Berton Rahn Research Award

Prof Dr med Dr med dent Berton Albert Anton Rahn
(1939-2008)

Background

The 'Berton Rahn Research Award' was established in recognition of Berton Rahn's immense contribution to the AO Foundation. The prize previously honored the best completed AO Start-up grant project of that year (based upon final reports and the publications resulting from all completed studies). Since 2017, the award is now open to any AO funded research. From August 2018, there is no longer an age limit for the award. The award consists of a keynote presentation at ARI's eCM conference (along with free registration, accommodation and travel to Davos) and a certificate.

Berton A Rahn

Here we inform you briefly about the Berton Rahn and his dedication to the Laboratory for Experimental Surgery Davos (LECD) and its continuation as AO Research Institute Davos (ARI), the AOCMF community and to the AO Foundation itself.

On March 26, 2008, Prof Dr med Dr med dent Berton Rahn passed away after a difficult illness. We as the AO Foundation family lost a friend, mentor and collaborator who dedicated himself to research for the Foundation in Davos. Berton was a highly respected scientist whose morphological-based bone histology is world-renowned and frequently used in AO courses, though often unperceived by those who use and benefit from it. At the 2009 Trustees Meeting in Chicago, the former AO Research Fund Prize Award, which annually honors the best external start-up research fund project, was renamed the Berton Rahn Research Fund Prize Award in honor of his many contributions to the AO Foundation.

Berton grew up in Schaffhausen, Switzerland and first studied dentistry in Zürich until 1964 and medicine in Berlin until 1968. In 1968 he then joined the Laboratory for Experimental Surgery (now ARI) in Davos under the Directorship of Prof Stephan Perren. Berton stayed with AO for over 37 years. Berton received his doctorate in dentistry in 1970, followed by one in medicine in 1973. He qualified as an assistant professor and in 1985 became an associate professor at the University of Freiburg in Germany. In addition to his lecturing responsibilities at the university, he gave lectures on bone healing mainly based on his own research work, at the AO Courses in Davos and worldwide. He also contributed chapters on bone biology and fracture healing to several respected books. His animal studies in sheep on healing of mandibular fractures (1970–1972) were extremely important because they showed that the healing pattern in craniofacial bones (membraneous bones) is the same as in postcranial bones.

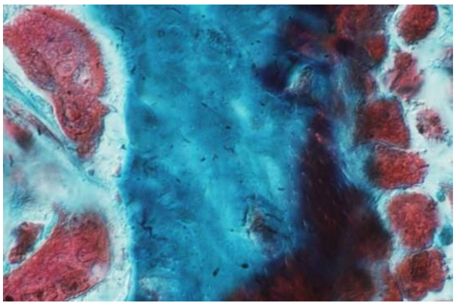
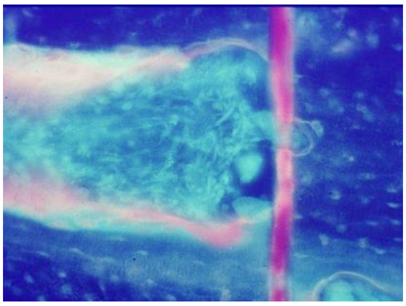
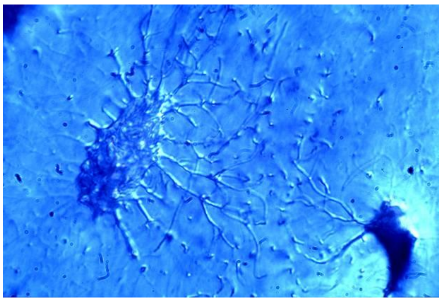
Berton was extremely interested in the microscopic pathology (histology) of bone healing and developed polychrome sequence labeling for newly formed bone (1969), used today worldwide in bone research. This technique also led to a decrease in the number of animals needed for research models. Berton also had strong interest in all forms of microscopy and interactions of cells within tissues and with cells and tissues to implants. Berton made important contributions to the development of craniomaxillofacial surgery as well as to the important field of dental implantology. The correction of deformed and damaged maxillofacial structures using Illizarov's distraction method took some fundamental steps forward thanks to the clinical application of Berton Rahn's research. Berton was an active member of many societies and helped place AO Research on the world map. He was one of the original council members of the European Society for Biomaterials (ESB), helped organize their meeting in Davos in 1984 and 1993 and was chosen as an honorary member in 2003. Berton was an author of more than 150 papers and has had several dozens of students pass through his hands, many of them earning their doctoral degree with his help. He always listened to his student's problems and liked to help them to solve these issues through their own reasoning. His research was characterized by its creativity, and above all by the support he offered to young researchers (including Geoff Richards in the early 90's).

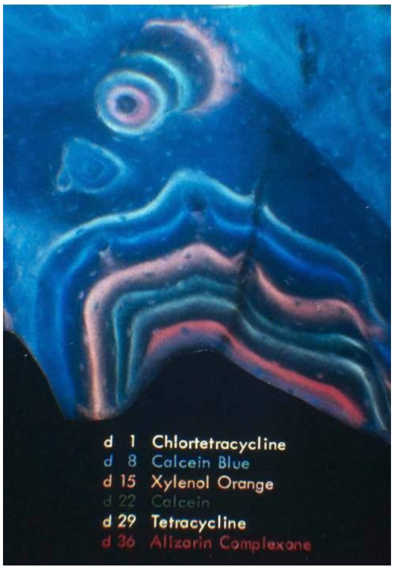
Berton was vice-director of the ARI (from 1975 onwards) and was intimately involved in the design and building of the AO Center on Clavadelerstrasse in Davos which opened in 1992.

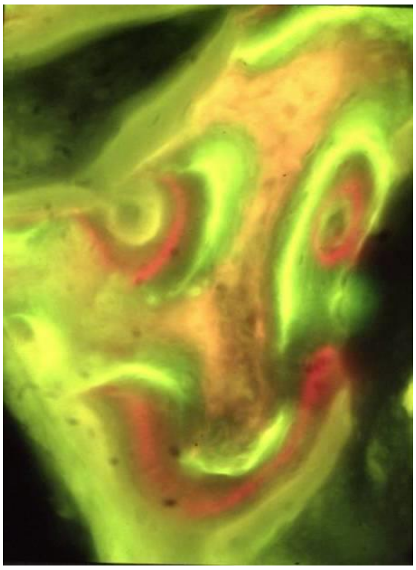
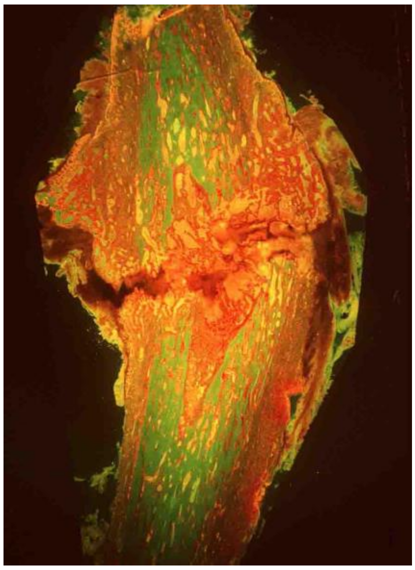
Berton was a reserved, sensitive man, but one who in the right moment could surprise with his unique dry sense of humor. His profound humanity made being in his company a great pleasure. In his short duration of retirement, he served as a Scientific Advisor to ARI until the symptoms of his illness manifested themselves in his bones, the very part of the body that he had spent a lifetime studying.

Berton's influence throughout the formative years of the AO Research Institute Davos, and the AO Foundation as a whole, is remembered with deep gratitude.

Prof R Geoff Richards, Director AO Research & Development
Prof Dr med Stephan M Perren, Honorary & Founding Member AO Foundation, past Director LECD & ARI
Prof Dr med Joachim Prein, Honorary Trustee, AO Foundation



Berton Rahn Research Award Winner 2022:

Biographical sketch

Stephen Ferguson

Stephen Ferguson is a Full Professor of Biomechanics at the Institute for Biomechanics of the ETH Zurich. He completed his studies as a mechanical engineer at the University of Toronto in 1991. Following a stint in industry, he completed his master studies at Queen's University in the area of degradable biomaterials for fracture fixation, which lead to a research internship at the AO Research Institute in Davos, the start of nearly three decades of collaboration. From 1996 – 2000 he performed his PhD research in the area of hip joint and soft tissue biomechanics at the AO Research Institute, in association with Queen's University. After his promotion, he spent two years as a postdoc at the University of Bern before assuming leadership of the Biomechanics Division there. In 2006 he received his Venia Docendi in "Musculoskeletal Biomechanics" at the University of Bern, where he was also co-director of the ARTORG Spine Research Center. In 2011 he was promoted to a full professorship at the ETH Zurich, where most recently he served as Head of the Department of Health Sciences and Technology.

The focus of his research is the study of the mechanical and biological mechanisms of musculoskeletal disorders and injuries and the development and application of innovative technologies for their treatment. The challenge presented by an ageing population is of primary importance in his work, with research programs on bone fragility, joint arthroplasty, disc degeneration and postural decay. He and his group study new biomaterials, material fabrication technologies, implant concepts and diagnostic methods and develop the technical means for their application in the clinic.

He is the author of over 250 scientific papers, 7 book chapters and 4 patent applications. He and his collaborators have received the European Spine Journal GRAMMER prize for best scientific work, the CTI Medtech Award for the translational project "BoneWelding" and two of his doctoral candidates have received the ETH medal for research excellence. He is on the editorial board of the journals Clinical Biomechanics, Journal of Biomechanics and European Cells & Materials and is a former president of the European Society of Biomechanics.

ANNUMECH

The direct repair of lesions of the annulus fibrosus (AF) has been limited to investigational studies of the use of suturing methods, membrane barriers or injectable sealants. The optimal biomechanical properties for such a repair remain an open question. The overall aim of the "ANNUMECH" project, within the AO Collaborative Research Program for annulus fibrosus repair, was to establish the functional requirements for next-generation annulus repair methods through iterative, parametric experimental and simulation studies, to develop methods for the fabrication of novel biomaterial-based repair devices, and to validate their mechanical and biological performance in organ models.

Electrospinning has established itself as a promising and versatile method for the creation of fibrous membranes with applications in tissue reconstruction surgery. However, conventional electrospinning, by nature of the process, creates fibre mats with random fibre orientation. Annulus fibrosus tissue is characterised by lamellar sheets with highly-oriented collagen fibre bundles. Orientation of fibres in electrospinning is possible using a rotating drum collector, however the resulting fibre mats often prove to have an insufficient inter-fibre spacing to promote cell and tissue growth. In our work, we developed a novel method based on the application of a secondary electric field to directly control fibre alignment during deposition, allowing the creation of strong and stiff oriented fibre structures, however with a high porosity and excellent cell and tissue ingrowth [1]. These methods were further extended to enhance cell and tissue adhesion on one side of the membrane, while preventing tissue adhesion on the other, ideal characteristics for an annulus repair strategy to be applied directly adjacent to sensitive neural structures.

In vitro biomechanical experiments performed in collaboration with several project partners established robust methods for the validation of annulus repair strategies [2] and defined the boundaries of the complex physiological loading that such a repair should be expected to endure. In our own simulation studies, a parametric spinal segment model was used to explore the range of local stresses and strains experienced by the annulus fibrosus, in response to global bending and compressive loads applied to the spine. Based on these simulations, which covered a broad range of normal intervertebral disc geometries, target design parameters were defined for a final membrane repair device, and the durability of such membranes was proven in long-term degradation studies [3].

In a final series of validation studies, the ability of the electrospun membrane to effectively seal complex lesions in the mid-substance of the disc and also in a challenging new endplate delamination model was proven [4]. The detrimental effect of disc injury and herniation was shown with this model, and the effectiveness of the repair strategy to promote a persistent restoration of mechanical integrity was also demonstrated. In subsequent trials, tissue growth onto and into the membrane was shown, incorporating the degradable membrane into de novo tissue. Finally, the entire consortium contributed to a highly relevant and promising in vivo validation of different repair strategies for the intervertebral disc, exploring the effects of injury and the potential for long-term repair, based on biochemical, biomechanical and histological outcome parameters [5].

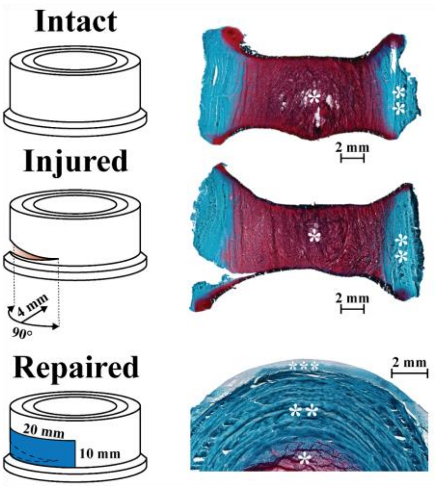


Fig. 1 is from Publication 4, with no restrictions on re-use than including a citation to source:
JOR Spine, Volume: 3, Issue: 4, First published: 16 July 2020, DOI: (10.1002/jsp2.1107)

"ANNUMECH" Publications

1. Walser, J. and Ferguson, S.J., (2016) "Oriented nanofibrous membranes for tissue engineering applications: Electrospinning with secondary field control", Journal of the Mechanical Behavior of Biomedical Materials, S1751-6161(15)00232-5.
2. Long, R.G., Zderic, I., Gueorguiev, B., Ferguson, S.J., Alini, M., Grad, S. and Iatridis, J.C. (2018) "Effects of level, loading rate, injury and repair on biomechanical response of ovine cervical intervertebral discs", Annals of Biomedical Engineering, 46(11):1911-1920.
3. Alexeev, D., Tschopp, M., Helgason, B. and Ferguson, S.J. (2020) "Electrospun biodegradable poly(epsilon-caprolactone) membranes for annulus fibrosus repair: Long-term material stability and mechanical competence", Journal of Orthopaedic Research Spine, e1130.

4. Alexeev, D., Cui, S., Grad, S., Li, Z. and Ferguson, S.J. (2020) "Mechanical and biological characterisation of a composite annulus fibrosus repair strategy in an endplate delamination model", Journal of Orthopaedic Research Spine, 3(4):e1107.
5. Long, R.G., Ferguson, S.J., Benneker, L., Sakai, D., Li, Z., Pandit, A., Grijpma, D., Eglin, D., Zeiter, S., Schmid, T., Eberli, U., Nehrbass, D., Iatridis, J.C., Alini, M. and Grad, S. (2020) "Morphological and biomechanical effects of annulus fibrosus injury and repair in an ovine cervical model", Journal or Orthopaedic Research Spine, 3(1):e1074.

AO Grants

2011 - 2016	AO Collaborative Research Program for annulus fibrosus repair: ANNUMECH Biomechanical determination of target properties for an annulus repair implant.
2011 - 2014	AO Spine International: Implications of age-related muscle loss (sarcopenia) for spinal posture, loading and fracture risk
2007- 2010	AO Spine International: Enhancing flow-induced solute transport in intervertebal disc tissue through electrical stimulation
2003 - 2005	AO Spine International: Bone augmentation for osteoporotic vertebral fractures

Follow-On Grants related to "ANNUMECH"

2018 - 2022	Swiss National Science Foundation (SNF)	"Electrospun nanofibrous scaffolds for acetabular labrum restoration"
2015 - 2018	SNF	"Mechanical biocompatibility of electrospun scaffolds for intervertebral disc repair"
2014 - 2017	ETH Foundation	"Hyperelastic hybrid membrane for biomimetic blood propulsion"

Berton Rahn Research Award Winner 2021:

Biographical sketch

Jos Malda

Professor Jos Malda is Head of Research at the Department of Orthopaedics, University Medical Center Utrecht and the Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Utrecht. He also leads the Utrecht Biofabrication Facility.

Throughout his career he has been intrigued by the combination of biology and technology. He received his Masters degree in Bioprocess Engineering (Wageningen University, 1999) and completed his PhD on Cartilage Tissue Engineering in 2003 (University of Twente). After a short postdoc in the group at the University of Twente, he accepted a research fellowship at the Institute of Health and Biomedical Innovation, (Queensland University of Technology, Brisbane, Australia). In 2007, Dr Malda was awarded a fellowship (NWO Veni award) that allowed him to establish his research group in Utrecht. Dr Malda has published over 185 articles in peer-reviewed international journals (overall in the 88 citation percentile), attracted over 20 million Euro in research funding and holds an ERC Consolidator grant. Further, he is one of the initiators of the first international master's program in Biofabrication. From 2014-2018, he was the President of the International Society for Biofabrication (ISBF) and is the 2022-2023 Secretary General of the International Cartilage Regeneration and joint preservation Society (ICRS).

He is a pioneer in the field of biofabrication and its application for the treatment of musculoskeletal conditions. His research aims to promote tissue regeneration by recreating 3D biological environments with the aid of biofabrication technologies and is established in collaboration with, and with support of, the AO Foundation.

3D printed constructs for osteochondral defect repair

Joint damage causes pain and loss of function, often impairing mobility. It can also trigger a vicious cycle of increasing degeneration of the cartilage and bone underlying joints, leading to the disabling disease of osteoarthritis (OA). For the long term, the ideal solution to joint injury is to successfully regenerate rather than replace the damaged cartilage with synthetic implants.

Three-dimensional (3D) bio-printing, a technology that provides a greatly controlled placement and organization of living constructs through the layer-by-layer deposition of materials and cells, can be used to generate 3D tissue structures. These tissue constructs can be applied as tissue models for research and screening. However, the lack of biomechanical properties of these tissue constructs has hampered their application to the regeneration of damaged, degenerated or diseased tissue.

With the support of the AO Foundation, and in collaboration with researchers at the OA Research Institute, Dr Malda has established a translational research line on the biofabrication of durable, mechanically stable, biological joint replacements and established the simultaneous (bio-)printing of resorbable thermoplastic polymers and cell-laden hydrogels that can aid in and steer the regeneration of the congruent articulating surface.

Advances in the complexity of the design were achieved at both macro- and microscales. For example, on macroscale, approaches to assess the shape fidelity of bioinks were established. Further, a converged printing process was developed, allowing for improved integration of the cartilage and bone components of the osteochondral implants. Moreover, this convergence allowed for control over the microfibre deposition and cell deposition simultaneously even on concave surfaces. Convergence was also achieved at the level of the interface between cartilage and bone by fusing the PCL microfibers in a calcium phosphate-based bone compartment and at the level of the fibre reinforcement of the hydrogels. This led to an improved strength between the engineered cartilage-to-bone interface.

Bioprinted constructs are evaluated in *ex vivo* defect models and bioreactors to provide tissue maturation and validation as close as possible as that occurring in the *in vivo* situation. Moreover, promising strategies are translated towards *in vivo* models with potential impact in human and veterinary medicine.

AO Grants

2009 - 2011: AO Foundation Research Fund Start-up Grant. Alternative Cartilage Tissue Engineering Strategies Adopting Smart Scaffold Design & Cell Aggregate Seeding (S-08-81W). Woodfield and Malda;

2017- 2020: AOCMF MACRON: MAndibular Condyle RegeneratiON (AOCMF-17-17G). Gawlitta, Malda, Custers, Rosenberg, Stoddart;

2017 - 2021: ARI CRP OCD Network 3D OC constructs: 3D printed constructs for osteochondral defect repair (ARI CRP OCD 2017 –2020). Eglin/Alini, Burdick/Mauck, Levato/Malda, Ho/Qin, Bastiaansen-Jenniskens/van Osch and Stoddart/Alini

Extramural research grants

	Project Title	Funding source
2021 - 2027	Pilot Factory for Regenerative Medicine	Nationale Groeifonds, Dutch Ministry of Economic Affairs
2021 - 2026	SMART	NWO Perspectief
2021 - 2023	CHIRON (114399)	EuroStars
2020 - 2023	MINIJOINT	Dutch Arthritis Foundation
2019 - 2023	MEFISTO (H2020-NMBP-TR-IND 2018; 814444)	EU Horizon 2020
2019 - 2029	Materials Driven Regeneration (MDR)	NWO Gravitation
2018 - 2023	Managing Joint Complexity LLP-12	Dutch Arthritis Foundation
2018 - 2023	Marie Curie CoFund ResCUE (801540)	H2020 MSCA-COFUND

	Project Title	Funding source
2017 - 2021	Regenerative Medicine Crossing Borders	RegMedXB Scale-up 1
2017 - 2021	Regenerative Medicine Crossing Borders	RegMedXB
2017 - 2020	BioArchitect (E11312)	EuroStars
2014 - 2020	3D-JOINT, ERC-CoG 2014 (647426)	ERC Consolidator Grant

Recent publications

1. Zhou L, van Osch GJVM, Malda J, Stoddart MJ, Lai Y, Richards RG, Ki-Wai Ho K, Qin L. Innovative Tissue-Engineered Strategies for Osteochondral Defect Repair and Regeneration: Current Progress and Challenges. Adv Healthc Mater. 2020; epub Oct 26:e2001008.
2. Schwab A, Levato R, D'Este M, Piluso S, Eglin D, Malda J (2020) Printability and shape fidelity of bioinks in 3D bioprinting. Chemical Reviews 120 (19), 11028-11055.
3. Schwab A, Levato R, D'Este M, Piluso S, Eglin D, Malda J (2020) Printability and shape fidelity of bioinks in 3D bioprinting. Chemical Reviews 120 (19), 11028-11055.
4. Tognato R, Armiento AR, Bonfrate V, Levato R, Malda J, Alini M, Eglin D, Giancana G, Serra T. A Stimuli-Responsive Nanocomposite for 3D Anisotropic Cell-Guidance and Magnetic Soft Robotics, Adv Funct Mater 29(9) (2019) 10
5. Augurio A, Cortelletti P, Tognato R, Rios A, Levato R, Malda J, Alini M, Eglin D, Giancane G, Speghini A, Serra T. A. Multifunctional Nanocomposite Hydrogel for Endoscopic Tracking and Manipulation. (2020) Adv. Int. Syst., 2019, 1900105.

Berton Rahn Research Award Winner 2020:

Biographical sketch

Ling Qin

Dr Qin is Professor and Director of Musculoskeletal Research Laboratory in the Department of Orthopaedics & Traumatology, the Chinese University of Hong Kong (www.ort.cuhk.edu.hk). Dr Qin also holds joint professorship in Shenzhen Institutes of Advance Technology (SIAT) of Chinese Academy of Sciences (CAS) and serves Director of the Translational Medicine Research & Development Center of Institute of Biomedical & Health Engineering of SIAT (www.siat.cas.cn). He obtained his PhD in Cologne Germany in 1992, postdoctoral fellow in AO-Research Institute, Davos, Switzerland and research scientist in Charité Medical University, Berlin, Germany, before joining CUHK in late 1994.

Dr Qin has been working on advanced diagnosis, prevention and treatment of bone metabolic disorders, especially osteoporosis and osteonecrosis, in collaboration with research and clinical scientists in medicine, geriatrics, rheumatologists, traditional medicine, biomedical engineering, and biomaterials. Dr Qin is the past President of the International Chinese Musculoskeletal Research Society (ICMRS) (www.icmrs.net) and member of a number of journal editorial boards, including Editor-in-Chief of Journal of Orthopaedic Translation (http://ees.elsevier.com/jot). He holds membership in several international and national orthopaedic and related research organizations, including college fellow of American Institute of Medical and Biological Engineering (http://www.aimbe.org), ICORS International College of Fellows/Fellow of International Orthopaedic Research (http://i-cors.org/events). As Principal Investigator, Dr Qin has received over 30 competitive research grants (including TRS, CRF, GRF, ITF, HMRF, NSFC-RGC, and EU-NSFC, 12.5 and 13.5 Key R&D projects of the MOST) and over 30 research awards. Dr Qin also holds 12 invention or new utility patents from PRC and USA, with 3 products in multi-clinical trials.

Dr Qin published 9 monographs as editor or associate editor, 5 conference proceedings, 90 book chapters, over 320 SCI publications in journal including; Nat Med, Nat Commun, Biomaterials, Acta Biomaterialia, JBMR, Osteoporosis Int, Bone, A&R, Am J Sports Med, Int J Sports Med, etc. with over 9000 citations and a H-index of 50. Dr Qin's innovative R&D work on biometals for clinical applications has been featured recently in Nature (https://www.nature.com/articles/d42473-018-00028-w).

Rapid Prototyping of Custom-Made Bone-Forming Tissue Engineering Constructs & Projects on 3D printing in collaboration with ARI consortia

Introduction: The RAPIDOS research project was from the first co-ordinated call for research proposals in Biomaterials launched by the European Union Commission and the National Natural Science Foundation of China in 2013 for facilitating bilateral translational research. We formed the RAPIDOS European and Chinese consortium with the aim to apply technologies creating custom-made tissue engineered constructs made of resorbable polymer and calcium phosphate ceramic composites specifically designed by integrating: 1) imaging and information technologies, 2) biomaterials and process engineering, and 3) biological and biomedical engineering for novel and truly translational bone repair solutions [1].

Methods: 3D printing developed or used included; advanced solid free form fabrication technologies, precise stereolithography, and low temperature rapid prototyping (LTRP). The China task force focused on modification of LTRP towards R&D of Class III bioactive porous composite scaffold materials, incorporating herbal or mineral based bioactive compounds, such as Chinese Medicine derived-molecule bone anabolic factor icaritin and icariin [2-3] and biodegradable magnesium powder [4] for repair of challenging bone defects in osteoporotic fracture and steroid-associated osteonecrosis. The biosafety of these degradable bone substitutes was tested using internal protocols and by regulatory body authorized testing centers.

Results: The major findings have been summarized in a significant number of relevant papers using animal experimental models, including quadrupedal rabbits [3,4] and bipedal emus [2] for treatment efficacy and in vitro tests for postulated biological mechanism. Results of ISO-based biosafety tests or modified ISO testing protocols for Mg-based biodegradable implants have also published and made available to public [5].

Discussion & Conclusions: Our preclinical study results are encouraging, and our joint efforts also laid down a solid foundation towards multi-center clinical trials. This fulfilled our initial goal of our funded EU-China collaboration where together we can advance therapeutic solutions for population suffering from bone non-healing in the future. This will help to achieve faster patient recovery through the development of custom-made implants and patient-specific therapy and/or 3D based bone substitutes for general applications to serve a large patient pool. However, in order to realize bench-to-bedside, establishing GMP for facilitating medical implant production and clinical trials is essential. How to find the industrial collaborators or create spin-off with investment are beyond academia, yet we do make efforts to explore such opportunities. Guangdong-Hong Kong-Macao Great Bay Area development might be one of such opportunities for international collaboration

Acknowledgements:

1. Rapid Prototyping of Custom-Made Bone-Forming Tissue Engineering Constructs. A joint NSFC-DG-RTD (NSFC: No.512111203; EU-NSFC: No. 604517) 2013-2016
2. Traditional Chinese Medicine (TCM) compound delivery system for treatment of osteoarthritis. Sino-Swiss collaborative project (MOST Ref No.. 2015DFG32200; SNF Ref No. 156362) 2015-2018
3. Osteochondral Bone Repair with Innovative Tissue-Engineering and 3D Bioactive Composite Scaffolds. (Ref No.: TA1711481) 2017-2020

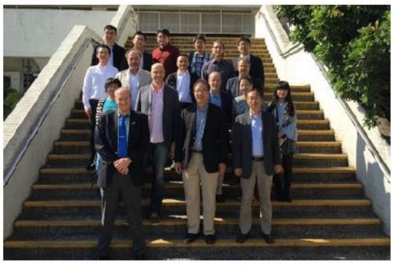
EUCN RAPIDOS Meetings

Davos, 06/2013

The Netherland, 06/2014

London, 05/2015

Beijing, 11/2013



Hongkong, 11/2014

Shanghai, 09/2015

Relevant references

1. Eglin et al. The RAPIDOS project on European and Chinese collaborative research on biomaterials. J Orthop Translat 3: 78-84, 2015
2. Qin L et al. Phytomolecule Icaritin Incorporated PLGA/TCP Scaffold for Steroid-Associated Osteonecrosis. Biomaterials, 59:125-143，2015
3. Lai YX et al. Porous composite scaffold incorporating osteogenic phytomolecule icariin for promoting skeletal regeneration in challenging osteonecrotic bone in rabbits. Biomaterials, 153:1-13, 2018
4. Lai YX, et al. Osteogenic magnesium incorporated into PLGA/TCP porous scaffold by 3D printing for repairing challenging bone defect. Biomaterials. 197:207-219, 2019
5. Wang JL, et al. Recommendation for modifying current cytotoxicity testing standards for biodegradable magnesium-based materials. Acta Biomater. 21:237-49, 2015.

Previous Berton Rahn Research Award Winners

2019

Projects on Fracture Related Infection in collaboration with AOTrauma Clinical Priority Program Bone Infection, ARI and AOTK

Willem-Jan Metsemakers, UZ Leuven, Department of Trauma Surgery, Leuven, The Netherlands

2018

CRP Annulus Fibrosus Rupture (AFR): (ANNUPHEN)

Characterization of intervertebral disc cells and identification on a suitable cell source for efficient tissue regeneration

Daisuke Sakai, Tokai University School of Medicine in Kanagawa, Japan

2017

CRP Acute Cartilage Injury (ACI): (HiCartia)

A novel platform for optimizing material design for cartilage tissue engineering and enabling drug discovery for cartilage restoration

Robert Mauck, University of Pennsylvania (USA)

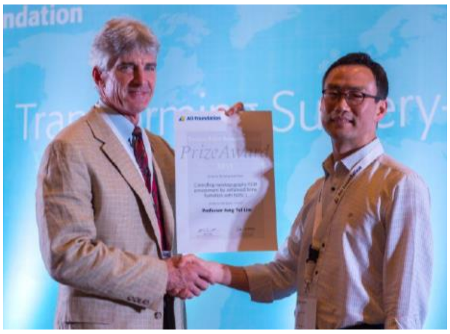
2016

Project S-12-27S:

Targeting endothelial to mesenchymal transition in fibrodysplasia ossificans progressive

Gonzalo Sánchez Duffhues, Leiden University Medical Center (NL)

2015



Project S-10-07L:

Controlling nanotopography-ECM environment for enhanced bone formation with hMSCs

Jung Yul Lim, University of Nebraska-Lincoln (USA)

2014

Project S-10-62Y:

Stem cell mobilization for enhanced bone healing

Clare Yellowley, University of California Davis (USA)

2013

Project S-07-1C:

Can low intensity pulsed ultrasound accelerate osteoporotic fracture healing?

Wing-Hoi Cheung, The Chinese University of Hong Kong (China)

2012

Project S-05-95J:

In-situ crosslinkable osteoinductive poly(lactide) scaffold for bone regeneration

Esmaiel Jabbari, University of South Carolina (USA)

2011

Project F-07-43L:

A pilot study of interleukin-12 local delivery for infection prevention after a traumatic open fracture

Bingyun Li, West Virginia University (USA)

2010

Project 04-J44:

Skeletal effects of estrogen

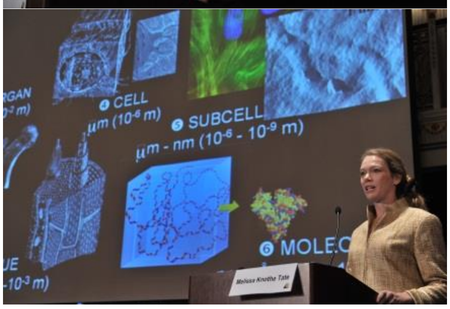
Teppo Järvinen, University of Tampere (Finland)

2009 (2 winners)

Project 04-I58:

Effects of cyclic compression on intervertebral disc cell metabolism

James C Iatridis, University of Vermont (USA)



Project 04-K3:

Unravelling endogenous mechanisms of bone regeneration through quantification of the interplay between bone cells and their environment

Melissa Knothe Tate, Cleveland Clinic Foundation (USA)