14th International Spectralis® Symposium (ISS)

November 25-26, 2016
Gartenpalais Liechtenstein · Vienna · Austria

Course Director
Oliver Findl (Austria)

Faculty
Matthias Bolz (Austria)
Balwantray Chauhan (Canada)
Erdem Ergun (Austria)
Roberto Gallego-Pinazo (Spain)
Frank G. Holz (Germany)
Anton Hommer (Austria)
Alex Huang (USA)
Felipe Medeiros (USA)
Norbert Pfeiffer (Germany)
Herbert Reitsamer (Austria)
Stefan Sacu (Austria)
Giovanni Staurenghi (Italy)
Michael Stur (Austria)
Pia Veronika Vécsei-Marlovits (Austria)

Guest Speakers
Donald C. Hood (USA)
Christian Mardin (Germany)
Vladimir Neroev (Russia)
**Scientific Program**

**Friday, November 25, 2016**

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**Saturday, November 26, 2016**

### 08.30 Welcome Coffee
**OCT Angiography - Moderators: Erdem Ergun, Pia Veronika Vécsei-Marlovits**
- **09.00** How to Read an Angio OCT (Giovanni Staurenghi) – page 43
- **09.20** The Use of OCTA in Assessing Patients for Choroidal Neovascularization (Taha Soomro) – page 45
- **09.30** OCTA Insights in Normal and Abnormal Vasculature (Frank G. Holz) – page 47
- **09.50** Label-Free Morpho-Functional Assessment of CNV: the Role of Cross-Sectional OCTA (Marco Lupidi) – page 49
- **10.00** Diabetic Maculopathy - Qualitative and Quantitative Approach (Gabriel Coscas) – page 51

### 10.20 Coffee Break

### Clinical Retina 2 - Moderators: Stefan Sacu, Norbert Pfeiffer
- **11.00** Macular Pigment in Macular Diseases (Giovanni Staurenghi) – page 53
- **11.20** Too Much Information – Why Sticking to the Basics Can Still Get You Very Far (Erdem Ergun) – page 55
- **11.40** Dissecting Dry AMD - Towards Precision Medicine (Frank G. Holz) – page 57
- **12.00** Long-Term Follow-Up of Anti-VEGF Treatment for Eyes with Neovascular AMD and Vision Better than 20/40 (Michael Stur) – page 59
- **12.20** Perception of Haidinger Brushes in Macular Disease (Philipp Müller) – page 61

### 12.30 Lunch & visit of the Liechtenstein Gallery & Library

### Glaucoma 1 - Moderators: Anton Hommer, Alex Huang
- **14.00** Aging and Glaucoma Progression (Balwantray Chauhan) – page 63
- **14.20** Optimizing Detection of Glaucoma Progression (Felipe Medeiros) – page 65
- **14.40** Structure vs. Function – Impact on Glaucoma Therapy (Herbert Reitsamer) – not available!
- **15.00** Relating Structural and Functional Damage Using the SPECTRALIS OCT Glaucoma Module (Donald C. Hood) – page 67

### 15.20 Coffee Break

### Glaucoma 2 - Moderators: Balwantray Chauhan, Herbert Reitsamer
- **16.00** Influence of Bruch’s Membrane Opening Area’s Size on the Diagnostic Value of BMO-MRW (RNFLT) in Glaucoma Patients and Suspects (Christian Mardin) – page 69
- **16.20** Anterior Segment Glaucoma Structure - Function (Alex Huang) – page 71
- **16.40** Flicker Defined Form Perimetry in Clinical Practice (Anton Hommer) – page 73
- **17.00** OCT in the Epidemiological Gutenberg Health Study (Norbert Pfeiffer) – page 75

### 17.20 “The Christian Mardin Glaucoma Battle”
**Interactive Cases and Quiz-Show – Win an iPad mini!**

### 18.00 END & Farewell Reception
Prof. Oliver Findl, MD, MBA, FEBO
Hospital Hanusch, Vienna, Austria

Oliver Findl is Professor of Ophthalmology and chairs the Department of Ophthalmology at the Hanusch Hospital, Vienna, Austria. He founded and heads the Vienna Institute for Research in Ocular Surgery (VIROS).

A research fellowship at Children’s Hospital in Boston was followed by residency and an anterior segment surgery fellowship at the Medical University of Vienna. He was a Consultant Ophthalmic Surgeon at Moorfields Eye Hospital, London for several years.

His research interests are in the fields of posterior capsule opacification, optical biometry and the pathogenesis of myopia. He has authored over 250 articles in international peer-reviewed journals and is currently the secretary of the European Society of Cataract and Refractive Surgeons (ESCRS) as well as the treasurer of the Austrian Ophthalmological Society.

Faculty Members:

Assoc. Prof. Matthias Bolz, MD
Kepler University Clinic, Linz, Austria

Matthias Bolz is interim head of the department of ophthalmology of the Kepler University Clinic Linz. He founded and is the head of the Ars ophthalmica study center in Linz.

He did his residency at the Medical University of Vienna, where he also co-founded and lead 2 study groups and was the medical director of the Vienna Reading Center.

Dr. Bolz is vitreoretinal, cataract and corneal surgeon. His research interests are in the fields of ocular imaging, treatment and surgery of retinal diseases and femtosecond laser assisted cataract and corneal surgery.
Prof. Balwantray C. Chauhan, PhD
Dalhousie University, Halifax NS, Canada

Balwantray Chauhan is Mathers Professor and Research Director of Ophthalmology and Visual Sciences, and Professor of Physiology and Biophysics at Dalhousie University. He obtained his Ph.D. at the University of Wales, Cardiff, UK, and his postdoctoral training at the University of British Columbia, Vancouver, Canada, under Dr. Stephen Drance.

Dr. Chauhan’s clinical research interests centre on changes in the visual field and optic nerve head in glaucoma. He has devised new strategies for detecting glaucomatous progression and conducted research leading to their translation to clinical practice. A key contribution in this area is the Topographical Change Analysis (TCA), used for identifying changes in optic nerve head topography with imaging techniques. Dr. Chauhan is Principal Investigator of the Canadian Glaucoma Study, a multicentre study on the risk factors for the progression of open-angle glaucoma. His recent contributions have been on the acquisition and analysis of anatomically and geometrically accurate neuroretinal rim measurements. He also conducts research with experimental models of optic nerve damage. Areas of activity include studies of neuron-glial interaction in the retina and optic nerve, in vivo imaging of retinal ganglion cells and neuroprotection. This research is conducted in the Retina and Optic Nerve Research Laboratory, a multidisciplinary facility he was instrumental in establishing.

Dr. Chauhan has received numerous awards and recognitions including Gold Fellow of the Association for Research in Vision and Ophthalmology and the Alcon Research Institute Award. He is president of the Glaucoma Research Society. His research is funded by the Canadian Institutes of Health Research (CIHR), the Atlantic Innovation Fund and other public and private sector agencies.

Erdem Ergun, MD
Sanatorium Hera Hospital Vienna, Austria

Erdem Ergun is an Associate Professor for ophthalmology and heads the Retina Service at the Sanatorium Hera hospital in Vienna, Austria.

He received his post doctorate and fellowship training at the University of Vienna and participated in various multicenter studies. His focus in research was in photodynamic therapy and retinal imaging.

At his current position, he has instigated various continued medical education projects for retina specialists and general ophthalmologists. Furthermore, he has concentrated on optimizing workflow processes in a medical retina clinic.
Roberto Gallego-Pinazo, MD, PhD, DiSSO
University and Polytechnic Hospital La Fe, Vitreous Retina Macula, Valencia, Spain

Dr. Roberto Gallego-Pinazo is the medical director of Vitreous Retina Macula Valencia, and retina specialist at the Unit of Macula of the University and Polytechnic Hospital La Fe of Valencia. He graduated from the University of Valencia Medical School in 2003. His general ophthalmology training was at the University Hospital La Fe of Valencia, Spain. He was awarded as the best in class resident doctors in 2008. He completed the Diploma Superior Specialist in Ophthalmology by the European School in the Advanced Studies in Ophthalmology, equivalent to the Certificate of Advanced Studies in Ophthalmology in the Swiss University Continuing Education. He has also undertaken a retinal fellowship during 2012 at the Royal Manhattan Eye, Ear and Throat Hospital, the New York University Bellevue Hospital, and the Vitreous Retina Macula Consultants of New York, with Dr Lawrence A. Yannuzzi and K. Bailey Freund.

Dr Gallego-Pinazo is actively involved in clinical research and has been awarded numerous research grants in Spain. In 2012, he was recipient of the Arruga Award of the Spanish Society of Ophthalmology. He completed the 2013-2014 Leadership Development Program of the Panamerican Association of Ophthalmology and the American Academy of Ophthalmology.

He has authored of over 125 scientific papers in international journals, as well as over 150 book chapters. He is principal investigator of the Panamerican Collaborative Retina Study Group (PACORES) and principal investigator of the Retics-Oftared research group of the Health Institute Carlos III.

Prof. Frank G. Holz, MD, FEBO
Department of Ophthalmology, University of Bonn, Germany

Frank G. Holz is Professor and Chairman of the Department of Ophthalmology at the University of Bonn, Germany. His major clinical interest is medical and surgical retina. His main research interests include the pathogenesis, biomarkers and new therapies for macular and retinal diseases including age-related macular degeneration. He has a keen interest in innovative retinal imaging technologies and image analysis strategies. He was a scholar of the German National Academic Foundation (Studienstiftung des deutschen Volkes), trained at the University of Heidelberg, Germany, and the University of Chicago/Pritzker School of Medicine, and passed a fellowship at Moorfields Eye Hospital, London, with Prof. Alan C. Bird. Professor Holz has been a cofounder of the Priority Program AMD of the German Research Council (DFG) and founded the GRADE Reading Center Bonn to perform digital image analysis in clinical natural history and interventional trials with a focus on dry AMD. He is a Board Member of the German Ophthalmological Society (DOG), EURETINA, German Retina Society, Member of the Club Jules Gonin, the European Academy of Ophthalmology (EAO), the Macula Society, the Gass Club, Editor-in-Chief of Der Ophthalmologe, and serves a reviewer for many peer reviewed journals.

He has received numerous awards including the Pro Retina Macular Degeneration Research Award, the Leonhard-Klein Award for Ocular Surgery, the Alcon Research Institute (ARI) Award, and the Senior Achievement Award of the AAO. He published more than 400 articles in peer-reviewed journals and is editor of several books on retinal diseases.
Anton Hommer, MD
Privat Practice, Vienna, Austria

Dr. Anton Hommer is Head of the Glaucoma-Ambulance in the Hera Hospital and has a scientific collaboration with University Hospital/MUW.

He was President of the Viennese Ophthalmological Society from February 2004 till January 2005. Dr. Hommer is Head of the Glaucoma Section of the Austrian Ophthalmological Society. He was part of the Executive Board Member of the European Glaucoma Society 2009 till 2015 and the treasury. He became a Honorary member of the Romanian Ophthalmological Society in 2012.

Alex Huang, MD
Doheny Eye Center of Pasadena, USA

Dr. Alex Huang graduated from Pomona College and completed his MSTP (Medical Scientist Training Program) M.D./Ph.D program at The Johns Hopkins University School of Medicine with Lasker Award winning Dr. Solomon Snyder in the Solomon H. Snyder Department of Neuroscience. After completing his residency at then USC/Doheny Eye Institute, Dr. Huang left USC to complete his glaucoma fellowship with Dr. Robert N. Weinreb at the prestigious Shiley Eye Institute. Joining the USC faculty as a clinician-scientist Dr. Huang left USC for the second time and became one of the inaugural faculty members of the Doheny Eye Institute/Stein Eye Institute/UCLA affiliation.

Dr. Huang is a National Institutes of Health/National Eye Institute supported clinician-scientists on a K08 award. Clinically, Dr. Huang is recognized as a thought leader in new angle-based minimally invasive glaucoma surgeries (MIGS) that he offers to his patients. He has directed his clinical acumen in MIGS into a research program dedicated to developing a combined Structure:Function understanding of aqueous humor outflow. This work has led to the invention of the Aqueous Angiography technique first published in PLoS ONE (1/2016). Dr. Huang has lectured regarding his research at American Glaucoma Society, American Academy of Ophthalmology, Chinese Ophthalmological Society, World Glaucoma Congress, and World Ophthalmology Congress. Aqueous Angiography and Dr. Huang’s research program has been featured in Ophthalmology Times, Eyeworld, and The Ophthalmologist magazines.
Prof. Felipe A. Medeiros, MD
Hamilton Glaucoma Center, UCSD Shiley Eye Center, La Jolla, USA

Felipe A. Medeiros, MD, PhD, is Professor of Ophthalmology and the Ben and Wanda Hildyard Chair for Diseases of the Eye at the UCSD School of Medicine. He is also Medical Director of the Hamilton Glaucoma Center, University of California San Diego and Director of Vision Function Research at the same institution. Dr. Medeiros has been ranked as one of the Top 5 Glaucoma Researchers in the World over the past decade (source: Annals of Library and Information Studies, Vol. 60, June 2013, pp. 98-106 and http://www.expertscape.com/blog/2013/11/07/press-release-expertscape-ranks-top-experts-institutions-glaucoma-disease-research-treatment/).

His research interests encompass many different areas in glaucoma, including identification of risk factors for development and progression of disease and methods and strategies for diagnosis, follow-up and management of glaucoma. He has published over 200 peer-reviewed publications in major Ophthalmology journals, 40 book chapters and 4 books on the evaluation of the optic nerve, visual field, intraocular pressure and progression of glaucoma. He is the principal investigator on a National Institutes of Health (NIH) R01 grant to evaluate functional impairment in glaucoma. His laboratory is currently evaluating the impact of the disease on activities of daily living in patients with glaucoma, using techniques such as driving simulation and virtual reality. The results of this research will have major impact in the understanding of how glaucoma affects quality of life and how physicians can better determine which patients are at higher risk for developing impairment from the disease.

Prof. Norbert Pfeiffer, MD
The University Hospital Mainz, Chairman and Director of the Department of Ophthalmology Johannes Gutenberg University Eye Clinic, Mainz, Germany

Norbert Pfeiffer studied medicine at the Universities of Gießen, Newcastle upon Tyne (England), Würzburg, Freiburg and Cambridge (England) and received his M.D. degree from Freiburg University (summa cum laude). He majored in ophthalmology at the Universities of Freiburg and Mainz. After a fellowship in pharmacology at Freiburg University in the group of Prof. Starke he focused his research interest on the diagnosis and treatment of glaucoma. In 1995 he became chairman and director of the department of ophthalmology at Mainz University and served as the CEO of Mainz University Hospital from 1999 – 2002, 2008 – 2010 and 2012-2014.

He is a member of several national and international societies including the American Academy of Ophthalmology, the Association for Research in Vision and Ophthalmology and the prestigious Leopoldina and serves on the Executive Committee of the European Glaucoma Society. His research has focused on elucidating important aspects of the diagnosis and treatment of glaucomatous disease combining both morphological and functional aspects and introducing basic science methods into the clinical diagnosis and treatment of glaucoma. He has authored or co-authored well over 400 scientific publications and was awarded several scientific prices including the prestigious Galenus von Pergamon Prize for the introduction of innovative medical therapies.
14th International SPECTRALIS® Symposium (ISS)  
Faculty Members & Guest Speakers  
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Prof. Herbert Reitsamer, MD  
University Eye Clinic Salzburg, Austria

Professor Herbert Reitsamer is Director of the University Eye Clinic Salzburg, Austria.

Assoc. Prof. Stefan Sacu, MD  
University Eye Clinic Vienna, Austria

Stefan Sacu is Assoc. Professor at the University Eye Clinic Vienna, Austria. He is Consultant Ophthalmic Surgeon with a main speciality of cataract and vitreoretinal surgery and Chief of Outpatient Clinic for Macular diseases at the Department of Ophthalmology, MUW. Also he is Chief of Macula Study Group Vienna, Vice-Chief of Outpatient Clinic for Vitreoretinal Surgery, MUW.

He published of more than 100 research papers in international peer reviewed journals and 6 Book chapters in the field of ophthalmology.
Prof. Giovanni Staurenghi, MD
Sacco Hospital, University of Milano, Italy

Giovanni Staurenghi, presently Professor of Ophthalmology is Chairman of the University Eye Clinic at Department of Biomedical and Clinical Science “Luigi Sacco” University of Milan Italy.

He got his degree at the University of Pavia (Italy) in 1986 and his residency at the University of Milan (Italy) in 1990. He was research fellow at the Schepens Eye Research Institute from 1991 to 1992 and Visiting Scientist at the same Institute from 1992 to 1993. He became associate professor in 1999 and full professor in 2007.

His research, publications and lectures have an important bearing on retinal degeneration; in particular his work is oriented on different types of imaging and treatment. He has been a member of ARVO since 1988 and Silver medal FARVO, Macula Society since 2004, Ophthalmic Photographer Society since 2006 and American Accademy of Ophthalmology since 2007 and Gass Club.

He serves as Editorial Board Member for IOVS and as Reviewers. He has received numerous awards including the Junius Kunt Award.

Prof. Michael Stur, MD
Vienna, Austria

Michael Stur graduated in 1977 at the medical faculty of the University of Vienna and started his residency in ophthalmology in 1980. He founded an outpatient clinic for retinal vascular and macular diseases at the 2nd Department of Ophthalmology of the University of Vienna in 1985, and worked full time for this unit until 2005, when he left to work in his private practice.

Michael Stur’s primary interest has always been ophthalmic imaging. He published several studies evaluating changes of the corneal endothelium using digital image analysis, and later switched to retinal imaging, pioneering the use of scanning laser ophthalmoscopy and optical coherence tomography. He participated as principal investigator in numerous clinical multicenter trials, investigating new treatment modalities for neovascular macular degeneration and diabetic retinopathy. He authored and co-authored more than 130 peer-reviewed papers and trained numerous young ophthalmologists in the field of medical retina. He has been a member of ARVO since 1981 and member of the Macula Society since 1998.
Prof. Veronika Vécsei-Marlovits, MD, MSc, MBA
Hietzing Hospital, Vienna, Austria

Dr. Vécsei-Marlovits is Professor of Ophthalmology and chairs the Department of Ophthalmology at Hietzing Hospital, Vienna, Austria. She founded and heads the research Institute for Process optimization and Quality management in Cataract Surgery. Residency, anterior and posterior segment surgery fellowships were performed at the Medical University of Vienna and Krankenanstaltenverbund Wien (KAV).

She was Consultant Ophthalmologist at the Medical University Vienna International for several years and projects (Kuala Lumpur, Abu Dhabi). Her research interests are in the fields of Quality-, Process-, and Risk management, toric and multifocal IOLs. He has authored over 60 articles in international peer-reviewed journals.

She is Member of the Austrian Ophthalmological Society (ÖOG), German Ophthalmological Society (DOG), European Retina Society (EURETINA), European Society of Cataract and Refractive Surgeons (ESCRS), American Academy of Ophthalmology (AAO), the Association for Research in Vision and Ophthalmology (ARVO) and serves a reviewer for many peer reviewed journals.
Guest Speakers:

Prof. Donald C. Hood, MD
Departments of Psychology and Ophthalmology, Columbia University, New York, NY, USA

Don Hood, the James F. Bender Professor of Psychology and Professor of Ophthalmic Science (in Ophthalmology), has been a member of the Columbia faculty since 1969. He holds M.Sc. and Ph.D. (1970) degrees from Brown University and an honorary degree from Smith College (2000). He is an elected Fellow of the American Academy of Arts and Sciences and a recipient of an Alcon Research Institute Award (2014). He currently serves on the editorial boards of Documenta Ophthalmologica (since 2004), and Translational Vision Science & Technology (since 2011) and IOVS (since 1992). He will be Editor-in-Chief of IOVS as of June 2017. While some of his 300 publications deal with issues of the basic neuroscience of vision, most of his work over the last 25 years has concerned research on diseases of the retina and optic nerve. He has had continuous grant support from NIH/NEI for over 40 years.

Prof. Christian Mardin, MD, FEBO
Department of Ophthalmology, University Erlangen-Nürnberg, Germany

Christian Mardin is senior consultant at the department of ophthalmology of the University Erlangen-Nürnberg in Erlangen, Germany.

He graduated at the University of Erlangen (Germany) in 1991 and spent his residency with GOH Naumann at the University of Erlangen until 1996. He wrote his doctorate thesis with J Jonas on the morphometry of the human lamina cribrosa and is since than interested in posterior segment and disc imaging with emphasis on glaucomas. He led several projects funded by DFG (German Research Foundation) on the topic of optic disc imaging. He became associate professor in 2000 and full professor in 2006.

His research, publications and lectures emphasize on glaucoma diagnosis and genetics. He is a member of ARVO since 1990, DOG since 1991 and SIDUO since 1996.
Prof. Vladimir V. Neroev, MD, PhD, Dr.MSci
Helmholtz Moscow Research Institute of Eye Diseases, Russia

Vladimir Neroev is Professor of Ophthalmology and Director at the Helmholtz Research Institute of Ophthalmology in Moscow, Russia. Also he is Ophthalmologist-in-Chief for the Ministry of Health of the Russian Federation, President of the Russian Association for Ophthalmology and Editor-in-Chief of the Russian Ophthalmological Journal.

His expertise & research interests are: vitreoretinal surgery, vitreoretinal complications of refractive surgery, diabetic retinopathy, anti-VEGF therapy and age-related macular degeneration.

Guest Lecture:

Bianca S. Gerendas, MD, MSc
Vienna Reading Center, Department of Ophthalmology, Medical University of Vienna, Austria

Bianca S. Gerendas will become the Director of the Vienna Reading Center in January 2017, with the mission to further progress in scientific understanding of ophthalmic diseases and treatment through efficient and reliable analysis of ophthalmic images in clinical studies. Since 2012 she coordinates the young international and interdisciplinary OPTIMA Study Group (Ophthalmic Image Analysis), with the aim of individualized treatment for retinal diseases, especially anti-VEGF therapy, based on automated image analysis and population based models from large-scale multimodal imaging data.

Her primary research interests as well as her PhD in Medical Physics are in the field of retinal and choroidal imaging, image analysis and translational ophthalmic research with a focus on diabetic retinopathy. She is a resident at the Department of Ophthalmology, Medical University of Vienna and will finish residency in 2017.

Dr. Gerendas finished her Medical School in 2009 at the University of Heidelberg, Germany, where she in parallel obtained her Master of Science degree in Healthcare Management. In 2010, she joined the Medical University of Vienna. Throughout her short career Dr. Gerendas has received numerous awards and scholarships and has authored original publications and book chapters in the field of retinal image analysis.
**OCT Anterior Segment Imaging**

Oliver Findl

Vienna Institute for Research in Ocular Surgery (VIROS), Hanusch Hospital, Vienna, Austria

**Purpose:** To present novel measurement techniques for anterior segment imaging, especially in the setting of planned cataract surgery as well as intra-operative applications.

**Methods:** Recently, swept-source OCT (ssOCT) technology has been introduced for ocular biometry. This allows not only measurement of axial length, but also high-resolution imaging of the cornea and the crystalline lens before planned cataract surgery. Additionally, OCT technology used during surgery may also have applications for anterior segment surgery.

**Results:** Examples of anterior segment images using ssOCT in various clinical scenarios will be shown to illustrate the applicability of this novel technology in ocular biometry and power calculation before cataract surgery. Also, biometric measurements of a new ssOCT by Heidelberg Engineering will be compared to those of other biometric machines.

**Conclusions:** Novel OCT technology appears promising to enhance the precision and accuracy of biometry and for better prediction of post-operative IOL position and, therefore, power calculation.
Intrinsic Fluorescence – Blue vs. Green and Quantitative Measures

Frank G. Holz, M. Fleckenstein, J. Steinberg, M Gliem, Ph. Müller, P. Charbel-Issa, S. Schmitz-Valckenberg

Department of Ophthalmology, University of Bonn, Germany

**Purpose:** Fundus autofluorescence (FAF) imaging allows for topographic mapping of naturally or pathological occurring fluorophores at the posterior pole. It is particularly helpful for the assessment of the retinal pigment epithelium/photoreceptor complex and macular pigment distribution.

**Methods:** The Spectralis instrument allows for both blue and green fundus autofluorescence as well as near-infrared autofluorescence imaging. Quantitative autofluorescence (qAF) imaging now allows for quantitation of signals derived from fundus autofluorescence imaging. By using an inserted reference fluorophore into the optical pathway. Besides the generation of reference values in normal probands, patients with a wide variety of retinal diseases were examined.

**Results:** Fundus autofluorescence imaging allows for refined phenotyping and detection of novel biomarkers. Such markers have been shown to be useful for early detection of diseases as well as for progression prediction. Macular pigment usually has a peak concentration at the foveal center, rapidly decreasing with eccentricity with very low levels at eccentricities >8 degrees. Macular pigment can be measured using a two-wavelength (blue, 488 nm and green, 512 nm) fundus AF method which is based on the absorption maximum of macular pigment at 460 nm. Various macular and diffuse retinal diseases are associated with alterations in MPOD. Other advantages of longer-wavelength excitation (green) light is that there is less absorption by the crystalline lens especially in patients with cataracts as well as better patient comfort. The use of qAF is helpful in the differential diagnoses particularly of monogenetic retinal degenerations but also in new insights in pathophysiological factors at the level of the RPE. It has been shown to be useful for various assessments, e.g. to distinguish ABCA4-related macular dystrophies from other forms of macular dystrophies.

**Conclusions:** Fundus autofluorescence imaging adds to a better understanding of macular and retinal diseases. It represents a helpful tool both for research application and for clinical routine. Blue, green and near-infrared FAF available in the Spectralis instrument may serve different purposes in clinical application. Quantitative AF imaging further enhances our understanding of disease processes and will be useful for monitoring therapeutic effects of therapeutic interventions as well as for natural history studies in monogenic and complex macular retinal diseases.
Revolutionizing Visual Field Assessment in Glaucoma

Felipe A. Medeiros, MD, PhD
Hamilton Glaucoma Center, UCSD Shiley Eye Center, La Jolla, USA

Purpose: Detection of visual field loss is an essential component in the management of glaucoma. However, current methods for visual field assessment, such as standard automated perimetry (SAP), are subjective, cumbersome and generally expensive. The purpose of this presentation is to describe the development and validation of the nGoggle (nGoggle, Inc), a portable brain-computer interface (BCI) for objective assessment of visual field loss.

Methods: The nGoggle is a BCI that integrates a wearable, wireless, dry electroencephalogram and electrooculogram systems and a head-mounted display allowing detection of multifocal steady-state visual-evoked potentials (mfSSVEP) associated with visual field stimulation. The ability of the BCI in detecting visual field loss was investigated in patients with glaucoma, a progressive neuropathy that results in characteristic damage to the optic nerve and visual field defects.

Results: In a group of 62 eyes of 33 glaucomatous patients and 30 eyes of 17 healthy subjects, the BCI mfSSVEP parameter outperformed SAP in detecting visual field loss with area under the receiver operating characteristic curve of 0.924 versus 0.813 for the best SAP parameter (P=0.046). An assessment of repeatability was performed by collecting repeated testing in 20 eyes of 10 glaucomatous subjects for 3 sessions of measurements separated by weekly intervals. BCI measurements exhibited low test-retest variability.

Conclusion: The portability of the proposed BCI could potentially allow users to routinely and objectively monitor the electrical brain activity associated with visual field in their living environments, potentially representing a transformative way of screening, diagnosing, staging and monitoring visual function loss in numerous conditions.
Positional Testing, Advanced Ophthalmic Imaging and Visual Mysteries

Alex S. Huang, MD
Doheny Eye Centers, Doheny and Stein Eye Institutes, Department of Ophthalmology, David Geffen School of Medicine, University of California, Los Angeles (UCLA), USA

**Purpose:** The seated position for which most ophthalmic diagnostics are performed represents only a minor percentage of the various body positions (supine [laying on one’s back], prone [laying on one’s abdomen], even microgravity in space etc.) people take through the day. Different body positions influence different internal homeostatic mechanisms and may have impact on the eye.

**Methods:** The Heidelberg Spectralis Flex module was originally developed for supine imaging of aqueous humor outflow (aqueous angiography) discussed later in this program. The Flex is a surgical boom arm that allows for imaging (optical coherence tomography [OCT] or angiography) in nearly any body position. Posterior segment and anterior segment OCT was performed in various positions such as seated, supine, and 15-degree head-down tilt.

**Results:** Early alterations were seen in intraocular pressure, choroid thickness, choroid luminal area, and anterior segment parameters in various body positions.

**Conclusion:** People spend a very significant proportion of their time in a supine position during sleep. This period offers an unknown period of homeostatic alternations often related to whole-body fluid shifts that may have pathological contributions. Flex-mediated imaging may be critical in understanding these processes in addition to evaluating visual mysteries such as vision loss in space.
Ocular Oncology Imaging

Marco Pellegrini, MD; Giovanni Staurenghi, MD FARVO
Eye Clinic Department of Biomedical and Clinical Sciences “Luigi Sacco” University of Milan, Luigi Sacco Hospital, Milan, Italy

Intraocular tumors represent a group of rare conditions typically requiring a prompt diagnosis with ocular ultrasound (US) and fluorescein angiography (FA) representing the gold standard for diagnosis. Nevertheless, US interpretation may be challenging and, in several conditions, FA alone does not show specific patterns. For these reasons, a multi imaging approach possibly using wide field devices and including fundus autofluorescence (FAF), fluorescein and indocyanine green angiography (FA + ICGA) and enhanced depth imaging optical coherence tomography (EDI-OCT) is advised. Additionally, OCT-angiography will offer new perspectives and possibilities. Purpose of the keynote will be offering useful insights for detecting and managing these pathologies choosing among all these imaging techniques.
Multimodal OCT Imaging of Diabetic Retinal Disease

Roberto Gallego-Pinazo, Rosa Dolz-Marco

Unit of Macula, University and Polytechnic Hospital La Fe, Valencia, Spain

**Purpose:** To summarize the main benefits of a multimodal imaging approach by optical coherence tomography (OCT) to diabetic retinal and macular disease.

**Methods:** The main possibilities of analyzing the retinal and macular status in patients with diabetic ocular disease will be reviewed in three major sections: detailed structural OCT assessment; morphometric analysis and OCT-Angiography appraisal.

**Results:** (1) Structural OCT: pattern classification, qualitative analysis, widefield analysis, and semiology; (2) Morphometric OCT analysis: treatment guidance, individual layer assessment; (3) OCT-Angiography assessment: foveal avascular zone, ischemic changes, microaneurysms.

**Conclusions:** Multimodal OCT imaging is of great value in the assessment of diabetic retinal diseases. Nowadays is mandatory to perform a meticulous, deep and active anatomic analysis of the status of both the retina and the macula in patients with diabetes in order to provide a quality eye care and to optimize the visual outcome.
Predictive OCT Biomarkers in the Treatment of Diabetic Macular Edema Using Aflibercept, Ranibizumab and Bevacizumab

Bianca S. Gerendas, Hrvoje Bogunovic, Wolf-Dieter Vogl, Thomas Schlegl, Amir Sadeghipour, Sebastian M. Waldstein, Ursula Schmidt-Erfurth

OPTIMA Study Group and Vienna Reading Center, Department of Ophthalmology, Medical University of Vienna; The source of the data is the DCRR.net, but the analyses, content and conclusions presented herein are solely the responsibility of the authors (OPTIMA study group) and have not been reviewed or approved by DCRR.net.

Purpose: Anti-VEGF therapy has been established as the gold standard in the treatment of diabetic macular edema (DME) achieving improvement in best-corrected visual acuity (BCVA) and central retinal thickness (CRT). The DRCR.net protocol T study has concluded that treatment outcome at year 1 depends on baseline BCVA. Our aim is therefore optimized treatment outcomes and disease management by identification of other predictive features from ophthalmic imaging. Advanced automated analyses of optical coherence tomography (OCT) images using computational methods allows to deduct predictive factors.

Methods: Post hoc analyses were conducted in randomized trial data from 629 individuals with central DME and BCVA from 78-24 ETDRS letters, randomized 1:1:1 to receive aflibercept (2.0mg), ranibizumab (0.3mg) or bevacizumab (1.25mg) in a per-protocol PRN regimen. Automated spectral-domain OCT image analysis was used for quantification of CRT in the central mm of the macula and volume of intraretinal cystoid fluid (IRC) and subretinal fluid (SRF) within the central 3 mm at baseline, weeks 4, 8, 12 and 24. Predictive computerized modeling was used for ranking of predictive features for BCVA.

Results: Baseline CRT and baseline IRC volume showed a moderate correlation with BCVA at baseline, while SRF had no relevant impact on baseline BCVA and no predictive value for BCVA outcomes at week 52. The IRC volume at week 4 (after the first injection) was already predictive of BCVA outcomes at week 52 with a mean difference of +4.3 letters (corrected for baseline BCVA) in patients with a baseline BCVA<69 letters, whereas persistent IRC were a poor predictive factor. Aflibercept was most efficient in reducing IRC volumes which translated into superior BCVA gains.

Conclusions: From treatment initiation, IRC volume reduction appears to be the most relevant morphologic predictive factor determining BCVA gains. An anti-VEGF substance having an effect on rapid IRC volume reduction enhances the benefit. High-resolution ophthalmic imaging, automated algorithms and computational modeling offer promising tools to identify predictive factors.
Diabetic Macular Edema: From Morphology to Therapy

Matthias Bolz
Department of Ophthalmology, Kepler University Clinic, Linz, Austria

**Purpose:** To define retinal morphologic findings relevant for treatment decisions in daily clinical routine

**Methods:** 71 eyes of 50 patients with clinically significant DME were examined with macular map OCT scans and fluorescence angiography using Spectralis HRA and OCT (Heidelberg Engineering©). Visual acuity was performed according to the ETDRS protocol (early treatment of diabetic retinopathy study) on the same day. All imaging data was evaluated by 2 readers according to a grading protocol abbreviated “SAVE” that was previously presented, whereas “S” stands for “subretinal fluid”, “A” for “area” (planimetric dimension), “V” for “vitreoretinal abnormalities” and “E” for edema type (focal, non-focal, ischemic, degenerative). All imaging and functional findings were correlated. In addition recent literature will be discussed that could improve decision making in the treatment of an individual case of DME.

**Results:** There was a good inter-grader agreement regarding the graded categories of the SAVE grading protocol. Subretinal fluid did not show a significant correlation with visual acuity, nor did edema expansion (category A). However, there was a correlation between the edema subtype (category E) and visual acuity. Visual acuity was significantly better in patients with edema type 1 (focal edema) than in type 3 (ischemic) or 4 (degenerative). The significance of the correlation between visual acuity and central retinal thickness depended on the morphologic sub-type.

**Conclusions:** Apart from describing the individual type and amount of alteration of DME, the SAVE grading protocol based on OCT and FA images reveals the correlation between retinal morphology and function. These findings are relevant not only for diagnosis in daily clinical routine, but also for treatment decisions and the definition of inclusion criteria in clinical trials. Apart from that, recent studies reveal that that apart from morphologic findings retinal function seems to be equally important in choosing a treatment modality.
The Evaluation of Retinal damage in Severe Proliferative Diabetic Retinopathy: Clinical Experience and Some Points of Attention

V. Neroev, T. Okhotsimskaya, O. Zaytseva

Helmholtz Moscow Research Institute of Eye Diseases, Moscow, Russia

In Helmholtz Moscow Research Institute of Eye Diseases there are a lot of experience in using Spectralis Heidelberg Retina Angiograph + OCT for diagnosis and monitoring of complex fundus pathology.

Detailed accession of retinal damage and proliferative tissue configuration in severe forms of PDRs with state-of-the-art imaging techniques is of crucial importance for the planning of surgical treatment. Multicolor photographic mode allows detailed visualization of pathological changes at different levels of the eye fundus.

This research focuses on the analysis of clinical symptoms, indicators of regional hemodynamics and vasoactive factors levels in PDR patients.
Describing Near-Infrared Autofluorescence Patterns in Diabetic Macular Edema

Hasan, Amira Mohamed Mostafa, MD
Medical Retina Specialist – iCare Eye Hospital, Alexandria, Egypt

Abstract: In diabetic retinopathy, Oxidative stress and inflammation result in up-regulation of growth factors and cytokines, which contribute to breakdown of the BRB and development of DME. Hence, morphological changes in the RPE melanin AF signal can be used as a reflection of the associated BRB dysfunction; especially when correlated with OCT pattern.

Methodology: In this retrospective study, 120 eyes of 90 patients with non-tractional Ci-DME were included. AF images of sufficient quality using cSLO (Spectralis® HRA + OCT, Heidelberg Engineering, Germany) were included. An area of 30ºx 30º centered on the “bright” fovea was scanned; using the same ICGA parameters without dye injection. High-speed 25-raster macular scanning of an area of 20ºx 20º using SD-OCT (Spectralis® HRA + OCT, Heidelberg Engineering, Germany) was performed.

Results: On correlating AF images with corresponding OCT scans, mosaic AF pattern is found to be associated with Ci-CME (36 eyes, 72%) with a mean CFT of 413.7 ± 95.6 μm, hyper-AF pattern is associated with foveal cystic spaces with underlying serous NSD (21 eyes, 95.5%) with a mean CFT of 531.1 ± 145 μm, and hypo-AF pattern is associated with diffuse retinal thickening (15 eyes, 31%) with a mean CFT of 340 ± 63 μm.

Conclusion: NIR-AF as a non-invasive imaging tool can be used efficiently to detect subtle changes of RPE & overlying photoreceptors, which in turn may explain discrepancy between visual acuity and DME status seen in some patients.
Atypical Peripheral Fundus Lesions in Patients with Best Vitelliform Dystrophy seen with Fundus Autofluorescence Imaging

Martina Jarc-Vidmar¹, Ana Fakin¹, Polona Jaki-Mekjavič¹, Damjan Glavač², Marko Hawlina¹

¹ University Eye Hospital, Medical Centre Ljubljana, Slovenia
² Department of Molecular Genetics, Institute of pathology Medical Centre, Ljubljana, Slovenia

Purpose: To describe atypical peripheral lesions outside the vascular arcades seen by fundus autofluorescence imaging in three patients with genetically confirmed Best vitelliform dystrophy with c.313G>C (p.Arg105Gly) mutation.

Patients and methods: Seven members from three generations with Best vitelliform dystrophy underwent ophthalmic examination, fundus colour and autofluorescence imaging (FAF, Heidelberg engineering) and optical coherence tomography (OCT).

Results: Six patients had bilateral lesions located at the fovea, whereas one patient presented with a unilateral extramacular vitelliform lesion. Macular FAF imaging showed different patterns in each patient, according to the stage of disease - central hiperautofluorescent lesions in early stages, later getting non-homogenous, finally being replaced by central hypoautofluorescent areas surrounded by hyperautofluorescent rings. OCT scans showed different changes according to disease progression. In three patients (mother and two children, aged 49, 27 and 23 years) additional multiple peripheral hyperautofluorescent lesions were seen on FAF imaging outside vascular arcades.

Conclusions: Atypical yellowish peripheral lesions were seen besides typical macular changes in three patients with genetically confirmed Best vitelliform dystrophy. On FAF imaging these changes were clearly seen as hyperautofluorescent areas radially outside vascular arcades, however only the younger child had evident lesions on fundus ophthalmoscopy.
Patient with Rapidly Vanishing Outer Retinal Layers

Polona Jaki Mekjavic, Martina Jarc Vidmar, Ana Fakin, Barabara Klemenc
Eye Hospital, University Medical Centre Ljubljana, Slovenia

Purpose: To present OCT features of patient with melanoma associated retinopathy (MAR).

Method: Ophthalmological examination including visual field testing, OCT, FA and ICGA was performed at baseline and during follow-up.

Results: 48 years old healthy patient with no previous eye history and no family history of eye diseases, presented due to 8-day progressive painless visual deterioration by means of doughnut-shaped scotoma in the right eye and temporal crescent-shaped scotoma in the left eye. Moderate vitreous exudation was noted on exam. FA was unremarkable, during late phases of ICGA sharply demarcated hypofluorescent dots were seen around temporal arcades and especially on the periphery of both eyes, but fewer in number in the left eye. OCT showed preserved macular contour and layers in the foveola and vanishing pigment epithelium layer with hyperreflective outer nuclear layer (ONL) parafoveolary.

Extensive workup for infective and autoimmune causes of uveitis was done. In the next four days the patient experienced visual acuity loss on both eyes and enlargement of pericentral scotomas, accompanied by complete loss of previously hyperreflective regions of ONL.

Electrophysiological examinations showed reduced amplitude of scotopic ERG in both eyes. Three weeks after presentation, the biopsy of enlarged inguinal lymph node confirmed metastatic malignant melanoma. By that time the patient’s visual acuity deteriorated to hand movement in the right and counting fingers in the left eye. On OCT there was complete loss of outer retinal layers in the right eye, whereas they were only partly detected in the foveola of the left eye.

Conclusion: Specific structural changes in OCT can indicate autoimmune retinopathy. OCT is a useful tool for monitoring disease progression.
**OCT Findings in Eyes with Pathologic Myopia**

Michael Stur

Private Office, Vienna, Austria

**Purpose:** OCT examinations of eyes with high myopia are complicated by deformations of the posterior pole, which often require shortening of the OCT scan length and reduce the information available. Eyes with high myopia, on the other hand, might have several concomitant pathologies, so that evaluation of the cause of visual loss is difficult. The presented overview intends to inform about pathologies to be expected in high myopia and their relevance for vision defects.

**Methods:** Typical cases with macular pathology in eyes with myopia are presented, and the OCT findings are compared to reports in the recent literature.

**Results:** Choroidal neovascularization (CNV) is one of the most frequent causes of vision loss in eyes with high myopia, and immediate treatment is required to allow for recovery of vision. Different causes of CNV might be present and treatment efficacy will be reduced if the exact etiology of the CNV is not recognized. Other macular diseases which might cause visual loss are myopic foveoschisis, a myopic macular hole, a serous detachment of sensory retina caused by a dome-shaped macula or by a tilted disk, choroidal cavitations, and damages to the nerve fiber layer caused by a parapapillary scleral protrusion.

**Conclusions:** Eyes with high myopia present a challenge. Early detection of pathologies with a high risk of vision loss and a timely treatment can be achieved if all possible causes are taken into account. Routine OCT examinations, on the other hand, will show pathologic findings in many asymptomatic eyes, and unnecessary surgical interventions should be avoided.
Vitrectomy for Epiretinal Membrane Secondary to Leber Miliary Aneurysm: On the Occasion of the 100th Anniversary of his Death

Jorge Orellana R., MD; Prof. Juan Verdaguer T., MD

1 Universidad de Antofagasta, Antofagasta, Chile
2 Fundaciòn Oftalmològica Los Andes, Santiago, Chile

Purpose: Macular Telangiectasia Type I is a disorder that usually occurs unilaterally in males. It consists of dilated capillaries or telangiectasia and aneurysms on both sides of the circulation, ischemia and leakage. Today, this disease is known as Coats` disease in childhood and referred to adult-onset Coats` disease or Leber`s miliary aneurysms depending on severity in an adult patient. The origin of the name of this last one firstly started in 1864, when a young Theodor Leber (1840-1917) presented a talk on "The Blood Vessels of the Human Eye " at the Heidelberg Ophthalmology Society Congress and a publication of in 1865, as a result of intensive research assisting to Prof. Carl Ludwig in the Department of Physiology in Vienna. Later on, in 1912, after he was Head of the Department of Ophthalmology at Heidelberg University, he distinguished a retinal degeneration involving multiple aneurysms, all cases presented the same manifestations "male juveniles age thirteen to twenty-six". We describe the management of an epiretinal membrane secondary to Leber miliary aneurysms.

Methods: In 2010, a 21 year-old man presented with decreased vision in the left eye and metamorphopsia for 1 month. His best corrected visual acuity (BCVA) was 0.4. The patient was examined with ophthalmoscopy, fluorescein angiography and optical coherence tomography (StratusOCT, Carl Zeiss Meditec, Dublin, CA).

Results: Ocular fundus revealed a thick epimacular membrane with edema and central vascular distortion associated with peripheral telangiectasia, lipid exudation and aneurysms. The patient underwent vitrectomy with removal of the epiretinal membrane, internal limiting membrane peeling and scatter laser treatment was applied to the periphery simultaneously. Six months postoperatively, his BCVA improved to 1.0 which remained stable until nowadays.

Conclusions: Ophthalmologists should be aware that an "idiopathic epiretinal membrane" in healthy-young men may be caused by macular telangiectasia type I. In OCT-Angiography era, we wish to commemorates the death, one hundred years ago, of a founder of ophthalmic research on ocular circulation regarding the 14th ISS will be held in Vienna, where Theodor Leber developed his work and Heidelberg University was his alma mater.
Assessment of Long-Term Retinal Changes in OCT after Macular Membrane Peeling

Pia Veronika Vécsei-Marlovits, Michael Burgmüller

Department of Ophthalmology, Hietzing Hospital, Vienna, Austria

**Purpose:** To evaluate long term vision outcome and central retinal thickness one year after pars plana vitrectomy and membrane peeling.

**Methods:** 18 patients who underwent pars plana vitrectomy and membrane peeling from January to July 2015 were included in this study. Best corrected visual acuity, best corrected near vision (Jaeger Chart), and central retinal thickness were examined one week, one month, three months and one year after surgery.

**Results:** Best corrected visual acuity improved significantly during the first three months after surgery (p=0.009). There was further improvement after one year, although this was not significant (p=0.152) compared to three month after surgery. Best corrected near vision did not improve significantly (p=0.055) after three months and remained stable after one year. But there is a tendency for near vision improvement during the first three months after surgery. Central retinal thickness decreased significantly (p=0.017) during the first three months and also one year (p=0.004) after surgery.

**Conclusions:** There is a continuous visual improvement in patients who underwent pars plana vitrectomy and membrane peeling during the first follow-up year. Central retinal thickness decreased continuously during the first year after surgery.
Retinal Nerve Fiber Layer Injuries after Macular Peeling Vitrectomies

András Seres, MD
Budapest Retina Associates, Budapest, Hungary

Purpose: Macular peeling vitrectomies can cause severe nerve fiber layer defects. We report here our observations regarding the incidence, severity and time course of typical findings as imaged by spectral domain optical coherence tomography (OCT) and infrared reflectance imaging.

Methods: After our initial observation, images of 27 eyes of 24 patients underwent macular peeling vitrectomies were prospectively collected. Descriptive statistics were used to describe the occurrence of nerve fiber layer defects on different OCT scan patterns, corresponding maneuvers on surgical videos and visual field defects as measured by automated perimetry.

Results: Vitrectomies were performed because of full thickness macular holes (9 eyes) or for epiretinal membranes (18 eyes). Mean follow-up was 21 months. Nerve fiber layers defects were evident in 22 of 27 eyes (81%). The defects were best imaged by confocal infrared reflectance imaging and on vertical OCT scans. In the first weeks swelling of the fibers were observed with progressive thinning up to 3 to 6 months. In most severe cases, inner nuclear layer microcystic changes similar to what Wolff and colleagues described in severe optic atrophy were found, which persisted over 2 years.

Conclusions: Severe nerve fiber layer injuries are frequent after macular peeling vitrectomies. Confocal infrared reflectance imaging and vertical OCT scans were superior to other methods to visualize them. Conventional methods used in glaucoma care to assess nerve fiber layer integrity and function (peripapillary circle scans and automated perimetry) were incapable to detect these lesions. These observations might have implications for understanding focal and diffuse glaucomatous defects as well.
How to Read an Angio OCT

Giovanni Staurenghi, MD FARVO
Eye Clinic Department of Biomedical and Clinical Sciences “Luigi Sacco” University of Milan, Luigi Sacco Hospital, Milan, Italy

Angio OCT represents a new methods of visualizing retinal and choroidal vessels without dye injection. However what we see could not be the reality. To better understand the images we have to consider a series of characteristics such as artifacts, the slab thickness, the location of the slab and the limitation of the technology. Artifacts for example, can be divided in acquisition ones and other relates to the technology such as projection artifacts. The importance to know them is crucial to better evaluate the exams.
The use of OCTA (OCT2 beta, SPECTRALIS) in Assessing Patients for Choroidal Neovascularization

Taha Soomro, James Talks
Royal Victoria Infirmary, Newcastle-upon-Tyne, United Kingdom

**Purpose:** To evaluate the findings of OCT angiography in patients being assessed for choroidal neovascularization (CNV).

**Methods:** A random sample of patients having standard OCT, fundal fluorescein angiography and indocyanine green angiography were imaged with OCTA. (Heidelberg Spectralis OCTA, beta version). The OCTA images were assessed for detection of a vascular network and correlated to the FFA/ICG interpretation.

**Results:** 19 patients had confirmed CNV on FFA/ICG. A vascular network was seen in 5/6 classic lesions, 2/9 occult, 1/2 RAP and 2/2 with a myopic CNV. The neovascular network was more clearly defined on OCTA compared to FFA/ICG as the availability of early shots varied and FFA leakage obscures the vascular pattern.

**Conclusions:** OCTA is a useful modality in detecting abnormal retinal vascularization, particularly in cases where there is Type 2, classic, choroidal neovascularisation. If the assessment of the size of the neovascular network is helpful for assessing treatment, which maybe the case with anti-PDGF therapy, OCTA will have an advantage.
OCT Angiography Insights in Normal and Abnormal Vasculature

Frank G. Holz, Maximilian Pfau, Moritz Lindner, Monika Fleckenstein, Steffen Schmitz-Valckenberg

Department of Ophthalmology, University of Bonn, Germany

**Purpose:** To demonstrate the use of OCT angiography (OCT-A) for 3-dimensional visualization of the microvascular structures at different retinal and choroid layers both in normal eyes and in association with various retinal and choroidal diseases

**Methods:** OCT-A images were obtained in a variety of diseases with the Spectralis OCT-2 (Heidelberg Engineering, Heidelberg, Germany) allowing generation of high quality OCT volume scans within a short period of time.

**Results:** Advantages of OCT-A include image acquisition without pupil dilation or intravenous dye injection. There is no masking by leakage, pooling or staining phenomena. OCT-A allows for exact 3-dimensional localisation of vascular alterations with disease. Perifoveal capillaries demonstrate a unique morphology according to the retinal layer. Capillary looping is least in RNFL/RGCL A uniform capillary diameter is noted in all layers (Mody 2016; Tan et al. 2012). Findings are discussed in various disease entities including neovascular and atrophic AMD, diabetic retinopathy, retinal vein occlusions, macular telangiectasia type 2, and pseudoxanthoma elasticum.

**Conclusions:** OCT angiography allows for unprecedented insights into physiology and pathology of the retinal and choroidal vasculature by high-resolution imaging of perfused vessels. Understanding retinal vascular structure and flow is key for understanding retinal pathophysiology.
Label-free Morpho-functional Assessment of Choroidal Neovascularization: The Role of Cross-sectional OCT-Angiography

Marco Lupidi MD1,2, Carlo Cagini MD1, Florence Coscas MD2,3, Gabriel Coscas MD2,3

1Department of Biomedical and Surgical Sciences, Section of Ophthalmology, University of Perugia, S. Maria della Misericordia Hospital, Perugia, Italy
2Centre de l’Odéon, 113 Boulevard St Germain, 75006, Paris, France
3Department of Ophthalmology, Centre Hospitalier Intercommunal de Créteil, 40 Avenue Verdun, Université Paris Est, 94010, Créteil, France

Purpose: To determine the sensibility and specificity of combined cross-sectional optical coherence tomography (OCT) and OCT-Angiography (OCT-A) approach in detecting choroidal neovascularization (CNV) and to highlight its role in differential diagnosis between neovascular and non-neovascular maculopathies.

Methods: Fluorescein angiography (FA) and indocyanine green angiography (ICGA) findings [Protocol I] on the presence and status (active or quiescent) of CNV were compared with those obtained from cross-sectional OCT and OCT-A [Protocol II] to define the sensibility and specificity of each imaging protocol. The integrated analysis of morpho-functional B-scan images was also performed to describe the strengths and elucidate possible diagnostic drawbacks in different macular diseases.

Results: Eighty-five eyes of 67 consecutive patients, suffering from different maculopathies, with suspected CNV were enrolled. Protocol I diagnosed a CNV in 76 of 85 eyes (89%), whereas a CNV lesion was clearly observed on Protocol II in 78 (92%) of 85 cases. Protocol I and Protocol II defined a lesion as active in 85% and 77% of the cases respectively. The sensitivity and specificity of Protocol II in detecting CNV seemed higher than Protocol I especially in case of inherited macular dystrophies, central serous chorioretinopathy and active multifocal choroiditis, while substantially similar results were obtained in case of neovascular age related macular degeneration.

Conclusions: Label-free cross-sectional OCT approach showed promising in detecting the presence and defining the status of CNV complicating different macular diseases. Although FA remains the gold standard in evaluating the retinal periphery, OCT and OCT-A offer a rapid, non-invasive monitoring of the retinal and choroidal structure and perfusion, aiding the diagnosis and treatment decisions during follow-up.
Diabetic Maculopathy- Qualitative and Quantitative Approach

Gabriel Coscas¹,², Marco Lupidi¹,³, Tito Fiore³, Carlo Cagini³, Florence Coscas¹,²

¹ Centre de l’Odéon, 113 Boulevard St Germain, 75006, Paris, France
² Department of Ophthalmology, Centre Hospitalier Intercommunal de Créteil, 40 Avenue Verdun, University Paris Est, 94010, Creteil, France
³ Department of Biomedical and Surgical Sciences, Section of Ophthalmology, University of Perugia, S. Maria Della Misericordia Hospital, Perugia, Italy

Purpose: To perform a qualitative and quantitative assessment of the foveal microvasculature in eyes with diabetic maculopathy (DM) using optical coherence tomography angiography (OCT-A).

Methods: Retrospective case series of 50 eyes of 34 patients with DM (14 females, mean age 64.4 ± 9.2 years) and 30 eyes of 30 age-matched controls, evaluated by conventional multimodal imaging and Spectralis OCT-A (Heidelberg Engineering, Heidelberg, Germany). The Full-spectrum amplitude-decorrelation angiography (FSADA) generated optical coherence tomography angiograms of the superficial and deep capillary plexa. Clinical features of DM such as microaneurysms, non-perfused areas and intraretinal micro-vascular abnormalities were qualitatively analyzed and recorded on OCT-A images. Moreover a fully automated micro-structural analysis of the FAZ (area, perimeter, major axis, orientation), foveal vessel’s density and non-perfused areas (in a 1mm radius area) was performed. Quantitative values from diabetic patients were then compared with those of healthy subjects.

Results: In the superficial capillary plexus, non-perfused areas were present in all DM eyes. Conversely, in the deep capillary plexus, non-perfused areas were detected in a lower number of cases. No significant differences were found in number of microaneurysms between the two capillary plexa. Capillary density values were significantly lower in nearly all layers of DM patients compared with healthy subjects. There was high (p< 0.05) inter-observer agreement both for morphological and quantitative OCT-A imaging analysis.

Conclusion: OCT-A is a useful technology for detecting DM abnormalities both in the superficial and deep capillary plexa. The fully automated quantitative retinal vascular analysis may offer an objective method for monitoring disease progression and the functional response to treatment.
Macular Pigment in Macular Diseases

Giovanni Staurenghi, MD FARVO
Eye Clinic Department of Biomedical and Clinical Sciences “Luigi Sacco” University of Milan, Luigi Sacco Hospital, Milan, Italy

Macular pigment (MP) is a blue-absorbing pigment. One of the technique for estimating the density of the human macular pigment noninvasively takes advantage of the autofluorescence of lipofuscin, which is normally present in the human retinal pigment epithelium. Stimulating the fluorescence with two wavelengths, one well absorbed by macular pigment (BAF) and the other minimally absorbed by macular pigment (GAF), we can make accurate single-pass measurements of the macular pigment density. There are a series of pathologies where macular pigment can be important such as macular teleangectasis, or in case of drug toxicity.
Too Much Information – Why Sticking to the Basics Can Still Get You Very Far

Erdem Ergun
Sanatorium Hera Hospital Vienna, Austria

**Purpose:** With the advent of different imaging modalities, highlighted by OCT-angiography, it has become difficult for clinicians to define optimum strategy and put these various modalities into perspective.

**Methods:** Using case studies, significant advantages and disadvantages of multimodal imaging methods, in particular conventional fluorescein and indocyanine green angiography, will be discussed.

**Results:** Highlighting the importance of conventional angiography, autofluorescence and OCT in the era of OCT angiography.

**Conclusion:** Conventional angiography with fluorescein and indocyanine green is still of paramount importance and represents an essential tool for the clinician.
Dissecting Dry AMD –Towards Precision Medicine

Frank G. Holz
Department of Ophthalmology, University of Bonn, Germany

**Purpose:** Dry AMD age-related macular degeneration encompasses a wide spectrum of phenotypic variations. A multimodal imaging approach is applied for refined characterization with respect to identification of subgroups as well as for differential diagnosis of macular diseases mimicking dry AMD.

**Methods:** A wide spectrum of dry AMD pathological characteristics including reticular pseudodrusen, sub-RPE drusen, hyperpigmentations, and geographic atrophy (GA) were examined as well as similar appearing disease entities in the elderly. Longitudinal examinations were conducted with fundus autofluorescence (FAF; excitation wavelength, 488 nm; emission wavelength, >500 nm) and near infrared (NIR) reflectance imaging (Spectralis HRA+OCT or HRA2; Heidelberg Engineering, Heidelberg, Germany).

**Results:** To detect reticular pseudodrusen FAF, NIR reflection and multicolor imaging along with SD-OCT imaging are most sensitive. While cSLO-based imaging modalities allow for highly accurate and reproducible area determinations in presence of GA, SD-OCT imaging enables differentiation of different border phenotypes with an impact on local progression as well as of choroidal thickness. Subtypes of GA included the ‘diffuse-trickling’ (dt-GA) phenotype with various discriminating features on multimodal imaging including faster progression, thinner choroid, lobular patterns as well as greyish FAF in the area of atrophy. Differentiating genetic features were identified when compared to other GA subtypes (e.g. the ARMS2_rs10490924 is significantly more prevalent in individuals with dt-GA compared to control individuals). Features of other disease entities in the elderly with GA are described for LORD, ARCA, EMAP and late-onset Stargardt disease. The latter shows a significantly slower progression rate when compared to AMD (1.14 ± 0.15 mm²/year vs. 1.48 ± 0.05 mm²/year; p < 0,05) and a longer median time to foveal atrophy (8.60 vs. 3.35 years; p < 0,05).

**Conclusions:** Multimodal imaging allows for precise phenotyping of dry AMD which shows a wide-spectrum of interindividual variability. Different pathophysiological factors have been identified for some of these subgroups. Further studies are needed to better understand the underlying pathophysiological differences and modifying factors e.g. for different progression rates. Differentiation is also key for interventional trials to assess eligibility and to pave the way towards precision medicine in the context of dry AMD.
Long-Term Follow-Up of Anti-VEGF Treatment for Eyes with Neovascular AMD and Vision Better than 20/40

Michael Stur
Private Office, Vienna, Austria

**Purpose:** There is only little and conflicting information available about the long term outcome of Anti-VEGF treatment of eyes with neovascular AMD and good vision.

**Methods:** In order to evaluate the long term outcome (5 years or more of follow up) I selected from my database all eyes which were started with intravitreal applications of one of the available Anti-VEGF medications at a time when the best corrected visual acuity (BCVA) was still 0,5 (20/40) or better, and which had a minimum follow up time of 5 years.

**Results:** 27 eyes of 24 patients were eligible for evaluation. Mean age at the day of first treatment was 77,4 ± 4,7 years, mean BCVA before first treatment was 0,76 ± 0,2, and mean follow up was 7,3 ± 1,3 years. Mean BCVA improved to 0,9 ± 0,22 after 12 months and then slowly worsened to 0,65 ± 0,3 at 5 years and 0,53 ± 0,29 at 7 years. Mean number of injections was 14,1 ± 9 (range: 1 to 36). There was no correlation between change of BCVA and number of injections. 5 eyes (22%) had a vision of 1,0 (20/20) 7 years after start of treatment, and 3 eyes had a vision loss to less than 0,1 (20/200). Loss of vision to less than 0,5 (20/40) was caused in 5 eyes (22%) by geographic atrophy and in 5 eyes (22%) by active CNV, two eyes (8%) had developed a fibrotic disciform scar.

**Conclusions:** Eyes which present with a neovascular AMD and BCVA of better than 0,5 (20/40) do have a good chance of maintaining vision for 5 years or more. Regular monitoring and an individualized treatment strategy are required to prevent early vision loss.
Perception of Haidinger’s Brushes in Macular Disease

Philipp L. Müller1,2, Frank G. Holz1,2, Wolf M. Harmening1, Peter Charbel Issa1,2,3

1University of Bonn, Department of Ophthalmology, Bonn, Germany
2Center of Rare Diseases, University of Bonn, Department of Ophthalmology, Bonn, Germany
3Oxford Eye Hospital, University of Oxford, UK

Purpose: Haidinger’s brushes are named after Wilhelm Karl Ritter von Haidinger, who first described the entoptic phenomenon between 1844 and 1854. Haidinger’s brushes can be observed when the gaze is directed at the sky or other sources comprising short-wavelength linearly polarized light. We aimed to optimize the perceptibility of the entoptic phenomenon and to investigate its association with visual acuity and macular pigment optical density.

Methods: This monocenter prospective cross sectional study included 92 eyes of 46 healthy subjects and 198 eyes of 99 subjects with retinal diseases affecting the macula. Each subject underwent best corrected visual acuity (BCVA) testing, funduscopy, and assessment of macular pigment optical density (MPOD) using the two-wavelength fundus autofluorescence method. Haidinger’s brushes visibility was tested with an optimized rotating linear polarizer and a controllable 3-LED color panel as light source. A simple model of macular pigment absorption was used to predict visibility of the entoptic phenomenon as a function of stimulus wavelength and MPOD.

Results: All healthy subjects and 34% of the subjects with macular diseases perceived Haidinger’s brushes with the optimized setup (“blue” LED-color, 464nm). The degree of psychophysical perception and the dependency on different wavelengths was in accordance with the absorptance model. In eyes of subjects with age-related macular degeneration (n=40) and cone/cone-rod dystrophy (n=106), minimum thresholds of MPOD and BCVA (≤ 0.6 LogMAR) were identified to be generally required for the perception of Haidinger’s brushes. Subjects with macular telangiectasia (MacTel) type 2 (n=52) showed lowest values of MPOD and were consistently unable to perceive the entoptic phenomenon despite relatively preserved BCVA.

Conclusions: Relatively persevered macular pigment and foveal function are necessary for the perception of Haidinger’s brushes. Using an optimized setup, healthy subjects are consistently able to perceive Haidinger’s brushes. However, they cannot be seen by subjects with macular disease resulting in low BCVA or MPOD. Haidinger’s brushes are usually not perceived by subjects with MacTel type 2, likely due to their characteristic foveal depletion of macular pigment.
Aging and Glaucoma Progression

Balwantray C. Chauhan
Department of Ophthalmology and Visual Sciences, Dalhousie University, Halifax, Nova Scotia, Canada

It has long been recognized that healthy aging results in loss of certain neurons in the nervous system. Cross-sectional histological data in eye bank eyes have estimated the loss of retinal ganglion cell (RGC) axons ranges from 0.5-1.5% year. With clinical measurements with optical coherence tomography (OCT), surrogate measurements of RGC numbers are made either in cross-sectional or longitudinal studies. While cross-sectional studies usually have larger sample sizes, the inference of longitudinal behaviour from these data is imperfect. Longitudinal studies usually contain relatively fewer subjects and short follow-up periods making estimates imprecise.

This presentation will present both cross-sectional (normative data base studies) and longitudinal data from OCT studies. The importance of age-related effects have likely been underestimated because most glaucoma follow-up studies do not include a control arm and the progression observed in glaucoma patients has been attributed to the effects of glaucoma only.
Optimizing Detection of Glaucoma Progression

Felipe A. Medeiros, MD, PhD
Hamilton Glaucoma Center, UCSD Shiley Eye Center, La Jolla, USA

**Purpose:** To describe recent advances on methods for diagnosis and detection of glaucoma progression using optical coherence tomography.

**Methods:** For diagnosis, a Bayesian retinal nerve fiber layer (RNFL) deviation map was built that uses information from both healthy and glaucomatous eyes to generate topographic maps and to estimate the prior probability that a specific location shows RNFL damage. By using prior information, the map decreases the chance of false-positives in areas where defects are unlikely to occur, and increases the probability of identifying expected patterns of RNFL damage. For assessment of progression, simulation studies were run evaluating the ability of Spectralis OCT RNFL measurements in detecting glaucoma progression as compared to SAP. Simulation studies also evaluated rates of false-positive detection of progression due to age-related changes.

**Results:** For diagnosis, the Bayesian deviation map incorporating priors from both glaucoma and healthy eyes had an ROC curve area of 0.95, which was significantly higher than the standard deviation map, which does not incorporate any prior information (ROC curve area of 0.69). The average RNFL thickness parameter had ROC curve area of 0.89. For assessment of progression, simulation studies showed that OCT RNFL thickness measurements were able to detect development of glaucoma an average of 5 years before SAP. Age-related change is an important source of false-positives.

**Conclusions:** A Bayesian deviation map approach performed better in discriminating glaucomatous from healthy eyes than standard approaches. Simulation studies on progression showed that OCT is able to detect progression in glaucoma suspects before SAP. However, it is important to take into account possible age-related changes when evaluating rates of OCT RNFL change in glaucoma.
Relating Structural and Functional Damage Using the SPECTRALIS OCT Glaucoma Module Premium Edition

Donald C. Hood

Departments of Psychology and Ophthalmology, Columbia University, New York, NY, USA

Purpose: Glaucoma is characterized by a specific pattern of anatomical (structural) and behavioral (functional) changes. In the clinic, functional changes are typically assessed with visual fields (VF) obtained with static automated perimetry and structure changes with fundus photos/exams and OCT scans. Here we describe and illustrate an approach for understanding functional changes based upon OCT scans.

Methods: Schematic model: Our theoretical framework for relating structural (OCT) and functional (VF) changes has three assumptions that specify: 1. a map that relates local regions of retinal ganglion cells (GC) to regions on the peripapillary circle scan around the disc; 2. the regions of the disc most vulnerable to glaucomatous damage; and 3. a map that relates VF test locations to local regions of GCs. Data: Eyes classified as suspects (abnormal/suspicious disc, but normal 24-2 VF) or with early glaucoma (abnormal/suspicious discs, and a 24-2 VF with mean deviations better than -6 dB) were tested with 24-2 and 10-2 VFs and the SPECTRALIS Glaucoma Module Premium Edition.

Results: In eyes with early glaucoma: 1. Most of the damage commonly seen on 24-2 VFs is associated with thinning of the peripapillary retinal nerve fiber layer (pRNFL) in relatively small regions of the disc, i.e., largely in the 45° temporal half of the superior and inferior quadrants. 2. The damage in these regions can vary in location, width, depth, and homogeneity (i.e., the degree to which local thinning varied within the damaged region); 3. This wide variety in patterns of pRNFL thinning results in a wide variety of abnormal VF patterns. 4. The agreement between functional (VF) and structural (OCT) measures can be best seen by overlaying VF information on GC and RNFL thickness/probability maps.

Conclusions: The patterns of glauomatous damage seen on VF can be understood by carefully examining the changes seen in the RNFL of OCT circular scans, as well as the pattern of abnormalities seen on GC and RNFL probability plots. There are important clinical implications. First, attempts to classify glaucoma based upon VF will have problems. Second, the results support our emphasis on qualitative, as opposed to quantitative assessment of OCT scans. Third, the relationship between structural and functional damage is better than suggested by correlational studies. Finally, the results support those interested in using OCT scans as endpoints in clinical trials.
Influence of Bruch’s Membrane Opening Area’s Size on the Diagnostic Value of Bruch’s Membrane Opening Minimum Rim Width (BMO-MRW) and Retinal Nerve Fibre Layer Thickness (RNFLT) in Glaucoma Patients and Suspects

Christian Mardin, Jonas Gmeiner, Robert Lämmer, Wolfgang Schrems, Laura Schrems-Hösl
Department of Ophthalmology, University Erlangen-Nuremberg, Erlangen, Germany

**Purpose:** To examine the influence of Bruch's membrane opening area on the diagnostic value of Bruch's membrane opening minimum rim width (BMO-MRW) and retinal nerve fibre layer thickness (RNFLT) in glaucoma patients and suspects.

**Methods:** One hundred eighty-one eyes consisting of 40 healthy controls, 50 subjects with preperimetric glaucoma and 50 with perimetric glaucoma were included (clinical trials identifier: NCT00494923). One randomly selected eye was included. BMO-MRW and RNFLT (three peripapillary circle scans, 12°/14°/16°) data were obtained using spectral domain optical coherence tomography (Spectralis, Heidelberg Engineering, Germany). Areas under the receiver operating characteristics curves (AUROC) as well as sensitivity at fixed specificity of 95% were computed globally.

**Results:** BMO-area (mm²), global BMO-MRW (µm) and global inner RNFLT (µm) was for normals (1.91±0.5, 307±84, 95.1±10.2), preperimetric (1.99±0.48, 211±61, 77.7±14.4) and perimetric glaucoma patients (1.90±0.39, 164±48, 61.7±15.) respectively. Cut point for small and large BMO-areas was 1.8mm². AUROC and sensitivity (%) for BMO-MRW/RNFLT for preperimetric patients with small BMO-area (0.90[0.81-0.99], 69.6; 0.86[0.74-0.97], 47.8) and those with large BMO-area (0.77[0.62-0.90], 25.9; 0.82[0.70-0.94], 40.7); for perimetric patients with small BMO-area (1.0[1.0-1.0], 100.0; 0.99[0.96-1.0], 87.0) and those with large BMO-area (0.89[0.79-1.0], 57.9; 0.93[0.86-1.0], 78.9) respectively.

**Conclusion:** BMO-area’s size influences diagnostic performance of BMO-MRW and RNFLT. Preperimetric and perimetric eyes with small BMO-areas seem to a higher degree be detected by BMO-MRW and those with large BMO-areas by RNFLT.
Anterior Segment Glaucoma Structure - Function

Alex S. Huang, MD
Doheny Eye Centers, Doheny and Stein Eye Institutes, Department of Ophthalmology, David Geffen School of Medicine, University of California, Los Angeles (UCLA), USA

**Purpose:** Like the posterior segment of the eye, the anterior segment can be described in a language of structure and function for which the aqueous humor outflow (AHO) that is impacted in glaucoma has a structural correlate bounded by the ocular outflow anatomy lumens and the functional component assessed by the movement of fluid flow itself.

**Methods:** Anterior segment AHO structural lumens were assessed by anterior segment optical coherence (OCT) with the Spectralis 360-degrees around an intact eye of a living human individual. Automated segmentation was developed and assessed by expert readers. Anterior segment AHO functional flow was performed by a new method termed aqueous angiography. Fluorescein or indocyanine green was introduced into the anterior chamber eye at physiologic pressures and the ocular surface imaged with the angiographic function on the Spectralis. Aqueous angiography mediated guidance of trabecular bypass stents toward initially low flow regions was tested. Imaging was also performed in intact eyes of living non-human primates.

**Results:** Anterior segment OCT demonstrated AHO outflow pathway lumens that could be detected by automated segmentation. Expert readings of the segmentation results demonstrated excellent accuracy and inter-observer variability for Schlemm’s canal. More false-negative detection was seen with collector channels. Creation of three-dimensional casts allowed the observation of the full outflow pathway in an intact eye of a living individual showing segmental characteristics and collector channel roots. Using aqueous angiography, segmental AHO patterns were observed with multiple dyes in multiple species using post-mortem and intact eyes of living subjects. Aqueous angiography was validated to be AHO by anterior segment OCT. Aqueous angiography mediated trabecular bypass showed improvement of angiographic outflow with targeting of surgeries to initially low flow regions.

**Conclusion:** Both structure and function can be separately evaluated for AHO in the anterior segment in the eye which is relevant for glaucoma. Future efforts will be geared synergizing these concepts together.
Flicker Defined Form Perimetry in Clinical Practice

Anton Hommer, MD
Hera Hospital, Vienna, Austria

Purpose: Also, the definition of glaucoma is based on the structural changes of optic nerve head and retinal ganglion cell layer, visual field defects are a result and for the patients their quality of live is strongly influenced by the loss of this visual function. Standard automated perimetry (SAP) is the gold standard in the care of our glaucoma patients. However, SAP is relatively weak in early detection of glaucomatous field defects. Flicker perimetry is a visual field test that evaluates an observer’s ability to detect light/dark stimulus alternations (flicker) at various locations in the visual field.

Flicker perimetry has been reported to be a helpful sensitive examination technique for the detection of early functional damages in several eye disorders, like retinal diseases, neurologic disorders and glaucoma.

In the presentation, the advantages and limitations of flicker perimetry in clinical use with glaucoma patients care will be discussed.
Optical Coherence Tomography in the Epidemiological Gutenberg Health Study

Norbert Pfeiffer, Stefan Nickels, Julia Lamparter, Esther Hoffmann, Alexander Schuster

Department of Ophthalmology, Mainz University Medical Center, Germany

Purpose: To investigate optical coherence tomography findings of the fundus in a large population based epidemiological study, the Gutenberg Health Study Mainz. The Gutenberg Health Study (GHS) is a population-based, prospective, observational cohort study in Germany, including 15,010 participants aged between 35 and 79 years. The sample was randomly drawn and equally stratified by sex and residence (urban/rural) for each decade of age. The baseline examination was conducted between 2007 and 2012 and comprised an ophthalmic examination, several general and cardiovascular examinations, as well as interviews and questionnaires. In the 5-year follow-up examination, spectral-domain imaging was added to the study design.

Methods: Macular OCT scans (Spectralis, Heidelberg Engineering) are performed as 15x15° volume scan (37 single scans) in enhanced depth imaging mode in both eyes among the participants of the Gutenberg Health Study Mainz. OCT-volume scans are graded with a protocol for properties of the vitreoretinal interface and of intra- and sub-retinal structures at Mainz Ophthalmic Reading Center. Proportions of participants with epiretinal membranes, vitreomacular-traction (VMT), full thickness (FTMH) and lamellar macular holes (LMH) are calculated. In addition, a peripapillary OCT-scan is performed and retinal nerve fiber layer thickness (pRNFL) is automatically segmented followed by manual correction. Association analysis of pRNFL with ocular, cardiovascular, morphometric and lifestyle factors are performed applying univariate and multivariable linear regression models.

Results: 2939 eyes of 1497 participants are included in this preliminary analysis for grading of macular volume scan. 4% (72 eyes of 65 participants) had an epiretinal membrane, 1% (19 eyes of 15 participants) had a VMT, 1 eye had a FTMH and 10 eyes of 8 participants had a LMH.

Global peripapillary RNFLT was measured in 3224 eyes of 1973 subjects. The multivariable regression model revealed a significant relationship between RNFLT and age in decades (p<0.02), spherical equivalent (p<0.0001), axial length (p<0.0001), glaucoma (p<0.0001), tinnitus (p=0.04), sleep apnoea (p=0.047), homocysteine (p=0.05) and alcohol intake (p=0.02). Glaucoma, sleep apnoea, higher homocysteine, higher alcohol intake and higher axial length as well as age were related to decreased RNFLT while higher spherical equivalent or history for tinnitus were related to thicker RNFL.

Conclusions: SD-OCT imaging enables to detect and distinguish pathologies of the macula in a population-based setup. Diseases of the vitreomacular interface are common in the age group 40-79 years. Measurement of pRNFL allows to non-invasively examine and quantify nervous structures of the central nervous system. Higher age, glaucoma, sleep apnoea and alcohol intake is linked to thinner pRNFL, while the association with homocysteine and prior tinnitus requires further exploration.
Merry Christmas!