and ICP-MS we are going to figure out if periprosthetic tissue contains debris of aluminum oxide. We harvested perprosthetic tissue from currently 72 patients which undergoes revised joint replacement after aseptic loosening of implants. All patients had titanium alloy implants, which surface was blasted with corundum to facilitate the ingrowth of bone. We discuss the applicability of using conventional histology and LA-ICP-MS to generate qualitative maps of elemental distribution in thin tissue sections of tissue surrounding the implant. Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) has been efficiently employed to generate qualitative and quantitative maps of elemental distribution in thin tissue sections of a variety of biological samples.

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Adhesion to Zirconia Ceramics: A Problem Solved?

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Establishing a durable bond between the hard dental tissues and the surface of the zirconia ceramic dental restorations is difficult due to the increased chemical stability of zirconia. Surface pre-treatment of the zirconia restorations with a nanostructured alumina coating (NAC) establishes a substantially stronger and durable bond than air-particle abrasion. However, it is crucial to integrate the synthesis of NAC to completely comply with everyday dental laboratory practices.

In our in vitro study, the effect of various dental laboratory firing procedures, such as glaze, veneer and regeneration firings of zirconia on the temperature-dependent phase evolution of NAC was studied and related to the resin cement shear bond strength provided by commonly used zirconia surface treatments. When the NAC was fired at 900 and 1050°C and topotactically transformed to γ- or a mixture of δ- and θ-aluminas, it provided highest and clinically acceptable bond-strengths (>20Mpa) not affected by thermocycling.

In minimally invasive dentistry, replacement of anterior teeth with resin-bonded fixed dental prostheses (RBFDPs) represents a potentially successfull treatment modality. In these type of restorations, however, limited bonding surface of zirconia restoration may lead to a premature debonding. In these cases an enhanced bond strength to zirconia ceramics offered by NAC would be preferable for establishing a long-term clinical success of the restoration. In order to study the clinical performance of NAC coated RBFDPs a clinical study has been designed, where 20 missing anterior teeth have been replaced with coated or air-borne particle abraded RBFDP. The average observation period was 0.82 years and the longest 1.45 years. The survival of the restorations in both groups was 100 %, with the success rate of 90 %. While only one restoration debonded in each group due to a traumatic injury, preliminary results suggest that NAC offers a potentially reliable clinical zirconia pretreatment alternative.

Characterization of New and Retrieved Titanium Dental Implants Materials

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Dental oral implants serve as a reliable treatment option for replacing the missing teeth. It is very important for an ideal implant material to be biocompatible and of adequate strength, corrosion, wear and fracture resistance. The most important step in the stability of the implant is a structural and functional connection between the implant surface and the newly formed bone, which is called osseointegration. It comprises of a cascade of complex physiological mechanisms. Implant's surface characteristics and roughness are the most important in achieving the biomecahanical concept of secondary stability.

Nowdays dental implants may be made from metals, ceramics or even polymers. Titanium and its alloys have shown long-term success and survival, therefore they have become a golden standard. Nontheless, there is a high incidence of perimplantitis and perimucositis connected to titanium dental implants. Further along, there might be even some allergy-like tissue reactions, which for time being are still not scientifically proven.

We have investigated new and retrieved dental implants materials, Ti, Ti6Al4V alloy and CoCrMo alloys using light microscopy, scanning electron microscopy (SEM) for surface morphology and microstructure and energy x-ray dispersive spectroscopy (EDS) for chemical analysis.

The results showed that surface of the implants Ti and Ti6Al4V were roughened by corundum blasting, and the contamination with Al_2O_3 (corundum) was found not only on the surface but also near the surface of both new and retrieved dental implant. It is assumed that retained corundum contamination on the surface of Ti or Ti alloy affects the osseointegration and longevity of the implant which will be studied in details.

Evaluation of Microbial Flora In Patients with Gingival Enlargement During Treatment with Fixed Orthodontic Appliance

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Backgrounds. Gingival enlargement is a common complication of treatment with fixed orthodontic appliance, due to increased plaque retention areas and consequently accumulation of dental plaque, which results in anaerobic conditions, suitable for periodontopathogenic bacteria.

Methods. 21 pacients with fixed orthodontic appliances and gingival enlargement in the upper dental arch were included in the study. For determination of periodontopathogenic bacteria *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythia* and *Treponema denticola* molecular microbiological method GenoType Test System was used.

Results. Three types of periodontopathogenic bacteria, *A. actinomycetemcomitans, T. forsythia and T. denticola*, were found to be present.

Conclusions. During treatment with fixed orthodontic appliance special care is advisable, since this kind of environment is suitable for periodontopathogenic bacteria.

Soldering of Periodontal Tissues by a Diode Laser-Activated Indocyanine Green Chitosan Membrane

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Background: Surgical treatment of periodontal disease requires tight closure of surgical wounds. Drawbacks of suturing are the risk of infection, opening of the wounds and scarring at the site of sutures. Recently developed chitosan membrane with the addition of indocyanine green (ICG) offers an alternative to the sewing material and barrier membranes. The aim of the study was to assess the usefulness of the ICG chitosan membrane in the closure of surgical wounds and as a substitute of membranes for guided tissue regeneration (GTR).

Materials and Methods: In this *in vitro* study, we utilized 50 extracted human teeth and 30 samples of gingiva and ten samples of oral mucosa, both of porcine origin. We have produced chitosan ICG membrane sized 5x7mm and welded them with a diode laser to the gingiva, oral mucosa, and root surface. Histological analysis was used to detect possible thermal damages. Rising of the temperature on the surface of the tissue during laser welding was determined from the temperature profiles recorded with ThermaCAM P45 thermal camera (FLIR Systems, USA). The strength of the linkages of the chitosan ICG membrane to the gingiva, oral mucosa and root surface were measured on a universal tearing machine Instron 4301 (Instron Corp., USA). To determine differences in mean maximum temperature and forces necessary to rupture linkages between the groups tested, we used parametric tests (t-test, ANOVA and LSD "post-hoc" test). For the level of statistical significance was assumed $p < 0.05$

Results: Laser welding of chitosan ICG membrane to the gingiva, oral mucosa and root surface was successful and without any significant thermal tissue damage The maximum temperature measured on the root surface during the welding chitosan ICG membrane was 42.6 ± 9.5 ° C and was significantly lower than for the later welding of the gums at the already welded on the membrane in the tooth (55.2 ± 8.0 ° C) (P = 0.005).Measured tear forces in three groups of laser welded gingiva, and oral mucosa ranged from 0.14 ± 0.05 N in the group gingival epithelial welding, over 0.06 ± 0.01 N in the group of gingiva welded on connective tissue side, to 0.06 ± 0.02 N in the group of oral mucosa.Tear forces in four groups of laser welded chitosan ICG membranes to the root surface and in the group of gingiva, welded to the root surface ranged from 1.41 ± 0.14 N in the group 0°, 0.89 ± 0.15 N in the group 30°, 0.80 ± 0.14 N in the group 60°, 0.52 ± 0.16 N in the group 90° and 0.85 N ± 0.18 N in the group of gingiva welded to the root surface.

Conclusions: Within the limits of our study, we can conclude that laser soldering of oral mucosa and gingiva with can be a complement to the closure of mucosal and periodontal surgical wounds, but it does not replace suturing wounds. Due to the favourable tensile strength of chitosan ICG membrane to the root surface and due to chitosan material properties ICG membrane is potentially useful for replacing nonresorbable membranes. Laser soldering of the gingiva to the root surface can additionally stabilize closure of the periodontal surgical wound.

Three-Dimensional Assessment of Jaw Morphology

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Introduction. Conventional diagnostics in orthodontics and dentofacial orthopaedics are based both on clinical examination, study cast analysis and radiographs to evaluate jaw morphology.

Conventional photographs and radiographs are routinely used for diagnosis and treatment planning. However, these methods are limited as they are a 2D representation of jaws, which are a 3D object. In addition, the unnecessary irradiation of children is unfavourable. Non-invasive 3D scanners have been proven to be safe and reliable in assessing the characteristics and growth of jaws in several case-controlled studies. In order to obtain 3D measurements dental casts have to be digitalized, which can be achieved either by scanning the dental stone models or by using an intraoral scanner. Until recently, the transverse discrepancy between the upper and lower jaw was evaluated by measuring the linear intercanine and intermolar distances. However, this method could be biased in assessing the transverse dimension due to a malposition or buccal tipping of the teeth; therefore the objective assessment of jaw morphology may be unreliable. 3D morphological techniques of jaw morphology assessment have been verified as a useful, reliable and repeatable assessment tool. As a simple and non-invasive method it is increasingly replacing standard diagnostic methods such as x-rays and linear measurements of dental study models. Instead of linear measurements it utilises surfaces and volumes to evaluate morphological characteristics of the jaws.

Aim. Evaluation of jaw morphological characteristics in children with unilateral functional crossbite.

Subjects and methods. A retrospective case-controlled longitudinal research on 55 children. Divided between a group with transverse discrepancy of unilateral functional crossbite (UFCB) and a group of healthy untreated children. Study casts of their jaws were digitalized with an optical 3D model scanner, which uses a laser and camera to obtain the shape of an object by a process of triangulation. Morphological traits of the jaws were analysed in a computer program. In order to measure the jaw surface, gingival surface area and calculate the jaw volume, the boundaries had to be defined. The gingival and distal planes were used as boundaries for the palate. The gingival plane was created by connecting the midpoints of the dento-gingival junction of all primary teeth. The distal plane was created through the two points at the distal of the second primary molar perpendicular to the gingival plane. A palatal surface, surface of the gingival plane and volume of the palate was then calculated. In the mandible, mylohyoid plane was used as the lower boundary and the gingival surface of the lower jaw, surface of the mandible and volume of the mouth floor were calculated. **Results.** Maxillary and mandibular morphological traits were compared between the UFCB and the control group of children. The results of our study showed that maxillary morphological characteristics of the UFCB group were significantly smaller while the mandibular ones were significantly larger compared to the control group. After the orthopaedic treatment of the UFCB group using palatal expansion the jaw morphological traits no longer differed compared to the control group. The values of their morphological traits were equal to the values to of the children in the control group. **Conclusion.** 3D contemporary measurements of jaw morphology such as jaw surface, jaw volume and gingival surface area of jaw morphology assessment were shown as a useful, reliable and repeatable assessment tool. Even though conventional diagnostics in orthodontics and dentofacial orthopaedics are still a golden standard in everyday clinical practice, the 3D contemporary technology may in the future contribute to improve accuracy and allow better diagnosis of morphological irregularities of the jaws. The main advantage of this method is its non-invasiveness which is especially appreciated as a diagnostic tool in growing children.

Three-Dimensional Assessment of Back Asymmetry

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Aim. The aim was to develop a non-invasive landmark independent three-dimensional method for the assessment of back asymmetry in children.

Subjects and Methods. A group of 70 subjects (36 boys, 34 girls; 6.8 ±1.2 years) in the pre-pubertal growth phase was included. Back scans were obtained with the subjects in a standing position using a three-dimensional stereophotogrammetric scanner. Back asymmetry was assessed qualitatively and quantitatively on colour deviation maps of superimposed mirrored three-dimensional back scans. The assessment was performed at different tolerance levels, starting at 2 mm, which was determined as the lowest technically possible tolerance level, based on twenty repeated scans. In order to determine the most valid tolerance level for the assessment of back asymmetry, the diagnostic accuracy was tested at the 2 mm, 4 mm, 6 mm, and 8 mm tolerance levels. As the golden standard we used a dichotomized state variable, based on the actual vertical calculated distances between the Y coordinates of two corresponding left and right reference points on 3D scans. In particular, the absolute vertical distance between the left and right shoulder, the absolute vertical distance between the left and right scapula and the absolute vertical distance between the left and right pelvis were dichotomized and a positive value was assigned when the distance was greater than either 2 mm, 4 mm, 6 mm or 8 mm threshold level. ROC curves were generated and the area under the curve calculated at different tolerance levels. Furthermore, for each tolerance level, the cut-off point with the highest sensitivity and specificity values was also determined. To quantify the full method error, the method of moments variance estimator was used on 20 pairs of randomly selected repeated recordings and was calculated as mean and 95% confidence interval.

Results. The greatest area under the ROC curve, showing at least a good method was seen for the assessment of back asymmetry at the 2 mm and 4 mm tolerance levels, with areas under the curve of 0.93 and 0.87, respectively. While for the 6 mm and 8 mm tolerance levels, the areas under the curve were below 0.70, indicating a poor method for the assessment. The cut-off point for the assessment of back asymmetry at the 2 mm tolerance level with the highest sensitivity (0.82) and specificity (1.00) was 14.2%, while for the 4 mm tolerance level it was at 1.2%, with the sensitivity of (0.86) and specificity (0.75). However, the method error calculated on repeated measurements was 1.6% (1.2%-2.6%) of asymmetry, which is higher than the cut-off point at the 4 mm tolerance level.

Conclusions. The use of a landmark independent stereophotogrammetric method is valid and reliable for the assessment of back asymmetry in children. The most valid level at which asymmetry could be detected was determined to be the 2 mm tolerance level.

Percutaneous Implantation of self-Expandable Left Atrial Appendage Occluders for Prevention of Thromboembolic Complications of Atrial Fibrillation

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Atrial fibrillation (AF) is the most common persistent arrhythmia, affecting up to 2 % of population. Presence of AF increases the risk of ischemic stroke up to 5-fold, and cardiogenic cerebrovascular events carry more mortality risk than do ischemic strokes of other etiologies.[1] For decades, prevention of AF associated thrombembolism was based on blood thinners, such as warfarin, and more recently, direct anticoagulant drugs. However, risk of bleeding associated with this drugs, as well as other factors complicating this therapy, resulted in considerable undertreatment, and less than ideal patient compliance, resulting in a number of unprotected patients with ongoing stroke risk.[2] It has been shown, that approximately 90 % of intracardiac thrombus formation in the setting of AF occurs in the left atrial appendage (LAA). Based on that fact, minimally invasive interventional tecniques of LAA mechanical occlusion have been developed, as an alternative for the patients with contraindication for anticoagulants. During the procedure, a self expandable umbrela-like device is introduced trans vascular via a guiding catheter into the left atrium. Then, it is positioned in the body or the neck of the LAA. The device consists of a nitinol cage with a thin polyethylene/polyester membrane covering the surface facing the LA. In that way, the LAA is excluded from the blood flow, and any potential thrombembolisation from this site is prevented. Data from randomized studies, and registries, has shown, that this treatment provides comparable thrombembolism prevention rates to oral anticoagulants, with lower risk of life threatening bleeding.[3] At our institution, first procedures were performed in 2010, and after several years hiatus, reinstituted in the 2018. Within the last 6 months, six patients were successfully implanted with the device, without complications. On follow up, echocardiographic control confirmed correct device position, and absence of blood flow in the LAA. In summary, percutaneous implantation of the LAA occluding device represents effective, and safe alternative method for the prevention of AF associated trhrombembolism in the patents with contraindication for anticoagulant drugs.

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Extracorporeal Membrane Oxygenation (ECMO) in Patients with Acute Respiratory Failure

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Extracorporeal membrane oxygenation (ECMO) is a method for oxygenation and removal of carbon dioxide in patients with respiratory failure in whom we can not achieve that with standard methods of invasive mechanical ventilation.

The method works as a extracorporeal bypass of blood, which we take from one central vein, then the blood goes through an oxigenator and returns oxygenated and free of carbon dioxide to another central vein. The system is run by a pump with steady non-pulsatile flow.

We use two standard ECMO types. For respiratory failure alone we use veno-venous ECMO, for heart failure we use veno-arterial ECMO. We can also combine more types of ECMO according to the patient´s needs.

We started to use ECMO in 2009, the number of patients is increasing each year. The majority of patients with the need of ECMO has influenza, pneumococcal pneumonia or Legionella species.

With this new method even the patients who would otherwise (even 10 years ago) die of respiratory failure. have a greater possibility to survive

Grit-Blasted Surfaces of Ti6Al7Nb Alloy Cementless HIP Endoprostheses

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Background: The premature failure of cementless hip endoprostheses can be caused by wear-particle-induced aseptic loosening. To enhance the osteointegration of cementless titanium hip implants numerous techniques have been developed to increase the surface roughness. The most widespread mechanical method for surface roughening is blasting using highly purified corundum. The aim of our studies was to investigate the effect of particulate debris from a corundum-blasted titanium implant alloy on the mechanical instability of the joint, on pain increases with detrimental biologic responses, on osteolysis, component loosening and premature implant failure, and to find the optimal grit-blasted surface.

Materials and Methods: The forty Ti6Al7Nb alloy samples were prepared from retrieved femoral stems as a substrate with a polished surface as the starting point for the application of different roughening procedures (blasting material such as SiC, corundum Al_2O_3, optimal blasting conditions in terms of pressure, time and cleaning of the blasted surface using different methods and also an oxygen plasma gaseous treatment) at FerroČrtalič, a leading company for surface-treatment technologies. The surface wettability, surface roughness, surface chemistry and microstructure, using static water-angle contact measurements and scanning electron microscopy with energy-dispersive x-ray spectroscopy were investigated.

Results: On the surface and near the surface of the retrieved and new femoral stems the corundum contamination was found. We used different corundum granulation with the purpose to achieve the 4–8-µm surface roughness and to avoid corundum contamination near the surface. The results of the optimal roughening procedure will be presented. Soft tissue near the femoral hip endoprosthesis obtained during the revision surgery of some patients contains corundum particles.

Conclusion: Corundum particles can cause wear-particles-induced aseptic loosening. The optimal grit-blasting surface modification by highly purified corundum as well as cleaning of the residual corundum on the surface must be achieved to avoid aseptic loosening of the hip endoprostheses.

Using New Designs of Reverse Shoulder Arthroplasty for Rotator Cuff Deficiency

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Introduction. Management of rotator cuff deficiency shoulder (RCD) is still challenging, indeed, and remains a subject of controversy. Several surgical options are available, but none of them is satisfactory. Latissimus dorsi or pectoralis major transfers should be reserved for patients under 65 years with intact subscapularis tendon and low grade osteoarthritis (Fukuda < 3). In older patients surgical arthrolysis or in association with acromioplasty, biceps tenotomy, anterosuperior capsular reconstruction and/or subacromial "ballon" insertion could relieving pain but has little effects on range of motion (ROM). However, reverse shoulder arthroplasty (RSA) is effective in reducing pain and also improve ROM. Finally, it have the best short and medium-term results in patients with RCD .

Methods. Between 2010 and 2014 we used Promos RSA in 62 patients for treatment RCD shoulder with or without osteoarthritis. RSA were performed by three surgeons. All patients were evaluated by independent examiner who performed a clinical pre-operative and post-operative evaluation (follow up of 25 to 38 months) by using Constant-Murley Score, DASH Score, Oxford Shoulder Score and U-Penn Score, as well as by measuring active shoulder ROM.

Results. Two RSP were revised for infection and one for humeral loosening, one because of humeral fracture. In one we remove RSA because of the infection. Finally, 60 patients were included in this series and all of them showed improvement of outcome (Constant Score 28.8 to 59.3, DASH Score 53.9 to 20.8, Oxford Score 19.7 to 39.9, U-Penn Score 25.2 to 59.3). ROM was better in postoperative vs. preoperative evaluation (abduction 106° vs. 46°, forward flexion 116° vs. 51°, external rotation 31° vs. 9°, internal rotation 28° vs. 8°). The pain during activities was reduced on average by 6 grades on VAS and all results were statistically significant ($p<0.05$).

Conclusion. Results of the early designs were apparently poor, although they were not subjected to rigorous clinical research. Authors reported greater pain relief and better function with the fundamental change of Grammont's design. We also confirmed those in our group of patients with RCD shoulder, which have excellent pain relief and significantly improve active elevation. However, RSA requires ongoing prospective studies, with challenges and controversies remaining around present-day designs.

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New Method to Evaluate Long Term Results Of Perthes Disease

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Background: An assessment of the long-term results of Legg-Calvé-Perthes disease is important for two reasons. The first is because of the risk that affected hips may develop osteoarthritis later in life, and the second is the determination of the prognostic criteria of hips at the time of disease and at skeletal maturity which could predict that risk. There are few long-term studies because of the difficulties in finding these patients after a prolonged period.

Methods: In order to study the effect of hip and pelvis geometry on development of the hip after Legg-Calvé-Perthes disease, we determined the resultant hip force and contact hip stress distribution in a population of 135 adult hips of patients who had been treated for Legg-Calvé-Perthes disease in childhood. Contra-lateral hips with no record of disease were taken as the control population. Biomechanical parameters were determined with two mathematical models: the model for resultant hip force in one-legged stance, and the model for contact hip stress. These models which constitute the method HIPSTRESS use as an input the geometrical parameters assessed from standard anteroposterior radiographs. We also compared clinical and radiological data of 66 conservatively and 113 operatively treated hips at the beginning of the disease and at the last follow- up.

Results: Hips that were subject to Legg-Calvé-Perthes disease in childhood had in adulthood considerably (25 %) and statistically significantly ($p < 10^{-8}$) larger femoral heads, and considerably (21 %) and statistically significantly ($p < 10^{-8}$) smaller Wiberg centre-edge angles. There was no difference in resultant hip force and in peak contact hip stress between the test and the control populations, but there was a considerable (148 %) and statistically significant ($p < 10^{-8}$) difference in the contact hip stress gradient index, expressing an unfavourable (steep) decrease of contact stress at the lateral acetabular rim. Most of the 179 treated hips belonged to men (83 %), who were treated between ages 2.3 and 17.6, the average time to follow- up was 25.8 years. For the conservatively treated patients Catterall and Herring scores were significantly lower at the time of the disease ($p < 0.01$, p < 10-4), while at the follow-up Stulberg score was significantly lower ($p < 10^{-4}$) and HHS (Harris Hip Score) higher ($p= 4 \times 10^{-6}$), whereas the difference in Kellgren – Lawrence score was not significant. This suggests a comparably good outcome for operatively treated patients, with both groups having a good average HHS and ROM (Range Of Motion).

Conclusion: Our findings indicate an increased risk of early coxarthritis in hips which are subject to Legg-Calvé-Perthes disease, and support the suggested role of hip stress distribution in development of the hip bones. Patients in our series are doing fine in the third decade after the treatment of Legg-Calvé-Perthes disease, results of our series are comparable with the ones published in the literature. HIPSTRESS method was successfully introduced as a novel method for predicting long term results of Perthes disease.

Coated Spine Implants – a Risk Factor for Surgical Site Infection?

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Surgical site infection (SSI) after posterior spondylodesis of thoracic and lumbal spine is the most common surgical complication, and a reason for revision surgery. There are many risk factors for SSI, such as comorbidities, age of patient, duration of surgery, type of implants, etc. Aim of this work is to analyze is the coating of spine implants a risk factor for the early SSI.

In our study we have analyzed the incidence of deep SSI after posterior spondylodesis performed on our Spine department during last 10 years (May 2008. – May 2018.). Including criteria were: posterior spondylodesis with transpedicular screws from Th1 to S2 due to different indications (injuries, degenerative diseases, deformities, tumors, etc), and absence of clinical signs of local or general infection prior the surgery.

Four hundred eighty nine patients with 505 surgeries have been included in this study, with average follow up of 4.3 years (2.0-10.5 y.). Early SSI (within a month after the surgery) has appeared at 13 patients (2.57 %). In the group of 153 patients whose titanium implants were uncoated, only 2 infections has been noted (1.31 %). The rest of 11 patients with early SSI were from group of 352 patients with coated spine implants (3.12 %). Type of implants we have used in some surgery was depended only by implant availability at that moment, and not by any other reason (diagnosis, age, etc.). All 13 patients with SSI have been treated by revision surgery as sooner as possible (thorough debridement, prolonged drainage, and antibiotic therapy according the instructions of infectologist). MSSA and MRSA were the main species in the both groups, while ESBL-producing Klebsiella has caused infection only in two patients from “coated” group. Other risk factors like diabetes, polytrauma, duration of preoperative hospitalization, duration of surgery, and advanced age were more common in group of 13 SSI patients, then in the other group of 492 patients without SSI.

In spite the fact that patients in our two groups were not stratified by age, diagnosis, presence of comorbidities, duration of surgery, or other risk factors that might influence on development of early SSI, its incidence was almost 2.5 times higher in the “coated” in comparison to the “uncoated” group (statistically insignificant $p>0.05$, $Chi^2= 0.773$). The larger cross-sectional study might confirm statistical significance, like in many other studies that support usage of uncoated titanium implants.

Sonication for Orthopaedic Implant-Associated Infection Diagnostics – Solution or Complication?

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Orthopaedic implant-associated infections are a major complication of primary arthroplasty or fracture fixation surgery. Traditionally, microbiologic diagnostics relied on multiple (3-5) periprosthetic tissue cultures for isolation of causative agents. However, this procedure was lacking sensitivity and relied on good sampling technique. Furthermore, it was difficult to process explanted orthopaedic material such as prosthesis or fixation devices in a microbiological laboratory due to its physical characteristics.

Sonication of explanted material, a procedure in which an explanted material is aseptically transferred to a sterile container, submerged into sterile solution (i.e. saline or Ringer) and sonicated with a low energy ultrasound waves to dislodge biofilm-associated bacteria was a major advancement in microbiologic diagnostics of these infections. First and many subsequent reports showed a significant increase in both sensitivity and specificity of PJI diagnostics. In addition, the method was more suitable for liquid-based culture diagnostic, now popular in microbiologic laboratories.

More than 20 years after the first publication of removed prosthesis sonication by Tunney et al. (1) and more than 10 years after the seminal paper from Trampuz et al. (2), we look at the adoption of sonication as a method in clinical microbiology laboratories and review the latest literature with respect to comparison of sonication to other diagnostic methods. Finally, we discuss the major strengths and limitations of the method in everyday clinical practice and reflecting our local results and experiences.

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Secondary Breast Reconstruction using 3D Template Enhanced Innervated Free DIEP Flap

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Autologous breast reconstruction has become the golden standard of reconstruction after oncologic treatment for breast cancer. Its advantages are even more profound in cases of secondary breast reconstruction, where there's a deficiency of soft tissue and skin envelope. For the purpose of achieving a better aesthetic result, the principle of 3D template enhanced secondary breast reconstruction was developed at our department. In recent years the concept of innervated autologous breast reconstruction has evolved. Combining both methods enables us to achieve a reconstructive result, that comes close to the goal of reconstructing "like with like".

In order to pursue this goal, patients, who are candidates for secondary autologous breast reconstruction are invited for a preoperative planning, where the contralateral healthy breast is scanned and a mirrored 3D template of the healthy breast is created. The breast is then reconstructed with autologous tissue (deep inferior epigastric perforator flap) using 3D template from the contralateral healthy breast. Additionally, a coaptation of the anterior branch of the 3rd intercostal nerve with the dominant lateral intercostal nerve innervating the DIEP flap is performed. To evaluate the results, patients are requested to complete the BREAST-Q questionnaire before the reconstruction and at the end of the follow up. The sensibility of the flap is tested on predefined areas of the reconstructed breast in intervals of 6, 12 and 24 months after the reconstruction.

According to previous studies sensibility of the reconstructed breast after innervated autologous breast reconstruction contributes significantly to the satisfaction of patients. In selected patients breast reconstruction using 3D template from the contralateral healthy breast can produce results that are superior to traditional methods of autologous tissue shaping, as in the cases of secondary breast reconstruction the weight of the removed breast and postmastectomy skin envelope is not available.

With the advantages of both methods combined, we are one step closer to the ideal reconstructed breast.

Ceramic-on-Ceramic Articulation

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Female of 64 years, was admitted to Clinics for Orthopaedic surgery, UMC Ljubljana, Slovenia, in December 2010 due to advanced arthrosis of the right hip. She has undergone total hip arthroplasty surgery - EcoFit endoprothesis, femur 8,75 lateral with acetabulum size 48, ceramic inlay and short ceramic head size 32.

In 2017 she reported pain and crepitations of the prothesis during the movements of right hip. She got local block injection in the trochanteric region. X-ray showed good position of prothesis. In December 2018 the patient reported pain in the right trochanteric hip region which exuberates during minimal movements. She limps when walks. X- ray of pelvis with hips presented cranialization of implanted head together with acetabular changes in the inferior part of the right hip endoprothesis. It has been speculated that ceramic parts have fractured and there have been soft tissue reaction due to ceramics.

In January 2019 she went for revision surgery due to fracture of ceramic implants of EcoFIt prothesis. Cemented double mobility prothesis together with matching femoral head was implanted. Additionally there was a lot of reactive soft tissue removed around the hip joint due to methalosis. Few days after she dislocated the prothesis and another revision surgery was made the size of the head was changed for XL. One week after she dislocated her hip (3rd time) an was rated with closed reposition. A month later she dislocated right hip again. Revision surgery was made with double mobility implant (PolarCup 55/28, stem 5 Link) and Muller ring. During rehabilitation she luxated her right hip two times more and was treated with closed reduction.

In April 2019 the patient went for a surgery where we released fibrous and necrotic tissue around right hip area as well as fixation of greater trochanter with the polypropylene mash and transposition of m. gluteus maximus to the insertion. Three weeks after this surgery patient came back with periprothetic infection. She went for a revision surgery and removal of the implant. Staphylococcus Aureus was treated with antibiotics and patient ended with 6 cm shortening of the right leg. She is able to walk with walker on a short distance.

Nano-Characterization of Wear Debris of Ceramic-on-Ceramic Bearing in Total Hip Replacement

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With around 1.3 million implantations of biomaterials worldwide per year, total hip replacement (THR) is considered as one of the most frequently performed implantations of biomaterials in orthopaedics. Ceramic-on-ceramic (COC) bearings, based in alumina or zirconia, are one of the prominent materials for such intervention. Studies about the reaction of tissues on organic and inorganic particles are a topic of a multitude of medical disciplines. Especially in the field of surgical disciplines like orthopaedics, particle studies that investigate the influence of the abrasion of different prosthetic materials on the peri-prosthetic tissue are undertaken to find out about the evidence on their respective biocompatibility.

In this case study artificial hip parts were constructed of COC bearings (femoral head and acetabular inner cup), a Ti-Al-V acetabular metal outer cup, and a corundum grit-blasted Ti-Al-V femoral stem. The aim of the study was to determine what kind of wear-debris particles were present in the tissue, what was their composition and possible crystal structure.

The debris particles were obtained by dissolving the tissue sample in 95–97 % sulfuric acid, washing the remains with distilled water, filtering them, and finally cleaning them with ethanol and leaving them to dry, and as such were used for the different, above-mentioned investigation techniques. Extracted debris particles were further prepared for the TEM with the drop-casting technique on a lacy formvar/carbon-coated Cu grid and analyzed at 200 kV. The particles were mainly agglomerated, which was clearly visible from the STEM elemental mapping, and were between a few μm to around 10 nm in size. Their shape varied from rods, rectangular and rounded. The larger particles usually had sharp edges, and the smallest particles in the nm range were usually a rounded shape. Some particles were amorphous and some crystalline.

3D Printed Acetabular Endoprosthesis in Major Acetabular Revisions

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Revision total hip arthroplasty (THA) in cases of large acetabular bone defects can be challenging especially in cases of major non-contained acetabular defects with a limited bone stock or in the presence of pelvic discontinuity (Paprosky type 3A or 3B). Achieving revision goals in terms of anatomy (bone stock restoration), stability and long-term fixation and biomechanics could be done with various techniques and devices available. Most defects could be treated with standard "techniques", but large non-contained defects involving both columns remain problematic.

Standard, ***double*** and ***jumbo cups*** provide good long term results but are not always suitable for large structural defects on both columns because they need large contact areas for osteointegration and they don't allow major bone stock restoration. "***High hip rotation center"*** technique could be used in superior but again limited bone stock insufficiency with awareness of leg length discrepancy and abductor muscle tension problem. ***Rings*** and ***cages*** (with or without ***impaction bone graftin***g) allows optimizing position for better stability, because on second stage cemented cup (all-poly, dual mobility) could be placed in more optimal position in terms of biomechanics (version, inclination, hip centre). Bone stock restoration is possible with this technique if there is enough containment and host bone contact but it is not successful in large structural deficiencies. In large, non-contained defects good structural support could be achieved with ***augments*** or ***structural allografts*** when good primary stability is possible, however augments cannot restore the bone stock and the allografts may fail before osteointegration.

Development of **custom-made acetabular components (CAC**) was driven by idea to overcome the problems of primary stability and hip biomechanics restoration in most severe cases of bone deficiency. The stability of such an implant could be optimized by maximizing host-bone contact trough customized shape of implant, by customized screw fixation, by customized and guided (with custom guides) bone defect preparation for optimal defect-implant fitting and by additional fixation trough three flanges that fit the iliac, ischial and pubic bone. Customization of hemispherical cup placement into the implant allows optimal hip centre, inclination and anteversion angle and hence the biomechanical restoration of joint. Designing of those implants is based on 3D models produced from CT scans trough the evaluation of specific bony situation and proposal of virtual implant solution according to mentioned biomechanical and fixation issues. Implant, model and guides are manufactured with additive manufacturing techniques with selective laser melting. In case of implant, focused laser beam melts Titanium powder layer-by-layer to produce the final implant with all planned information (shape, fixation, surface, final cup position). Presented will be our short to mid-term results, preoperative planning, intraoperative issues, and complication with this treatment option for large acetabular bone defects.

Thermodynamic Effect on Selective Laser Melted Biomedical Implants

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Many patient specific implants (PSI) are nowadays produced using selective laser melting of Titanium alloys. The main objective of PSI is to fit the surrounding bone tissue, enable good osteointegration and provide mechanical stability and durability. While the fitting and some aspects of osteointegration mainly depends on the modelling process, the mechanical properties mainly depend on the processing parameters of the SLM process. Several thermodynamic effects, which occur in Selective Laser Melting (SLM) process, influence the metallurgical, mechanical, and chemical properties of a component. Metallurgical and mechanical properties include microstructure, porosity, hardness, ductility, tensile and surface properties. Whereas, corrosion resistance depends on the metallurgical properties of the component. These properties depend on several phenomena included in melting, fusion and solidification functions. The phenomena can be regulated with the proper states of the fabricating parameters. There are several parameters included in the environment, powder layer properties, and laser scanning strategies. Whereas, the technological parameters included in energy density namely laser power, scanning speed, hatch spacing, and layer thickness lead egregious role on these phenomena and eventually, lead the product properties as well as productivity. These technological parameters consequence several physical behaviors of the material and that influence melting quality, spattering, stability and viscosity of melt pool, balling effect, inert gas entrapment, oxidation, air behavior at the action zone, fusion, cooling rate, and solidification process. Carrying out several experiments with Ti-6Al-4V alloy specimens, this paper is going to present the influences of laser powers, scanning speeds, hatch spacings and remelting on the characteristics of the components.

Effect of Autoclave or Plasma Oxygen Gaseous Sterilization on Surface Properties of Ti6Al7Nb Alloy Femoral STEMS

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Background: Zweymüller uncemented hip endoprosthesis with SL-PLUS femoral stem has been used for the last two decades, nowadays made of forged Ti-6Al-7Nb alloy. Grit-blasted surface roughness 4-8 μm enhances bone ingrowth. Approximately 10 % of these implants fail prematurely due to aseptic loosening, infection or latent infection. Our aim is to evaluate the impact of material and roughening procedure on clinical outcomes of hip arthroplasty and compare them with the new stems of different producers. The aim is to investigate the effect of cleaning and sterilization procedures of retrieved and new femoral stem on surface wetting properties, roughness and cell response

Material and Methods: The retrieved ZM type Ti6Al7Nb femoral stems were selected from the register of the Orthopaedic Clinic of University Medical Centre Ljubljana and two new femoral stems for comparison. Both new and retrieved stems were sterilized by classical autoclave procedure and for comparison by plasma oxygen gaseous sterilization. Surface wettability was determined by measuring the static contact angle of a water drop, whereas the surface energy was calculated from static contact angles using two liquids water and diiodomethane (DI). The most hydrophobic stem was treated in RF plasma reactor of oxygen plasma (pressure 50 Pa, current through the coil 0.3 A for min).

Results: The surface of the femoral stems is hydrophobic. There is no significant difference when comparing wettability of the new and retrieved stems. The wettability of the investigated femoral stems was quite similar. Because there were no significant differences between different hips, we choose a hip with the most hydrophobic surface further plasma treatment to change its wettability. When applying the water drop to the plasma sterilized surface, it completely wetted the surface – no drop was formed on the surface, therefore it was not possible to measure the contact angle for water only the contact angles for diiodomethane.

Conclusion The surface of the femoral stems sterilized by autoclave method is hydrophobic. There is no significant difference when comparing wettability of the new and retrieved stems. After plasma treatment the surface of the stem changed from hydrophobic to super-hydrophilic.

Titanium Coated PEEK For Spinal Interbody Fusion: The Best Of Both Worlds?

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Degenerative spine disorders often require surgical intervention. Spinal interbody fusion is a rapidly evolving procedure with advances in terms of approach and implant design and material selection. The fundamental goals of this procedure are pain relief and functional status improvement. The role of interbody devices or cages is restoration of disc height, mechanical load transmission and stress shielding until arthrodesis occurs.

Most commonly used materials for manufacturing cages represent PEEK (Polyetherether-keton) and titanium alloys. Titanium became widely used since discovery of its excellent osteointegration capacity. Downsides of the titanium are radioopacitiy and its high module of elasticity (≈110 GPa), which is considerably higher than cortical bone's (≈5 GPa). This represents hazard for subsidence and implant failure. On the other hand PEEK's module of elasticity (≈4 GPa) is similar to the cortical bone's, along with the advantage of radiolucency[1]. Drawbacks are inert and hydrophobic nature of the material that may lead to poor osteointegration, the so called "PEEK-halo effect"[2].

Most appropriate implant selection would thus include the ability of the surface of the implant to integrate into the bone (titanium), structural similarity to cortical bone – module of elasticity (PEEK), and radiolucency to allow for assessment of placement and fusion (PEEK). With these principles in mind a titanium coated PEEK (Ti-PEEK) was developed.

Studies report of Ti-PEEK's superior in-vitro osteogenic potential and less cytotoxicity in comparison to PEEK[3]. Micro-CT imaging and histological analysis confirmed bone ongrowth on the titanium coated PEEK surfaces, compared to fibrous tissue along PEEK's surfaces[4]. Study of ovine lumbar fusion also found boney ingrowth and ongrowth on the Ti-PEEK, leading to greater construct stability compared to regular PEEK[5]. A prospective single surgeon study reports fusion rate of 95 % (20 patients) in ALIF procedure using Ti-PEEK with a mean follow up of 15 months[6].Several other studies found out improved or identical fusion rates with Ti-PEEK compared to PEEK[1]. Wear and loss of coating material during impaction were found to be significantly greater in Ti-PEEK compared to normal and porous PEEK[7,8], and recently published study reports that porous PEEK was associated with improved osteogenic differentiation and greater implant fixation rate compared to smooth PEEK and Ti-PEEK[9].

Conclusion: Studies promote Ti-PEEK as a safe material combination that could theoretically improve fusion and fusion rates, although long-term studies are necessary for confirmation. Adjustments of coating methods are in place in order to reduce the wear during impaction.

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Titan vs Polyetheretherketone (PEEK) Cages in Interbody Fusion: Review

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Spinal interbody fusion is an accepted surgical method in degenerative spine conditions (1, 2). With the aid of interbody devices, fusion between two adjacent vertebrae is achieved. Many authors evaluated Titanium and Polyetheretherketone (PEEK) cages for bony fusion, with different results reported in literature.

Titanium displays good corrosion resistance, low density and the ability to enhance cell adhesion and osseointegration (1, 3). While Titanium has favorable fusion rates, it has some significant shortcomings. High radiodensity causes imaging artefacts and hinders accurate assessment of fusion (2, 3). Because of the difference in Titanium and bone elasticity, cage subsidence is caused, with the cage sinking into the adjacent vertebral body (1, 4).

PEEK is a hydrophobic polymer with elastic properties closer to cortical bone (1, 5). This contributes to lower stress generation between PEEK cages and vertebral endplates, resulting in lower subsidence rates (1, 5). Additionally, it is radiolucent which allows a clearer assessment of bony fusion (4, 5). However, PEEK is chemically inert and only allows cell adhesion to a limited degree (1-3). Because of lower PEEK osseointegration micromotion might be induced between cage and vertebral endplate surfaces, leading to focal bone resorption and osteolysis (2, 4).

To address the shortcomings of both materials, new PEEK composites with Titanium coating are under development (3).

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Hemodialysis Catheters: Different Citrate Locking Solutions and Biofilm

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Hemodialysis is a method of treatment acute and end-stage renal failure. Hemodialysis requires a vascular approach, which may be an arteriovenous fistula, graft, or hemodialysis catheter. Precurved non-tunneled jugular hemodialysis catheters have been established as a permanent vascular approach in recent years, particularly in elderly patients with associated diseases. The most important complications of using hemodialysis catheters in long-term are thrombosis and infection. To avoid these complications, hemodialysis catheters are filled in interdialysis period with trisodium citrate solution after each procedure, which prevents catheter thrombosis and has an antimicrobial effect, preventing infection and critical biofilm growth in the hemodialysis catheter lumen. So far, little research has been done to investigate the efficiency of different concentrations of trisodium citrate on biofilm and the safety of its use. Higher concentrations of trisodium citrate more effectively prevent thrombosis or blood clot formation and are more effective in preventing infections and biofilm formation, but due to their potential side effects, their use is limited.

Use of hemodialysis catheters is a major risk factor for bacteremia in dialysis patients, and prolonged use of hemodialysis catheters increases the risk of inadequate blood flow due to thrombosis of hemodialysis catheters. Biofilm is formed in the lumen and on the surface of hemodialysis catheters. It is a collection of microorganisms covered with a dense matrix and is involved in infections of hemodialysis catheters inserted into patients. Dissemination of the biofilm in dialysis patients may results in bacteremia and endotoxemia.

The purpose of our study is to compare the effect of two different concentrations of trisodium citrate solution (30 % and 4 %) on biofilm formation in hemodialysis single-lumen jugular hemodialysis catheters and to determine the effectiveness of preventing hemodialysis catheter dysfunction.

The research will be performed as a prospective controlled clinical trial. About 60 patients will be included in the study. In the patients to be included, after the simultaneous insertion of two jugular catheters, one catheter will always be filled with 30 % trisodium citrate solution, the second catheter with 4 % trisodium citrate solution in the interdialysis period. In the included patients we will compare time to onset of hemodialysis catheter dysfunctions and possible catheter related infections: bacteremia or sepsis. In the selected patients we will examine by electron microscope catheter inner surface and the morphological characteristics of the biofilm. Microbiological characteristics of the biofilm will be evaluated by microbiological method (sonication) of the catheter segment and cultivation on solid and liquid media.

Occurrence of hemodialysis catheter dysfunction, morphological parameters and microbiological characteristics of the biofilm in the lumen of hemodialysis catheter are expected to be statistically different using different concentrations of trisodium citrate solutions (30 %, 4 %). The data obtained will help us to understand the adverse events occurring with the use of hemodialysis catheters, filling with different concentrations of trisodium citrate solutions, and will guide us to use one of the investigated citrate solutions (30 % or 4 %) with the greater potential in preventing biofilm formation and dysfunction.

New Medium Cut-Off Membrane for Hemodialysis

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Hemodialysis (HD) is the predominant treatment method of acute and chronic end-stage renal disease (ESRD). ESRD results in the retention of uremic toxins which are classified into small (<500 Da) and middle-molecular (500 Da-60 kDa) water-soluble solutes and protein-bound substances. While conventional high-flux HD removes small solutes and smaller-sized middle molecules, clearance of larger middle molecules and protein-bound substances is poor. Studies have associated middle molecules to pathological features of uremia, such as immune dysfunction and inflammation, as well as a risk factor for cardiovascular diseases and higher mortality in dialysis patients. Medium cut-off (MCO) dialyzers utilize a novel class of membranes designed to increase the removal of larger middle molecules in HD. Most recently designed MCO dialyzer is made of polyarylethersulphone-polyvinylpirrolidone (PES-PVP) membrane (Theranova®), which has novel properties: the membrane structure is aassimetric and has 3 distinct layers (a very thin inner, a sponge-like intermediate and a finger-like macro-porous outer layer). This structure enables higher clearance of middle molecules and only limited albumin loss despite of increasing pore sizes. During HD, blood is exposed to an extracorporeal circuit which activates thrombogenic pathways and clotting, which in turn decreases HD efficiency, and may be associated with increased inflammation and accelerated atherosclerosis in dialysis patients. Therefore, effective intradialytic anticoagulation is required. While unfractionated heparin (UFH) is still the most commonly used intradialytic anticoagulant, regional anticoagulation with citrate has been established as the best possible method of intradialytic anticoagulation, particularly in patients with active bleeding or a higher risk of bleeding.

The purpose of our study is to compare the efficiency and biocompatibility of citrate and heparin anticoagulation during HD with PES-PVP membrane, which has never been done. The research will be performed as a prospective clinical trial and will include 35 patients. Every patient will have 2 HD procedures with PES-PVP membrane in a randomized order: 1 with UFH and 1 with 8 % trisodium citrate. We will compare the efficiency of both types of anticoagulation by measuring clearance of small and middle molecules: serum concentration of uremic toxins (urea, creatinine, β2-microglobulin, phosphate) before and after HD, total dialysate concentration of β2-microglobuline and phosphate, sieving coefficient (SC) after 15 minutes and just before the end of HD. Biocompatibility will be evaluated by measuring activation of: complement (serum concentration of C3a and C5a), leukocytes (serum concentration of myeloperoxidase) and thrombocytes (serum concentration of PF4). We will also monitor complete blood count for occurrence of leukopenia and thrombocytopenia. We will measure all the parameters of biocompatibility before, after 15 min and 1 hour and at the end of HD. After the HD electron microscopy of the membrane will be done to evaluate adsorption of cells and formation of blood clots on the membrane.

We expect to show statistically higher clearance and biocompatibility of HD with PES-PVP with citrate anticoagulation in comparison to heparin anticoagulation. Findings could represent the basis for routine use of PES-PVP membrane in maintenance HD, which could lead to reduced risk of cardiovascular diseases and to lower mortality rate in dialysis patients. However, to prove that, additional randomized clinical trials would be needed.

Ultrahigh Molecular Weight Polyethylene (UHMWPE) with Improved Wear and Oxidation Resistance for Use in Arthroplasty

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In total hip, knee, shoulder and ankle arthroplasty, the ultrahigh molecular weight polyethylene (UHMWPE) has been used as a material of choice since the year 1962, when it was clinically introduced by Sir John Charnley. Due to the linear polymer chains and high molecular mass (from 2 to 7 millions) UHMWPE is resistant to wear and possesses good mechanical properties.

In this contribution, will present the development of a highly crosslinked UHMWPE (HXLPE) with improved properties in comparison to conventional UHMWPE. HXLPE of the first generation was clinically introduced in 1990s and possessed a high resistance to wear but reduced mechanical properties. However, HXLPE of the second generation, introduced in 2005-2008, showed improved mechanical properties and oxidation resistance, while maintaining a high resistance to wear. Differences in properties of HXLPEs of the first and second generations will be explained by differences in their structures as a consequence of various treatment processes.

Structural Changes of Ultra-High Molecular Weight Polyethylene Upon Gamma Irradiation

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Ultra-high molecular weight polyethylene (UHMWPE) has been in use in total joint replacements for well over four decades. It is used as a cup or liner material which slides past a metal femoral head. Although considering all chemical and mechanical properties, UHMWPE is currently the ideal polymer for such use, any small deviations in the chemical structure of the polymer may result in a change of mechanical behavior of the replaced joint. UHMWPE represents the weakest point in artificial joints.

It has been found that the wear rate depends on aging due to oxidative degradation of the UHMWPE material. Aging may occur in UHMWPE by the oxidation reaction of free radicals produced in components during high-energy ion irradiation in the cross-linking process. Thus, we will present a recent study of structural and oxidative changes of UHMWPE exposed to several different doses of gamma irradiation. The application of infrared and Raman spectroscopy enables direct observation of oxidative processes as well as a cross-linking process due to exposition to gamma irradiation. In the proposed talk we will present the general practicability of vibrational spectroscopy for improving the functionality of UHMWPE in a replacement arthroplasty.

Treatment of implant-associated Infections

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Biomedical implants have revolutionized medicine and have significantly improved patients' quality of life. Invasive devices and implants are inserted for treatment in nearly all anatomical locations of the body; currently more than 500,000 medical devices are registered for use on the global market. However, implants have a risk of becoming infected, which is one of the most serious complications that can have catastrophic consequences for the patient. Implant-associated infections are the result of complex interactions between the pathogen, the implant and the host immune response to both. Because bacteria causing implant-associated infections form biofilms on biomaterials, have mechanisms to evade host immune system and can even modify host immune response these infections are notoriously difficult to treat. Conventional management of implant infections usually consists of the removal of the implant and antibiotic therapy that can be applied systemically and/or locally. Especially in orthopaedic surgery there are many materials that are used as carriers for local antibiotic delivery: polymethyl methacrylate bone cement, calcium-sulfate beads, hydrogels, synthetic bone substitutes and so on. When possible, antibiotics that are active against biofilm should be used for systemic therapy of implant-associated infections (i.e. rifampicin for staphylococcal infections and fluoroquinolones for infections caused by Gram-negative bacilli). New therapeutic options that are currently under investigation include phage therapy, use of antimicrobial peptides and quorum-sensing inhibitors. Also, modifications of microtopology and nanotopology of the implant surface that interfere with bacterial adhesion and formation of biofilm are being investigated.

Bio Polymeric Composite Membranes for Guided Tissue Regeneration

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Guided tissue regeneration (GTR) is a method utilized to regenerate the tooth supporting tissues affected by periodontal disease. More than 8 % of adults aging between 20 and 64 have periodontal disease, and ~ 5 % of them have moderate to severe form related to diabetes, osteoporosis and other systematic cardio-, cerebrovascular and respiratory diseases. The cell-occlusive, space making, tissue integrative, clinically manageable, biocompatible are attributes to ˝ideal˝ membrane, for which the large diversity of (non)biodegradable, and bioactive materials have been use. Despite diversity, their limited success have been reported. This work focus on new GTR membranes, systematically engineered as graded, multilayer composites, based on bacterial cellulose and gelatin protein. The major idea is site-specific introduction of the morph-chemical and structural triggers within a single material, to emulate the complex ECM of periodontal tissues (Figure 1).

The interlayers integration, physiological stabilization and µ-structuring, were achieved through combination of perodate-medited oxidation of BC, freeze/thawing treatment and carbodiimide crosslinking chemistry. The post mineralization process using fast, 10x SBF-mediated procedure adapt formation of bone-regeneration- relevant minerals. Selected fibroblast and osteoblast cell lines were used for in vitro assessment of biological performance of processed composites, the cytotoxicity, membrane integrity, barrier function and bone regeneration function. For bacterial management, the antimicrobial peptide nisin was post-synthetically introduced, demonstrating activity against periodontal pathogens *E. faecalis*, *P. intermedia* and *F. nucleatum* at amounts as lower as 10

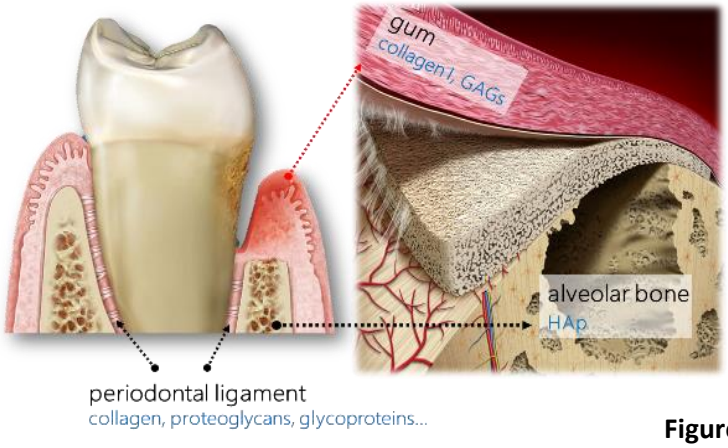

Figure 1

µg/sample.

MAGEC Growing Rod System for Early Onset Scoliosis

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Our aim is to present the ongoing experience and extended follow-up results with magnetic growing rods for early onset scoliosis treatment. We aim to present our cases and comment on our views compared to the literature. We commenced magnetic growing rods (Magec, Nuvasive specialized orthopedics, CA, USA) implantation in 2014.The standardized implantation and correction methods have not differed since then. We distract the rods three mm every three months, concave side first. We monitor the first year of distractions by ultrasonography, and perform radiological follow-up every 9 to 12 months, sooner in case of inconclusive ultrasonography. We monitor time of follow-up, Cobb angle of the major curve, and T1 to S1 height preoperatively, postoperatively and at the latest follow-up. The levels of the screws, the fused levels, and any adverse events are marked. Our series consist of nine patients with median follow-up of 24 months. One patient was converted to magnetic growing rods from standard growing rods after seven months. All patients have secondary scoliosis; two suffer from muscular dystrophy, three from spinal muscular atrophy, two from cerebral palsy, one from Ehlers Danlos syndrome and one form Prader Willi syndrome. Mean preoperative Cobb angle of major curve was 82° (48° -96°), 43° (21° -60°) postoperatively, 44° (24° -58°) at the latest follow-up. Mean T1 to S1 height was 296 (242-337) mm preoperatively, 337 (286-437) mm postoperatively, 352 (303-456) mm at final follow-up. In two patients we experienced screw insertion problems, therefore three screws were inserted instead of two for better purchase. We had no major complications. Our results show that magnetic growing rods are a safe alternative to standard growing rods in early onset scoliosis treatment. They enable fairly good curve corrections, spinal growth and prevent deformity deterioration until definitive fusion.

The science and Characteristics of Hyaluronic Acid Soft-Tissue Fillers and their Use in Aesthetic Medicine

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Over the last 20 years, hyaluronic acid (HA) fillers have become the most popular injectable biomaterial for soft tissue correction. Dermal fillers are commonly used in aesthetic medicine to shape the face or to treat signs of facial ageing. With the increasing number of available HA fillers and the multiplication of facial treatments all over the world, there has been a need from physicians to better understand the HA fillers science.

HA is a naturally-occurring component of the extracellular matrix. It is a glycosaminoglycan (GAG) polymer consisting of repeated disaccharide units of glucuronic acid and N-acetylglucosamine. Approximately 50 % of the body's total HA is in the skin, where it acts as a scaffold for the extracellular matrix, providing rigidity, hydration and turgor whilst allowing cellular movement and regeneration. It is also important in protecting the skin from free radical damage, particularly against UVA and UVB. HA is rapidly metabolised in the tissues, with one third of total body HA being turned over daily.

Variability in methods used to manufacture HA fillers have given rise to differences in properties such as degree of cross-linkage, particle size and concentration. These properties are vital in determining the clinical performance of the filler. Chains of hyaluronic acid are linked using hydrogen bonds, forming stable complexes. This makes HA more resistant to degradation and therefore enables it to last for several months in the skin.

Different physicochemical properties of the HA-gel relate to the clinical outcome. For example, the gel strength as measured by rheology has been said to relate to the lifting capacity and tissue integration. Rheological characteristics represents an essential tool to guide physicians in the selection of the most appropriate HA fillers, administration techniques and depths of injection for their clinical applications. A better knowledge of these HA fillers' rheological parameters can help the physicians to optimize their aesthetic outcomes, safety and patient satisfaction

Once injected, fillers are subject to shearing, vertical compression and stretch from muscle movements, compression and gravity. It is our role as practitioners to understand the way fillers will behave when injected into a particular area or layer of the skin and to choose the most appropriate dermal filler to achieve the desired aesthetic result. Fillers used to treat different parts of the face have very different desirable qualities.

Mechanical Resonance of Femoral Part of Hip Prosthesis as Possible Cause of Aseptic Loosening

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Mechanical resonance is the property of a mechanical system that responds to the oscillations coming from the outside of the observed system. The response amplitude of the system is the highest when the frequency of oscillations matches the system's natural frequency (its resonance frequency). It is known that resonance may cause swaying motions and even catastrophic failure in improperly constructed structures. The phenomenon is known as resonance disaster. Sonic energy enters the system through excitation and is dissipated through damping. Damping can be internal (within the material) or external (mounting of an object).

Six retrieved stems of hip endoprostheses were studied. For each of them sonograms were made, showing a very distinctive and narrow resonance curves with one major resonance peak followed by several higher harmonic peaks. Simulation of endoprostheses standing waves was also performed resulting in the demonstration of various standing wave modes depending on the observed frequency.

Results clearly show that, due to the geometry and the used material, the observed endoprostheses have a very distinctive sonic resonance characteristics. The resonance is excited by the sound coming from outside (or inside) of the human body. The energy of resonance movement of the endoprosthesis is dissipated through the endoprosthesis – bone interface. A long-term exposure to the resonance oscillations adds to other causes of aseptic loosening of endoprostheses.

High Sensitive Magnetoelectric Composite Sensors for Biomagnetic Field Sensing Applications

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The diagnostics of biomagnetic fields has developed in the last years allowing detection of magnetic fields in the range of few fT/√Hz in the low frequency regime [1]. Such fields can be detected with SQUID sensors that are considered as a gold standard for biomagnetic measurements. However, such measurement devices are large, expensive and unpractical, as they require cooling with liquid nitrogen. For this reason, new sensors are being developed, that allow detection of biomagnetic signals without the previously mentioned limitations. One type of such sensors are composite magnetoelectric sensors. These sensors are constructed from a piezoelectric and a magnetostrictive material bounded together with a substrate allowing the transformation of magnetic field signals into voltage signals. The sensors output is enhanced by designing them in a cantilever form and utilizing the mechanical resonance of it by six orders of magnitude [2]. To make the sensors flexible in terms of frequency readout, a special technique called magnetic frequency conversion (MFC) [2] is used. For MFC a second magnetic signal is applied to modulate the biomagnetic signal, with the frequency set to the difference between the resonance frequency and frequency of the biomagnetic signal. By mixing the two signals, the ending signal is formed, that falls in the resonance frequency of the sensor, leading to the enhanced output and readout of the biomagnetic signal. Within this research, several modifications have been made to increase the sensitivity of the sensors. One of the newest and crucial improvement was done by implementing a special magnetic structure called antiparallel exchange bias (APEB) as the magnetic phase. The new structure allows the suppression of the magnetic noise that was previously plaguing these sensors [4]. With the improved sensors, a limit of detection of 50 pT/√Hz at 10 Hz could be reached. The sensors also indicate for the first time a limitation of the noise level due to thermomechanical noise with the MFC technique. The new APEB structure has opened many opportunities for further advancement of the sensors towards producing highly sensitive, ultra-low noise biomagnetic sensors.

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