11th International Spectralis® Symposium (ISS)

October 18-19, 2013
Metropolitan Club · New York · USA

Course Director
K. Bailey Freund, USA

Faculty
David Brown, USA
Balwantray Chauhan, Canada
Karl Csaky, USA
François Delori, USA
Jeffrey S. Heier, USA
Glenn J. Jaffe, USA
David Sarraf, USA
Richard F. Spaide, USA
Giovanni Staurenghi, Italy
Sebastian Wolf, Switzerland
Lihteh Wu, Costa Rica

Special Feature by:
Lawrence A. Yannuzzi, USA
Scientific Program

Friday, October 18, 2013

09.00 Registration and Welcome Coffee

Innovation I - Moderators: K. Bailey Freund, Glenn J. Jaffe

09.50 Welcome Note (K. Bailey Freund)
10.00 MultiColor Imaging (Giovanni Staurenghi) – page 10
10.20 Ultra-Widefield Imaging (Steffen Schmitz-Valckenberg – guest lecture) – page 12
10.40 3D-OCT Imaging (Richard F. Spaide) – n/a
11.00 Measuring Macular Pigment (Sebastian Wolf) – page 14
11.20 The Ring like Distribution Autofluorescence Profile of Macular Pigment is Heritable (Eric van Kuijk) – page 16

11.30 Coffee Break

Innovation II - Moderators: Richard F. Spaide, Giovanni Staurenghi

12.10 Basics of Transverse Section Analysis (David Brown) – n/a
12.30 Possible Correlations between Transverse OCT Scans and Flat Mounted Retina Imaging in Cystoid Macular Edema (Bruno Lumbroro – guest lecture) – page 18
12.50 Imaging the Choroidal Anatomy (Lihteh Wu) – page 20
13.10 Quantitative Fundus Autofluorescence (François Delori) – page 22
13.30 Fluorescent Lifetime Imaging Ophthalmoscopy (FLIO) in patients with choroideremia (Martin Zinkernagel) – page 24

13.40 Lunch

14.15 All Poster Session Starts - Presentation Posters 01-10, Moderators: Sebastian Wolf, Giovanni Staurenghi

AMD - Moderators: David Brown, David Sarraf

15.00 Refining the Diagnosis and Management of CNV in AMD (K. Bailey Freund) – page 26
15.20 Outer Retinal Tubulation (ORT) in AMD: OCT Findings Correlate with Histology (Karen B. Schaal) – page 28
15.30 Biomarkers for Neovascular AMD Therapy (Glenn J. Jaffe) – n/a
15.50 Peripapillary Subretinal Neovascularization (Mark Nelson) – page 30
16.00 Choroidal Anatomy in Geographic Atrophy (Karl Csaky) – page 32
16.20 Focal Choroidal Elevations (Eric Sigler) – page 34

16.30 Coffee Break

Basic Research & More – Moderators: Lihteh Wu, Francois Delori

17.10 Subcellular Basis of SD-OCT Reflectivity: Why it Matters What We Name the Bands (Christine A. Curcio – guest lecture) – page 36
17.30 Histological Quantitative Autofluorescence Maps of Human RPE (Thomas Ach) – page 38
17.40 Hyperspectral Autofluorescence Imaging of the Human RPE Ex Vivo (R. Theodore Smith) – page 40
17.50 SD-OCT Anatomic Correlates to Visual Function (Karl Csaky) – page 42
18.10 Ischemia of the Superficial and Deep Capillary Plexus Identified with SD OCT Imaging (David Sarraf) – n/a
18.30 Swelling and Dimpling of Inner Retinal Layer after ILM Peeling: Multimodal Assessment (Sebastien Giugou) – page 44

19.00 Welcome Reception
Saturday, October 19, 2013

Optic Nerve Head/ Glaucoma - Moderators: Balwantray Chauhan, Jeffrey S. Heier

09.00   Incorporating SD-OCT into the Clinical Examination of the Optic Nerve Head (Balwantray Chauhan) – page 46
09.30   SD-OCT Examination of the Lamina Cribrosa (Sung Chul Park – guest lecture) – page 48
10.00   Microcystic Macular Edema in Optic Nerve Pathology (Sebastian Wolf) – page 50
10.20   Coffee Break

Clinical Retina I - Moderators: Carl Csaky, Sebastian Wolf

11.00   Toward a More Specific Classification of PCV and its Therapeutic Applications (Gabriel Coscas – guest lecture) – page 52
11.20   Vascular Network Characteristics of PCV in a Randomised Controlled Trial (Tock Han Lim) – page 54
11.30   Monitoring anti-VEGF Therapy: Film, Fundus Photos & Fluid (Jeffrey S. Heier) – page 56
11.50   Multilayered PEDs and Mechanisms of RPE Tear Formation (David Sarraf) – n/a
12.10   The Clinical Significance of Pseudodrusen (Richard F. Spaide) – n/a
12.30   Lamellar Hole Associated Epiretinal Proliferation (LHEP) (Claudine E. Pang) – page 58
12.40   Lunch

13.15  All Poster Session Starts – Presentation Posters 11-19, Moderators: Richard F. Spaide, Lihteh Wu

Clinical Retina II - Moderators: K. Bailey Freund, Giovanni Staurenghi

14.00   Clinical Applications of Real-Time Angiography (David Brown) – n/a
14.20   Clinical Applications of Ultra-Widefield Imaging (Jeffrey S. Heier) – page 60
14.40   Optical Coherence Tomography Findings in Retained Emulsified Silicone Oil after Removal Surgery (Yale Fisher) – page 62
14.50   Evaluating Focal Vitreomacular Adhesions (Glenn J. Jaffe) – n/a
15.10   The Premacular Bursa’s Shape Revealed in Vivo by Swept-Source OCT (Michael Engelbert) – page 64
15.20   Multimodal Imaging of Macular Telangiectasia 2 (Lihteh Wu) – page 66
15.40   ICGA in Geographic Atrophy and Stargardt Disease (Giovanni Staurenghi) – page 68
16.00   Coffee Break

16.30  A Special Interactive Session with Lawrence A. Yannuzzi & K. Bailey Freund

18.00   Farewell Reception
Poster Presentations

Poster 01 - Nikolaus Feucht:
A Transient Additional Band in Spectral Domain OCT Observed in Acute Retinal Ischemic Conditions – page 70

Poster 02 - Florence Coscas:
Changes in Choroidal Thickness in Adult Onset Foveomacular Vittelliform Dystrophy versus AMD – page 72

Poster 03 - Yutaka Imamura:
Choroidal Thickness in Eyes with Posterior Recurrence of Vogt-Koyanagi-Harada Disease after High-dose Steroid Therapy – page 74

Poster 04 - Mihoko Suzuki:
Pseudodrusen Subtypes-Multimodal Imaging Characteristics – page 76

Poster 05 - Nicolas Yannuzzi:
Increased Fundus Autofluorescence Related to Outer Retinal Disruption – page 78

Poster 06 - Sotaro Ooto:
Outer Retinal Corrugations in Age-related Macular Degeneration – page 80

Poster 07 - Sabah Shah:
Subretinal Hyperreflective Exudation Associated with Neovascular Age-Related Macular Degeneration – page 82

Poster 08 - Tobias Duncker:
Distinct Characteristics of Inferonasal Fundus Autofluorescence Patterns in Stargardt Disease and Retinitis Pigmentosa – page 84

Poster 09 - Jesse Jung:
The Incidence of Neovascular Subtypes in Newly Diagnosed Wet Age-Related Macular Degeneration – page 86

Poster 10 - Suqin Yu:
Multimodal Imaging Findings In Deep Capillary Ischemia – page 88

Poster 11 - Oudy Semoun:
En Face Enhanced Depth Imaging Optical Coherence Tomography of Polypoidal Choroidal Vasculopathy – page 90

Poster 12 - Rosa Dolz-Marco:
High-Resolution Enhanced Depth Imaging Optical Coherence Tomography in Alport’s Syndrome – page 92

Poster 13 - Roberto Gallego-Pinazo:
The Macula in Angioid Streaks: Typical and Atypical Findings – page 94

Poster 14 - Chiara Veronese:
Early Autofluorescence Findings of Relentless Placoid Chorioretinitis – page 96

Poster 15 - Sarah Mrejen:
Assessing the Cone Photoreceptor Mosaic in Eyes with Pseudodrusen and Soft Drusen in vivo Using Adaptive Optics Imaging – page 98

Poster 16 - Suzanne Izer:
Expanded Clinical Spectrum of Enhanced S-cone Syndrome – page 100

Poster 17 - Ioannis Theocharis:

Poster 18 - Luna Xu:
Geographic Atrophy in Patients Receiving Anti-Vascular Endothelial Growth Factor for Neovascular Age-Related Macular Degeneration – page 104

Poster 19 - Eduardo Cunha de Souza:
Expanding our Understanding in MEWDS: A Case Series – page 106
Course Director:

K. Bailey Freund, MD
Vitreous Retina Macula Consultants of New York
Clinical Professor of Ophthalmology, NYU School of Medicine

K. Bailey Freund, MD specializes in all retinal disorders including macular degeneration, diabetic retinopathy, and retinal vascular diseases and is an expert in difficult-to-diagnose and rare conditions. He has initiated and conducted many clinical trials for treatments for retinal diseases. Dr. Freund is a Clinical Professor of Ophthalmology at New York University School of Medicine. He is a senior partner at Vitreous Retina Macula Consultants of New York. He is an attending surgeon at Manhattan Eye, Ear and Throat Hospital and New York Presbyterian Hospital. Dr. Freund is a member of the Retina Society, Macula Society, and the American Society of Retina Specialists. He is on the Editorial Board of the journal Retina and is an Associate Editor for Retinal Cases & Brief Reports. He has authored over 150 peer-reviewed scientific manuscripts and has written numerous book chapters. He has received numerous awards including the prestigious Young Investigator Award from the Macula Society. He is a graduate of Williams College and the New York University School of Medicine and completed his residency training in general ophthalmology and fellowship in medical and surgical retina at the Manhattan Eye, Ear, and Throat Hospital. Dr. Freund is also a prominent collector of vintage magic apparatus.

Faculty Members:

David Brown, MD
Vitreoretinal Consultants, Houston, Texas, USA

David M. Brown, MD is Clinical Assistant Professor, Department of Ophthalmology, The Methodist Hospital, Weil College of Medicine, Cornell University and in private practice at Vitreoretinal Consultants, both in Houston, Texas. He is the director of clinical research at the Greater Houston Retina Research Center at The Methodist Hospital, Houston, Texas. Dr. Brown received his medical degree and completed his internship at Baylor College of Medicine. He completed an ophthalmology residency and a fellowship in medical retina and vitreoretinal surgery at University of Iowa Hospitals and Clinics in Iowa City, where he was a Heed Fellow and Knapp Fellow. In 1994 he was awarded the Ronald G. Michels fellowship award presented to the top vitreo-retinal surgery fellow in the United States of America. Dr. Brown is an elected member of the Retina Society, the Macula Society, the Society of Heed Fellows, and the Ronald G. Michels Fellowship Society. He is the past president of the Iowa Eye Association and the Harris County (Texas) Ophthalmology Society. Dr. Brown was the recipient of an American Academy of Ophthalmology Honor Award in 2000 and in 2007 was elected by his peers to “America’s Best Doctors”. He is currently the principal investigator for multiple clinical trials evaluating treatments for diabetic macular edema, age-related macular degeneration, and central retinal vein occlusion. Dr. Brown is on the editorial board of Retinal Physician and serves as a peer-reviewer for five major ophthalmology journals and the New England Journal of Medicine.
Balwantray C. Chauhan, MD
Dalhousie University, Halifax NS, Canada

Balwantray Chauhan is Professor and Research Director of Ophthalmology and Visual Sciences, and Professor of Physiology and Biophysics at Dalhousie University. He is also the holder of first endowed Chair in Vision Research at Dalhousie. He obtained his Ph.D. at the University of Wales, Cardiff and his postdoctoral training at the University of British Columbia under the supervision of Dr. Stephen Drance. Dr. Chauhan’s clinical research interests are in the diagnosis of early changes in the visual field and optic disc in glaucoma. He has devised new strategies for detecting glaucomatous progression and conducted additional research leading to their translation to clinical practice. A key contribution in this area is the Topographical Change Analysis (TCA), a widely used technique for identifying changes in optic disc topography with modern imaging techniques such as scanning laser tomography. Dr. Chauhan is the principal investigator of the Canadian Glaucoma Study, a multicentre study and the largest of its kind, investigating the risk factors for the progression of open-angle glaucoma. His research is shedding new information on the nature and mode of glaucomatous progression. His research interests also include experimental models of optic nerve damage. This work complements his clinical research and address research questions to provide new clues about the aetiology of glaucoma and possible new avenues of therapy. Recent areas of activity include studies of neuron-glia interaction in the retina and optic nerve, in vivo imaging of retinal ganglion cells and neuroprotection. He conducts his basic science research in the Retina and Optic Nerve Research Laboratory, a multidisciplinary facility he was instrumental in establishing. This laboratory of 6 principal investigators from 4 departments in the Dalhousie Medical Faculty, and over 25 students, fellows and technicians is unique in the country and provides an excellent opportunity for discovery and training.

Dr. Chauhan holds research grants for both his clinical (since 1991) and basic science (since 1997) research from the Canadian Institutes of Health Research (CIHR) and other public and private sector agencies. He is a member of the CIHR Group in Retina of 4 scientists at Dalhousie involved in collaborative basic science research.

Karl Csaky, MD, PhD
Duke Center for Macular Diseases, Durham, NC, USA

Karl Csaky is a retina specialist and scientist. In addition, he diagnoses and treats medical retina diseases such as age-related macular degeneration and diabetic retinopathy. Dr. Csaky conducts both laboratory and clinical research on age-related macular degeneration and has directed research on new therapies for age-related macular degeneration.

His laboratory is studying the pathogenesis of all forms of age-related macular degeneration, investigating the use of sustained drug delivery as a therapeutic modality. Dr. Csaky is a member of the American Academy of Ophthalmology, the Macula Society, and the Association for Research in Vision and Ophthalmology. He is fellowship trained in retina diseases and is board certified in ophthalmology.
François Delori, MD  
Schepens/Mass Eye and Ear Infirmary, Boston, MA, USA

François Delori was born in Belgium and obtained his PhD in physics from Imperial College, London, in 1972. He then joined Schepens Eye Research Institute. He is now a Senior Scientist at the Institute, and an Associate Professor in Ophthalmology at Harvard Medical School. His interests include light damage to the retina, and the roles of macular pigment and of RPE lipofuscin in age-related macular degeneration (AMD).

Jeffrey S. Heier, MD  
Vitreoretinal Specialist, Ophthalmic Consultants of Boston, USA

Dr. Heier is the Director of the Vitreoretinal Service at Ophthalmic Consultants of Boston, and Co-director of the Vitreoretinal Fellowship. He is the Secretary of Online Education for the American Academy of Ophthalmology and the past President of the Center for Eye Research and Education in Boston, MA. Dr. Heier is one of the leading retinal clinical researchers in the country for new treatments in exudative and non-exudative macular degeneration, diabetic macular edema, venous occlusive disease, vitreoretinal surgical techniques and instrumentation, and diagnostic imaging of the retina. He serves on the Scientific Advisory Board or as Clinical Design Consultant to over twenty biotechnical or pharmaceutical companies, lectures nationally and internationally on retinal research and the innovative approach to the treatment of retinal diseases, and has authored numerous works in peer-reviewed journals.

Dr. Heier received his medical degree from Boston University, then did his transitional internship and ophthalmology residency at Fitzsimons Army Medical Center. Between his internship and residency, Dr. Heier served as a physician in a Combat Support Hospital in the Persian Gulf War, for which he was awarded a Bronze Star. Dr. Heier then completed a vitreoretinal fellowship at Ophthalmic Consultants of Boston/Tufts University School of Medicine.
Glenn J. Jaffe, MD, PhD
Duke Center for Macular Diseases, Durham, NC, USA

Dr. Jaffe is Professor of Ophthalmology and Chief of Vitreoretinal Diseases and Surgery Service. His clinical interests are vitreoretinal diseases and retinal cell biology, macular holes, retinal detachment, subretinal neovascularization, proliferative diabetic retinopathy, posterior segment surgical procedures for diagnosis or therapy of uveitis. He has an active basic and clinical research program and has been principal investigator on several funded clinical studies including investigations of an oral ganciclovir prodrug to treat CMV retinitis and a study to determine the safety of a cyclosporine sustained drug delivery implant in the treatment of uveitis. Dr. Jaffe is principal investigator of an ongoing multicenter trial of a fluocinolone sustained drug delivery implant to treat patients with severe uveitis and a trial of this same implant to treat diabetic macular edema. Recently, he has investigated the use of ultrasonography and optical coherence tomography to diagnose macular edema in a variety of ocular diseases.

Dr. Jaffe maintained an ongoing basic research program to test the hypothesis that cytokines are important in the development of proliferative vitreoretinopathy, an important intraocular wound healing disorder. He is actively involved in resident and fellow education and gives lectures to residents and fellows on a variety of topics related to uveitis and vitreoretinal diseases and train fellows to perform vitreoretinal surgery. Also he trains post-doctoral students and medical students to conduct clinically relevant research and serves as a mentor for the Duke third year medical school research program. Dr. Jaffe has served on a yearly basis as course faculty at many national and international meetings.

David Sarraf, MD
Jules Stein Eye Institute, UCLA, Los Angeles, CA, USA

Dr. David Sarraf is a full time faculty member and Clinical Professor of Ophthalmology at the Jules Stein Eye Institute at UCLA and is a member of the Retinal Disorders and Ophthalmic Genetics Division at JSEI. He has published approximately 75 research papers, case reports, reviews and book chapters. His focus of research interest is the wet form of age-related macular degeneration (ARMD) and specifically the evaluation of pigment epithelial detachment and retinal pigment epithelial tears. Dr. Sarraf has also published numerous papers studying novel imaging findings of various retinal diseases, including new SD OCT and fundus autofluorescence findings of the white dot syndromes, acute macular neuroretinopathy and ischemia of the superficial and deep retinal capillary plexi, and has described imaging characteristics of various new and old retinal toxicity disorders.

Dr. Sarraf is associate editor for the journals Retinal Cases and Brief Reports and OSLI Retina. He is a member of the BCSC section of the AAO responsible for editing the Retina volume and has been awarded achievement and secretariat awards by the AAO. He is also co-director of the Pacific Retina Club and the International Retinal Imaging Symposium and is a member of the ASRS, Retina Society, Macula Society and Gass Club.
Richard F. Spaide, MD  
Vitreous Retina Macula Consultants of New York, USA

Dr. Spaide specializes in diseases of the retina and vitreous. His particular interests include retinal surgery, macular degeneration, macular holes, macular pucker, diabetic retinopathy, and intraocular inflammation. Dr. Spaide has published more than 140 articles and book chapters and 4 books about the diagnosis and treatment of retinal diseases. He has given lectures around the world. His research interests include macular degeneration, biochemical analysis of lipids in Bruch’s membrane, ocular imaging, and intraocular inflammation. He was instrumental in the development of combined photodynamic therapy and intravitreal triamcinolone for age-related macular degeneration, a very promising therapy that is currently the focus of a randomized trial. He has also developed comprehensive theories explaining the etiology of age-related macular degeneration and also for serous detachment of the retina. He has developed numerous surgical instruments that were named after him. His current research interests include development of autofluorescent photography of the eye using a fundus camera.

He is the recipient of the Richard and Hilda Rosenthal Foundation Award in the Visual Sciences, given to individuals “…under the age of 45 years whose work gives high promise of a notable advance in the clinical treatment of disorders of the eye.” Dr. Spaide is on medical boards of a number of institutions, and has been mentioned in multiple Who’s Who and Best Doctors lists. He is a Section Editor of the journal Retina, is on the Editorial Board of the American Journal of Ophthalmology and reviews articles for a number of prestigious journals.

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 Milano (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, Macula Society since 2004, Ophthalmic Photographer Society since 2006 and American Accademy of Ophthalmology since 2007.
Sebastian Wolf, MD
Inselspital University of Bern, Switzerland

Sebastian Wolf is Professor of Ophthalmology, Director and chairman of the Dept of Ophthalmology, Inselspital, University of Bern, Switzerland. He earned a PhD degree for biotechnical engineering from the Rheinisch Westfälische Technische Hochschule (RWTH) Aachen, Germany. Subsequently, he attended medical school at the RWTH Aachen, Germany. He passed his residency in Ophthalmology at the Department of Ophthalmology, University of Aachen and did fellowships at the Scheepens Eye Research Institute, Harvard Medical School in Boston, USA and the Dept. Ophthalmology at the RWTH Aachen. His major clinical interests are in medical and surgical retina. His main areas of scientific interest are age-related macular degeneration, diabetic retinopathy, retinal vein occlusions, imaging, and vitreo-retinal surgery. Dr Wolf has authored over 180 publications in peer-reviewed journals, including Ophthalmology, Archives of Ophthalmology, AJO, IOVS, Diabetes Care, and Hypertension. He serves on the editorial board of various scientific journals including IOVS, Ophthalmologica, European Journal of Ophthalmology, and Graefes Archives. He is a frequent speaker at national and international meetings.

He is a member of many professional organisations, including Deutsche and Schweizer Ophthalmologische Gesellschaft, Deutsche Retinologisch Gesellschaft, the Association for Research in Vision and Ophthalmology, the Retina Society, EURETINA, Club Jules Gonin, and the American Academy of Ophthalmology. He has been appointed as ARVO Gold Fellow and he has been elected as General Secretary of the EURETINA.

Lihteh Wu, MD
Instituto de Cirugía Ocular, San José, Costa Rica

Following the completion of his undergraduate studies at Cornell University, where he graduated with distinction in all subjects, Dr. Wu went on to Tulane University School of Medicine to pursue his medical education. During this time he was awarded a Pew Research Fellowship that allowed him to spend a year at the Rockefeller University in New York. He then trained at Columbia Presbyterian Hospital in New York City (internship), the Mount Sinai Medical Center in New York City (ophthalmology residency), and the National Retina Institute in Baltimore under the mentorship of Drs. Bert Glaser and Robert Murphy (vitreoretinal fellowship). In 1999, Dr. Wu returned to Costa Rica where he was appointed Associate Professor at the University of Costa Rica and the Director of the Vitreo-Retinal Department at the Insituto de Cirugía Ocular in San José, Costa Rica. Dr. Wu is a founding member of the Pan American Collaborative Retina Study (PACORES) Group. He has authored and co-authored more than 50 peer reviewed articles, more than 40 chapters and has edited 5 books. He has been awarded the Senior Honor Award (2007) by the American Society of Retina Specialists, Senior Honor Award (2010) by the Greek Vitreoretinal Society, Achievement Award (2006) and the Senior Achievement Award (2013) by the American Academy of Ophthalmology.

Dr. Wu is past President of the Pan American Retina and Vitreous Society and serves as the current Spanish Language Secretary for the Pan American Association of Ophthalmology. He also served two terms as President of the Costa Rican Ophthalmological Association. In addition, he is certified by the American Board of Ophthalmology. He is a member of the Club Jules Gonin, Macula Society, Retina Society and the American Society of Retinal Specialists. Dr. Wu has been invited to speak at several international meetings like the American Academy of Ophthalmology Retina Subspecialty Day and the Vail Vitrectomy Meeting.
Guest Speakers:

Gabriel Coscas, MD
University of Paris XII, France

Gabriel Coscas was trained at University of Paris. He established Department of Ophthalmology in 1970 in Creteil (University Paris XII) and served as Professor of Ophthalmology and Chairman until 1999. He is now Emeritus Professor. He devoted most of his activity on macular diseases. President of French Retina Society. He organized the first randomised clinical trial on macular photocoagulation for AMD in France.

Author and co-author of over 450 peer review papers and many books, including “Atlas of ICG angiography”, 2004, Elsevier, “OCT and AMD”, Springer Edit. 2009; and “Macular Oedema”, Karger Edit 2010. He received many awards and lectures, including Gass Medal at the Macula Society and the Arnall Patz Medal in 2012. He was honoured as first recipient of the “Gabriel COSCAS Lecture” 2001. Founding member of Global Alliance against Trachoma, at WHO.

Christine A. Curcio, MD
University of Alabama School of Medicine, Birmingham, USA

Christine A. Curcio, PhD, Professor of Ophthalmology, has focused her research career on chorioretinal aging and age-related macular degeneration (AMD). Trained in neuroanatomy and morphometry at University of Rochester and University of Washington, her early work on human photoreceptor and ganglion cell topography are widely cited. Dr. Curcio’s contributions to AMD pathobiology include documenting that rods die before cones in aging and AMD; discovering, characterizing, and contextualizing a large age-related accumulation of lipoprotein particles of intra-ocular origin in human Bruch’s membrane (with M. Johnson, N. Dashti, B.H. Chung, and C. Guidry; 1998-2011) that constitutes the largest single pathway in drusen; and characterizing AMD-specific lesions including basal linear deposit (1999) and subretinal drusenoid deposit (with R. Spaide, 2009-present). She was awarded the Roger H. Johnson Prize (2002) and Prix Soubrane de la Recherche en Ophtalmologie (2011).

Funded by the National Eye Institute since 1985, current research focuses on the cell and tissue basis of optical coherence tomography and fundus autofluorescence, two widely used diagnostic tools for retinal disease, exploiting a repository of donor eyes obtained from the Alabama Eye Bank. Dr. Curcio serves on the editorial boards of Investigative Ophthalmology and Visual Science, Current Eye Research, and Progress in Retinal and Eye Research and on the Board of Scientific Counselors of the National Eye Institute.
Bruno Lumbroso, MD
Private Centro Oftalmologico Mediterraneo, Rome, Italy

Bruno Lumbroso, MD, he got his medical degree at the University of Paris in 1958 and his residency at the University of Rome in 1963. He was clinical fellow at the University of California from 1960 to 1961. He has been Director of the Department of Ophthalmology of the Rome Eye Hospital and Professor LD of Clinical Ophthalmology in the University of Rome La Sapienza for more than 35 years. He is now Director of the Private Centro Oftalmologico Mediterraneo for Retinal Diseases, Rome, and General Secretary of the Italian Laser Society. He has written handbooks on retinal imaging in fluorescein angiography, Indocyanine green angiography, time domain OCT and Spectral Domain OCT.

He is involved in medical education in ocular imaging. His main interests are in logical methods of retinal imaging analysis and interpretation, and in clinical applications of OCT technology for retinal disorders. Recently he worked on clinical applications of “en face” OCT and edited a Clinical “en face” OCT Atlas.

Sung Chul Park, MD
New York Eye and Ear Infirmary, New York, USA

Dr. Park is Assistant Professor of Ophthalmology at New York Medical College and the Peter Crowley Research Scientist and the Director of Moise and Chella Safra Advanced Ocular Imaging Laboratory at the New York Eye and Ear Infirmary. He is a clinician-scientist in the field of ophthalmology and his areas of expertise include glaucoma, cataract, anterior segment disorders, minimally invasive glaucoma/cataract surgery, ocular imaging, and perimetry. He pioneered the new field of three-dimensional high-resolution imaging and analysis of the optic nerve head in human glaucoma, discovering a new set of pathogenic mechanisms of the development and progression of glaucoma. He also elucidated the risk factors and progression pattern of central visual field loss in glaucoma and revealed that patients with central visual field loss would benefit from visual field tests with centrally condensed test points.

He has more than 110 peer-reviewed articles, abstracts and book chapters including top ophthalmology journals such as Ophthalmology, IOVS, and JAMA Ophthalmology. He has given more than 40 lectures in the US, Germany, Netherlands, Australia, France, China, India, South Korea and Saudi Arabia. He is an expert reviewer for 10 top peer-reviewed journals including Ophthalmology, IOVS, and JAMA Ophthalmology. He has been honored with 15 nationally or internationally recognized awards, grants and scholarships from the American Glaucoma Society, New York Glaucoma Research Institute grants, American Academy of Ophthalmology, Association for Research in Vision and Ophthalmology, and World Glaucoma Association. Dr. Park received his medical degree from Seoul National University, College of Medicine. After his ophthalmology residency and glaucoma fellowship at the Samsung Medical Center, Seoul, Korea, he joined the New York Eye and Ear Infirmary in 2009 and finished a clinical and a research glaucoma fellowship in 2010 and in 2011, respectively. He is a member of 7 professional societies including Association for Research in Vision and Ophthalmology, American Glaucoma Society, and World Glaucoma Association Associate Advisory Board. He is also serving as an organizer of international academic meetings including the World Ophthalmology Congress, Asia Pacific Academy of Ophthalmology Congress, and Glaucoma Foundation Optic Nerve Rescue and Restoration Think Tank.
Steffen Schmitz-Valckenberg, MD
Department of Ophthalmology, University of Bonn, Germany

Steffen Schmitz-Valckenberg, MD, is private lecturer and assistant medical director at the Department of Ophthalmology, University of Bonn, Germany (Chairman: Professor Frank G. Holz). He has a particular interest in retinal imaging and the pathogenesis of macular diseases. He is co-founder of the GRADE Reading Center which specializes in the analysis of fundus autofluorescence imaging. Steffen Schmitz-Valckenberg was visiting fellow to Richard F. Spaide at VRM Consultants of New York, USA and worked as a research fellow with Professor Fred W. Fitzke and Adnan Tufail at the Institute of Ophthalmology and Moorfields Eye Hospital in London, United Kingdom. He is co-editor of the Atlas of Fundus Autofluorescence Imaging and has authored over 40 peer-reviewed articles.

Special Feature by:

Lawrence A. Yannuzzi, MD
Vitreous Retina Macula Consultants of New York, USA

Larry Yannuzzi is a graduate of Harvard College and Boston University Medical School, where he was honored as a distinguished alumnus. He is a professor of clinical ophthalmology at Columbia University Medical School, vice–chairman and director of The Retinal Research Center of the Manhattan Eye, Ear & Throat Hospital, and founder and president of The Macula Foundation, Inc. He is a world renowned retinal specialist who has published more than 300 scientific papers and 11 textbooks, with particular interest in diseases of the macula, such as diabetic retinopathy and age–related macular degeneration. He has also been given awards and distinctions in his field for contributions on retinal imaging drug development, ophthalmic laser, and the diagnosis and treatment of macular and retinal diseases. His achievements have gained worldwide respect and admiration. Most recently, he was given an honorary doctorate at the University of Ancona, the Michelson Award for Retinal Vascular Disease in Gent, the Alcon Research Institution Award, a distinguished alumnus award at Boston University, and a lifetime achievement award by the American Academy of Ophthalmology.
MultiColor Imaging

Giovanni Staurenghi, MD
Sacco Hospital, University of Milano, Italy

The interpretation of MultiColor imaging could be somehow difficult. A series of new instruments are right now on the market. Heidelberg Spectralis uses simultaneous three lasers: blue for the blue channel, green for the green channel and infrared for the red channel. Nidek F10 has the possibility to acquire sequentially different images obtained with blu, green and red lasers and the software sequentially create the multicolor image. These two instrument use also a confocal mode. Optos use only two laser, green and red to obtain a multicolor image. A regular color fundus picture is obtained using white light and collecting all the visible spectrum. Because of all these differences the multicolor images are different from color pictures. Using color and multicolor image comparisons a series of these differences will be underline.
Ultra-Widefield Imaging

Steffen Schmitz-Valckenberg, Julia S. Steinberg, Viola Graham, Monika Fleckenstein, Frank G. Holz

Department of Ophthalmology, University of Bonn, Germany

**Purpose:** To evaluate a novel ultra-widefield non-contact lens for confocal scanning laser ophthalmoscopy (cSLO)

**Methods:** Acquisition of different cSLO imaging modalities, including near-infrared reflectance (NIR), bluepeak fundus autofluorescence (FAF) as well as fluorescein (FA) and indocyanine green angiography (ICGA), was carried out in different retinal diseases (Spectralis HRA+OCT, Heidelberg Engineering, Germany). Images at different field sizes were obtained by changing the lens of the camera head (standard lens, widefield lens and ultra-widefield lens).

**Results:** Following changing the lens within a few seconds, evenly illuminated and non-distorted images with high contrast were obtained far beyond the vascular arcades with the ultra-widefield lens using FA and ICGA. Easy detection of retinal neovascularization, non-perfused retinal areas and distribution of laser scars following laser treatment was feasible. Although the resolution was inferior compared to the 55° and 30°x30° degree lenses, even subtle changes such as reticular drusen were still visible far beyond the vascular arcades by NIR imaging with the ultra-widefield lens. FAF imaging was possible in young patients, particularly with retinal dystrophies and a presumably enhanced load of intrinsic fluorophores. In subjects with deep set eyes, camera alignment was challenging.

**Conclusions:** Retinal cSLO imaging at high-resolution of the retinal periphery far beyond the vascular arcades is possible using a novel non-contact ultra-widefield lens in the clinical setting. Visualization of peripheral retinal areas in one images may allow for mapping and monitoring of pathological alterations that are not identifiable by standard imaging system. This may be helpful for the assessment of the extension of retinal diseases in order to improve patient management.
Measuring Macular Pigment

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Purpose: The optical and antioxidant properties of MP, its possible relation to the pathophysiology of ARMD, and the possibility to modify macular pigment optical density (MPOD) by nutritional supplementation has resulted in a growing interest in research on macular pigment. MPOD can be measured using psychophysical and optical methods. Especially, the two wavelength autofluorescence method has been shown to provide reliable and robust data on MPOD in various disease.

Methods: A MultiColor™ Spectralis™ HRA+OCT was used to measure MPOD using 486 nm (blue light) and 515 nm (green light) autofluorescence images. Macular pigment densities were assessed by calculating a macular pigment density (MPOD) map and comparing foveal and parafoveal autofluorescence at 488 nm and 515 nm. Density maps were processed to calculate MPODc within a 1 degree-diameter circle centered on the fovea. MPODc is expressed in optical density units (D.U.).

Results: We have measured macular pigment in subjects with various diseases. Diagnosis included healthy subjects, diabetic retinopathy, age related maculopathy, geographic atrophy, exsudative macular degeneration, and retinal vascular occlusion. In all subjects measuring of macular pigment using the simultaneous two wavelengths mode (486nm and 515nm) was possible. The build-in software allowed reproducible calculation of macular pigment density (MPD) maps and quantitative analysis of MPOD within the fovea as well as assessment of MPDO distribution in the macula.

Conclusions: The two-wavelength autofluorescence densitometry used with the MultiColor™ Spectralis™ HRA+OCT has been evaluated as a save and highly repeatable method of measurement. Allowing not only for overall quantification of MPOD but also for analysis of distribution and quantification in circumscribed areas is an advantage of this method of MPOD imaging.
The ring like distribution autofluorescence profile of macular pigment is heritable

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Purpose: Macular pigment (MP) protects the retina from damage due to blue light and other oxidative stress. Genetic factors determine the distribution profile of MP, which may also be important in protection from oxidative stress. In addition it has been suggested that the ring pattern (with a “shoulder” in the profile at ~0.5 degrees from the fovea) may be protective of AMD.

Methods: 314 healthy white female twin volunteers, aged 16-50 years (mean age 40 +/- 8.7 years) had macular pigment optical density (MPOD) measured by 2-wavelength fundus autofluorescence (AF). The sample consisted of 76 monozygotic twin pairs, and 74 dizygotic twin pairs.

Results: At baseline, mean MPOD by AF was 0.41 density units (SD 0.21; range 0.04 to 1.25) in the central half-degree field, and exhibited a near-normal distribution. The ring like MP distribution profile was observed in a number of subjects (prevalence 0.29, 95% CI 0.24-0.34). Concordance in monozygotic twins was 0.84 (95% CI 0.60-0.90) compared to 0.35 in dizygotic twins (95% CI 0.23-0.63), (p for diff<0.001).

Conclusions: The finding that the monozygotic twin concordance is approximately double the dizygotic concordance suggests that genetic factors are important in determining the MP distribution in the macula. Two wavelength AF is useful to achieve quantitative analysis of observed changes in the AF signal.
Possible correlations between Transverse OCT scans and flat mounted retina imaging in Cystoid Macular Edema

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Purpose: Compare OCT transverse images with flat mounted retina histological imaging to understand correlations between different retina condition en face OCT scans and macular microstructure.

Methods: Transverse scans were carried out at different depths in the retina, trying to follow exactly inner nuclear layer, outer plexiform layer and Henle layer in the outer nuclear layer in normal eyes, and eyes affected by Cystoid Macular Edema, Irvine Gass syndrome, macular juvenile retinoschisis, macular holes, lamellar holes. These scans were confronted to histological images of flat mounted retina.

Results: Transverse OCT scans show in some disorders a stellar pattern very similar to some microstructure pattern highlighted in flat mounted retina images.

Conclusions: OCT en face images and flat mounted retina histological imaging show some correlations between different retina disorders en face OCT scans and macular microstructure. Macula microstructure study allows a better understanding and interpretation of transverse scans in some diseases.
Imaging the Choroidal Anatomy

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Despite the fact that the choroid plays an important role in the structure and function of the eye, it has not been studied in detail in vivo. Improvements in OCT imaging technology allow routine imaging of the choroid and deep optic nerve structures in most patients. As with any new technology, it needs validation in both healthy and diseased eyes. Reproducible measurements of choroidal and lamina cribrosa thickness are possible. Several variables such as age, axial length and time of day, affect choroidal thickness and must be taken into account when interpreting data on choroidal thickness. Choroidal thickness may be used to differentiate between CSC, PCV and exudative AMD. EDI- OCT of the choroid may detect tumors not detectable by ultrasound. Studying the choroid may help us gain insight into the pathogenesis of several diseases such as AMD, CSC, glaucoma, posteriorly located choroidal tumors and PCV among others.
Quantitative Fundus Autofluorescence

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Purpose: To quantify autofluorescence (qAF) in subjects with healthy retinas and in patients with retinal degeneration. The objective was to establish normative data and identify factors (race, gender, genetics) that influence the accumulation of RPE lipofuscin.

Methods: AF images were acquired from 277 healthy subjects and in 42 patients with Stargardt disease (STGD1) using a Spectralis confocal scanning laser ophthalmoscope (488-nm excitation; 30°) equipped with an internal fluorescent reference. Image acquisition is initiated by an exposure to bleach the photopigment. For each image, mean gray level was calculated in 8 preset regions, and was corrected for reference, magnification, and optical media density (normative data for lens absorption).

Results: qAF levels in healthy subjects exhibited a significant increase with age, and were highest supero-temporally. qAF were significantly greater in females, and, compared to Hispanics, was significantly higher in whites and lower in blacks and Asians. No associations with axial length and smoking were observed. In STGD1, qAF levels were significantly higher than age-matched healthy subjects.

Conclusions: qAF provides a novel diagnostic tool and will aid in achieving a better understanding of disease pathogenesis and progression, and could contribute to the assessment of drug and gene therapies.
Fluorescent lifetime imaging ophthalmoscopy (FLIO) in patients with choroideremia

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**Purpose:** The fluorescence of organic molecules is not only characterized by the emission spectrum, it has also a characteristic lifetime or decay rate. Retinal fluorescence lifetimes can be measured with the fluorescence lifetime imaging ophthalmoscope (FLIO) based on a Heidelberg Engineering Spectralis® system. However, during excitation of the retina, many retinal fluorophores are excited simultaneously. Therefore the measured multi-exponential fluorescence decay represents the superposition of all individual decay components. Therefore it is important to gain a better understanding how individual retinal layers influence fluorescence lifetimes. Here we characterize fluorescence lifetimes in patients with choroideremia, a rare hereditary condition characterized by progressive degeneration of the retina, the retinal pigment epithelium (RPE) and the choroid.

**Methods:** Fluorescence lifetime measurements of 3 patients with choroideremia were acquired. Fluorescence decay times were measured in a short wavelength channel (498 – 560 nm) and in a long wavelength channel (560 – 720 nm). Mean fluorescence lifetimes in each channel were calculated for each acquired pixel within the retina by time-correlated single photon counting. The areas affected by chorioretinal degeneration were identified by fundus colorphotographs and fundus autofluorescence (FAF) imaging and compared to the images acquired with the fluorescence lifetime ophthalmoscope.

**Results:** Mean fluorescence lifetime for both channels were significantly longer in the areas of chorioretinal atrophy. Interestingly, in the border zones between healthy and atrophic retina fluorescence lifetime imaging provided an excellent contrast with characteristic fluorescent lifetimes. These border areas were not easily identified by FAF or fundus colorphotographs.

**Conclusions:** In advanced choroideremia the sclera and large choroidal blood vessels become exposed. We show that these areas display significantly extended lifetimes, probably representing the collagen within the exposed sclera. Interestingly the border zones between healthy and atrophic retina, were the photoreceptors are still identifiable with OCT, display characteristic fluorescence lifetimes. These areas may represent degenerating retina. FLIO may therefore be able to identify areas at risk, providing a tool for monitoring disease or assessing therapeutic effects for example in gene therapy.
Refining the Diagnosis and Management of Choroidal Neovascularization in Age-Related Macular Degeneration: Correlation of Initial Lesion Composition with Long-Term Visual Outcomes

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**Purpose:** To determine the frequencies of lesion subtypes as determined by FA vs. FA+OCT grading in neovascular AMD and whether long-term Va outcomes using a “treat & extend” dosing regimen correlates with initial lesion composition.

**Methods:** We retrospectively analyzed a consecutive series of newly diagnosed treatment-naïve eyes treated by a single physician with anti-VEGF therapy for the diagnosis of neovascular AMD from January 2006 through January 2012. Inclusion criteria included: age over 50, baseline visual acuity of 20/40 to 20/800, absence of permanent structural damage at the fovea, and a minimum of 1 year of follow-up. Two graders classified the baseline lesions using FA [poorly defined (occult), well-defined (classic), retinal angiomatous proliferation (RAP) or mixed] and anatomically using FA and OCT [type 1 (sub-RPE), 2 (subretinal), type 3 (intraretinal) neovascularization or mixed]. PROC GLM in SAS was used for multivariate regression analysis. PROC FREQ was used to test associations between categorical outcomes.

**Results:** 266 eyes fit the inclusion criteria. Mean age at first injection was 81.4, 67.7% were women, and 95.5% were white. For the entire cohort, mean Va at baseline was 20/180. Mean Va (Snellen) at 12, 24, 36, 48, 60 and 72 months was 20/144, 20/164, 20/134, 20/197, 20/205, and 20/296 respectfully. The distribution using FA classification alone were 49.6%, 12.0%, 28.6%, and 9.8% among occult, classic, RAP and mixed respectively. The corresponding mean initial / final visual acuities were 20/170 / 20/153, 20/290 / 20/384, 20/157 / 20/213 and 20/157 / 20/984 among mixed lesions. Based on anatomical classification including FA and OCT, 39.9% had type 1, 9.0% type 2, 34.2% type 3, and 16.9% mixed lesions. The corresponding mean initial / final visual acuity were 20/213 / 20/157, 20/213 / 20/266, 20/213 / 20/213, and 20/213 / 20/810. Multivariate analysis explained about 7% of the variation in visual acuity. Only type 1 was significant, p<0.05. There was strong agreement between FA and anatomical classification, p<0.01.

**Conclusions:** With both forms of grading, we found a higher incidence of type 3 (RAP) than found in prior studies. FA+OCT grading identified a higher frequency of mixed CNV lesions that FA alone. Va outcomes appear to correlate better with the FA+OCT grading than with FA grading, with type 1 lesions showing the best long-term visual outcomes.
Outer Retinal Tubulation (ORT) in Age-Related Macular Degeneration (AMD): Optical Coherence Tomographic (OCT) Findings Correlate with Histology

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**Purpose:** To correlate OCT and histologic findings of ORT 2° to advanced AMD in living patients and post-mortem specimens.

**Methods:** High-resolution OCT raster scans of 43 eyes (33 patients) manifesting ORT 2° to advanced AMD were correlated with histologic studies of post-mortem specimens. High-resolution sections through the fovea and superior perifovea donor eyes preserved ≤4 hours of death (8 atrophic AMD and 44 neovascular AMD) were examined by light microscopy.

**Results:** ORT seen on OCT correlated with the histologic finding of tubular structures comprised largely of cones lacking outer segments and, in some cases, lacking inner segments, leaving a luminal border delimited by the external limiting membrane (ELM). ORT was observed in both open and closed configurations that were typically easily distinguished from cysts and photoreceptor islands on both OCT and histologically. Histology showed that the hyper-reflective luminal material seen on OCT represents retinal pigment epithelium (RPE) and non-RPE cells trapped within the ORT structure. ORT histologic findings correlated with OCT findings in regard to composition, location, shape, and different stages in ORT formation, for ORT with luminal cross-sectional diameter ≥ 31 µm on OCT.

**Conclusions:** Histologic correlation gives a better understanding of ORT formation and composition. ORT is comprised primarily of cone and Müller cells. While the defining feature of ORT on OCT is a hyper-reflective line that appears to represent the ellipsoid zone, the occasional occurrence of ORT bordered solely by ELM without inner segment ellipsoids (“ELM-only-ORT”) challenges OCT interpretation in the differentiation of ORT from cysts.
Peripapillary Subretinal Neovascularization

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**Purpose:** Describe the characteristics of peripapillary subretinal neovascularization that qualify it as a separate phenotypic and genotypic sub-classification of Exudative ARMD.

**Methods:** 840 eyes from 829 patients with Exudative ARMD were evaluated and sub-classified using ICG/multimodality imaging. 76 eyes of 70 patients were found to have a peripapillary origin and were evaluated for lesion characteristics, treatment response, and visual outcomes. Genetic analysis was performed on 400 of these patients.

**Results:** 32% of 76 eyes had classic neovascularization with or without arteriolarization. 57% of eyes had occult membrane with subRPE arteriolarized neovascularization or polyps. 11% had non-specific etiologies and were probably related to long standing lesions. Treatment responses were successful with Krypton photocoagulation, anti-VEGF monotherapy, PDT (half and full fluence) alone, and ICG-directed PDT Triple Therapy.

**Conclusions:** Peripapillary subretinal neovascular membranes were found to be more prevalent in patients without ARMS2 risk alleles and more common in patients with CFH related protective alleles. These lesions respond very nicely to all treatment modalities, however, require more aggressive treatment when subfoveal involvement is present. Therefore, careful screening with early detection is critical.
Choroidal Anatomy in Geographic Atrophy

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**Purpose:** While the etiology of geographic atrophy (GA) in patients with age-related macular degeneration (AMD) is still not clear, associated histologic changes include loss of the retinal pigment epithelium and photoreceptors with apparent loss of the choroid and choriocapillaris. The goal of this study was to study the effects of developing GA on underlying choroidal structures as defined by enhanced depth imaging (EDI) and a novel 3D reconstruction software.

**Methods:** Patients classified as having intermediate AMD or geographic atrophy were included and serial SD-OCT sections of the choroid and choriocapillaris were obtained (Spectralis HRA+OCT) using EDI. Varying thickness locations of the choroid were obtained to generate an overall thickness profile in the macula of these patients and reconstructions of the choroidal structures were generated to determine diameters and extensiveness of vessel ramification. These results were compared to a databank of age-matched controls and results were reported as percent change from normal for choroidal thicknesses.

**Results:** One eye from patients with intermediate AMD (n=17; age=75.4±8.6y) or central geographic atrophy (GA) (n=15; age 73.8±7.6y; GA area 3.2±3.3 mm²) was examined. The percent change from normal for choroidal thicknesses from each group were: -21%±29% (extensive soft drusen), and -36%±37% (GA). 3D reconstructions detailed loss of smaller caliber vessels but in some case enlargement of remaining choroidal vessels.

**Conclusions:** Loss of choroidal structures may be progressive pathology in intermediate drusen and in patients with GA. Monitoring these changes may become an important anatomic marker of successful treatment of dry AMD.
Focal Choroidal Elevations

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**Purpose:** To describe the clinical and imaging characteristics of focal chorioretinal contour changes overlying specific choroidal vessels in the context of an overall thin choroid, or focal choroidal elevations.

**Methods:** Prospective, observational case series involving enhanced-depth imaging optical coherence tomography performed on consecutive patients presenting for retinal evaluation over a two-month study period. Patients with focal choroidal elevation were further analyzed with Amsler grid testing, fundus photography, fundus autofluorescence, and fluorescein angiography.

**Results:** 38 of 787 (4.8%) patients presented with focal choroidal elevations. Overall mean age±standard deviation was 80±9.4 years. Underlying diagnoses included ARMD (n=25), pathologic myopia (n=5), or idiopathic (n=8). Mean central macular choroidal thickness was 86±40 µm. Focal choroidal elevations appeared as a pigment epithelial detachment (PED) in 36/38 patients on ophthalmoscopy. Overall mean lumen diameter of the vessels inducing FCE was 131±33 µm (range=78-239 µm). 19/38 (50%) lesions were subfoveal. Metamorphopsia in the absence of additional pathology were demonstrated in 17/38 (55%), all of which were subfoveal. 27/38 (71%) patients had a history of choroidal neovascularization in their fellow eye.

**Conclusions:** Focal choroidal elevations are relatively common lesions in age-related macular degeneration, high myopia, and age-related choroidal atrophy. The lesions may simulate pigment epithelial detachments or chorioretinal folds, may induce metamorphopsia, and have a distinct optical coherence tomography appearance.
Subcellular basis of SD-OCT reflectivity: why it matters what we name the bands

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Purpose: The four outer retinal hyper-reflective bands of SD-OCT invite a subcellular basis for reflectivity, because internal structures in the contributing cells are strictly segregated in the vertical axis. This feature is best documented for photoreceptors but is also true for the retinal pigment epithelium (RPE).

Methods: Cellular and extracellular components capable of contributing to the hyper-reflective bands will be reviewed. Studies utilizing ex vivo OCT and histology of human eye pathology specimens, OCT and histology in animal models, and in vivo SD-OCT imaging of human subjects will be reviewed to assess evidence that melanosomes and mitochondria are independent reflectivity sources.

Results: The evidence for melanosome reflectivity includes examples from ex vivo OCT of pathology specimens, OCT of retinomotor movements in frogs, and SD-OCT of patients with albinism. The evidence for mitochondrial reflectivity includes accurate vertical localization of the second outer retinal hyper-reflective band (called IS/OS), in vitro OCT of frog retina, and reflectivity in outer retinal tubulation in AMD.

Conclusions: The resolution of currently available SD-OCT is adequate to permit subcellular localization of reflectivity in the outer retina due to the massed effects of vertically compartmentalized cells. Even as transmission electron microscopy began elucidating one cellular organelle at a time in the 1960’s, histologically informed SD-OCT can provide an ultrastructural toehold on chorioretinal diseases today.
**Histological Quantitative Autofluorescence Maps of Human Retinal Pigment Epithelium**

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**Purpose:** Fundus autofluorescence (AF) imaging is well established in clinical diagnosis and treatment monitoring. However, no comprehensive data on histological AF and retinal pigment epithelium (RPE) cell number at locations relative to the fovea exist. We provide maps of histological AF and cell density (cells/mm²) from eyes of young and old adult donors.

**Methods:** RPE-Bruch’s membrane flatmounts were dissected from human chorioretinal tissues (18 subjects; < 50 and > 80 yr; no gross macular pathologies). RPE cytoskeleton and lipofuscin AF were monitored microscopically in flatmounts at up to 90 predefined locations chosen in a systematic and unbiased manner. Maps were assembled, and each counted cell was represented as a Voronoi region. Histological AF values were normalized to a quantitative AF (qAF) standard (Delori; PMID 22016060). RPE cells were counted using an ImageJ plugin.

**Results:** A ring of higher AF signal centered on the fovea is visible at the perifovea in all tissues, corresponding to areas of highest rod photoreceptor densities (Curcio; PMID 2324310) and fundus AF (Delori, PMID 11431454, 22016060). AF maps show large variability that is only partly explained by age. RPE cell maps show peak density at the fovea, independent of age. While AF difference maps (< 50 vs. > 80) highlight increasing AF in the perifovea with age, no net RPE cell loss is detectable in the corresponding density difference maps.

**Conclusion:** Our maps of histological AF attributable to lipofuscin improve the cellular basis of interpreting clinical qAF imaging. These maps will be the basis for planned studies with AMD eyes. A correlation between an age-related increase in lipofuscin AF and RPE density is not apparent. These findings may impact our understanding of lipofuscin’s role in AMD pathogenesis.

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Hyperspectral Autofluorescence Imaging of the Human Retinal Pigment Epithelium (RPE) Ex Vivo

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**Purpose:** To describe hyperspectral autofluorescence imaging as a method to search for individual component fluorophores of lipofuscin ex vivo and to demonstrate preliminary results using this technique.

**Methods:** Hyperspectral autofluorescence emission images were acquired from 6 pure RPE-Bruch’s membrane preparations of human donor eyes using a Nuance FX camera (Caliper Life Sciences, USA) at 3 locations (fovea, parafovea, and periphery) and at 2 excitations (430 and 488 nm) with long-pass emission filters. Each image was a spectral-spatial cube with the spectral dimension from 420 to 720 nm at 10 nm intervals and the 2 spatial dimensions of a 40X field on a Zeiss Axiom Imager A2 microscope (Carl Zeiss, Germany) with plan-apochromat objectives. These data were then decomposed into spectra for lipofuscin and Bruch’s membrane using the Nuance software and further studied with mathematical tools of orthogonal matrix projection and Gaussian mixtures.

**Results:** The lipofuscin spectra were consistently modeled by Gaussian mixtures of 4 abundant fluorophores, with one peak similar to the spectrum of A2E, a known RPE fluorophore, and three others that may represent new compounds to be identified through analytic biochemistry. The total signal intensities were lower at the fovea (which lacks rods) and higher in the perifovea (rod hotspot) and in the periphery (highest rod-to-cone ratio). Spectra were clearly distinguishable from those of Bruch’s membrane.

**Conclusions:** Identification of these new individual RPE fluorophores will help us further understand lipofuscin’s role in health and disease.
SD-OCT Anatomic Correlates to Visual Function

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Purpose: Anatomic changes of dry age-related macular degeneration (AMD) are the main features that are used to determine progression of disease. However as anatomic changes progress very slowly and central visual acuity can remain stable despite extensive anatomic changes the present study was undertaken to determine the extent of visual function changes in patients with progressive dry AMD.

Methods: 8 eyes of 8 patients with early AMD, 17 eyes with intermediate AMD and 15 eyes with advance AMD (GA) were examined. Rod-mediated sensitivities were measured from retinal areas within the retinal arcades but outside the area of central GA using a modified fundus microperimeter (MP-1S, Nidek Technologies). Subsequently SD-OCT scans (Spectralis HRA+OCT) were obtained from the retina. Thickness measurements of various dimensions of the neurosensory retina in the areas corresponding to the retinal sensitivities were quantified.

Results: The overall mean scotopic retinal sensitivities = 33 dB ± 2.6 (mean ± SD) for early AMD, 32.1 dB ± 3.6 (mean ± SD) for intermediate AMD and 25.6 dB ± 6.1 (mean ± SD) for advanced AMD (GA). Correlation analysis (Pearson coefficient) demonstrated that of the various retinal anatomic parameters, only inner segment and outer segment thickness correlated with scotopic retinal sensitivities but in the multivariate correlations, changes in anatomic parameters could only account for 16% of the sensitivity variability (cumulative R square = 0.16).

Conclusions: In this preliminary study, there is a loss of rod sensitivities in patients with advancing dry AMD that does not correlate to anatomic changes in the neural retina as detected by SD-OCT suggesting there is a structure-function mismatch in rod function in patients with advancing dry AMD.
Swelling and dimpling of inner retinal layer after internal limiting membrane peeling: multimodal assessment

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Purpose: To investigate the inner retinal layer outcome after internal limiting membrane (ILM) peeling in idiopathic epiretinal macular membrane (ERM) with new Spectral Domain Optical Coherence Tomography (SD OCT)

Methods: Prospective, randomized, comparative case series. Vitrectomy and ERM removal were performed using brilliant peel staining before and after ILM peeling. All eyes were examinated pre and postoperatively (W1, M1, M3, M6) using Spectralis HRA (Heidelberg) with autofluorescence, red free, infrared filters and SD OCT with B-scan and C-scan images. Videos of the surgeries are retrospectively analyzed.

Results: Thirty four eyes with ERM underwent pars plana vitrectomy with (n= 19) or without (n= 15) ILM peeling associated. In the ILM peeled group a dissociated optic nerve fiber layer (DONFL) appearance was detected in 12 eyes (63%) on Red free filters. Dimples of the nerve fiber layer are seen in 19 eyes (100%) which correspond to the DONFL appearance. It appears at M1 visit and persists until M6 and was never seen in the non-ILM peeled group. C-scan or “en face OCT” shows a dimpling of the inner retinal layer which correspond to the area of the ILM peeling. Swelling of the arcuate nerve fiber layer (SANFL) was detected in 14 eyes (73%) in the ILM peeled group and in 5 eyes (33%) in the non ILM peeled group. It appears at W1 and regess at M1 visit. Autofluorescence imaging shows a dark point at the beginning of the arcuate striae and correspond to the initiated peeling with the forceps on the video.

Conclusion: SD OCT is more sensitive than Red free photography to detect DONFL appearance which correspond actually to dimples in the inner retina. New “en face OCT” is very usefull in this indication. Autofluorescence and infrared photography show transient SANFL which probably correspond to a direct traumatism when peeling. Thus, peeling in the temporal inferior area may be the best way to begin the surgery and avoid microscotoma. Multimodal examination (HRA and SD OCT) allows us to describe two different ways of healing after ILM removal. ILM peeling is correlated with SANFL and DONFL and further functional studies are necessary to analyze such nerve fiber layer defects.

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Incorporating SD-OCT into the Clinical Examination of the Optic Nerve Head

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Presently, the clinician evaluates neuroretinal rim health according to the appearance of the optic disc, the clinically visible surface of the optic nerve head (ONH). Recent anatomic findings with SD-OCT have challenged the basis and accuracy of current rim evaluation because the disc margin lacks a solid anatomic foundation and results in variably inaccurate rim measurements for two reasons. First, the clinically visible disc margin is an unreliable outer border of rim tissue due to clinically and photographically invisible extensions of Bruch’s membrane. Second, rim tissue orientation is not considered in width measurements. An alternative anatomic and geometrically accurate SD-OCT based approach has been proposed for clinical assessment of the ONH that is anchored to the eye-specific anatomy and geometry of the ONH and fovea.
SD-OCT Examination of the Lamina Cribrosa

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**Purpose:** SD-OCT has been used to assess retinal nerve fiber layer (RNFL) and neural tissue of the optic nerve head in glaucoma. Because the lamina cribrosa (LC) is considered the primary and principal site of retinal ganglion cell injury in glaucoma, in vivo evaluation of the LC may enhance our understanding of glaucoma pathophysiology and be helpful in the management of glaucoma patients.

**Methods:** Serial enhanced depth imaging (EDI) OCT scans of the optic nerve head were obtained from normal subjects and glaucoma patients for volumetric analysis. EDI OCT scans were reviewed for the presence of focal LC defects and reconstructed 3-dimensionally for spatial correlation between focal LC defects and glaucomatous damage. Position of the anterior LC surface relative to the Bruch's membrane opening was assessed to investigate its shape in normal eyes and its posterior displacement in glaucomatous eyes.

**Results:** EDI OCT visualized focal LC defects of various shapes and sizes in glaucomatous eyes. Focal LC defects were spatially correlated with neuroretinal rim loss, RNFL defects and visual field defects and were associated with visual field progression. The LC had a central ridge that appeared to be a supporting structure of the LC. The LC was posteriorly displaced in glaucomatous eyes compared to normal eyes, as well as in eyes with visual field defects compared to fellow eyes with no visual field defects.

**Conclusions:** The LC can be evaluated using EDI method of Spectralis OCT. EDI OCT-guided evaluation of the LC structure and its deformation will be helpful in giving glaucoma patients more individualized care.
Microcystic Macular Edema in Optic Nerve Pathology

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**Purpose:** Several reports have shown that microcystic macular edema occurs in a subset of patients with multiple sclerosis (MS). Recently we have observed microcystic macular edema in a patient with non demyelinating optic neuropathy. The aim of this study was to determine the prevalence and characteristics of microcystic macular edema in patients with non demyelinating optic neuropathy.

**Methods:** We conducted a retrospective study of consecutive patients with confirmed optic neuropathy and who had a macular high resolution spectral domain optical coherence tomogram after diagnosis. Patients with MS and glaucoma were excluded. We determined age, sex, location of microcystic macular edema. Using segmentation of the different retinal layers we determined the thickness of individual inner and outer retinal layers.

**Results:** We included 180 eyes from 117 patients and found microcystic macular edema in 16 eyes (8.8%) from 9 patients (7.7%). This macular edema had a microcystic aspect with a characteristic perifoveal distribution and was restricted to the inner nuclear layer identical to the microcystic macular edema described in patients with MS. The ganglion cell layer was significantly thinner in regions with microcystic macular edema as compared to regions without microcystic macular edema (p=0.007) and microcystic macular edema was associated with nerve fibre loss. Young age was a significant risk factor.

**Conclusion:** Microcystic macular edema is caused by optic neuropathy and is not specific to multiple sclerosis. Our findings support the notion that microcystic macular edema is caused by retrograde retinal degeneration of the inner layers leading to impaired fluid absorption in the outer retinal layers.
Toward a more specific classification of polypoidal choroidal vasculopathy and its therapeutic applications

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Purpose: To suggest a clinical distinction between idiopathic typical polypoidal choroidal vasculopathy (PCV) and secondary polyps associated with late AMD and its therapeutic application.

Methods: Retrospective case series of 30 eyes of 30 consecutive patients (xx females and xx males) with PCV. Initial diagnosis was based on SLO-ICGA, associated with FA and EDI SD-OCT, which allowed a clinical distinction between two subtypes of polyps. This multimodal imaging and visual acuity testing were repeated then at regular follow-up visits. The central macular and choroidal thickness, presence and number of hyper-reflective dots in retina and in choroid were also evaluated.

Results: The two groups were clinically different, based on demographic and ethnical characteristics, imaging findings and topography of lesions, presence of drusen, of true CNV, and changes in choroidal thickness. Therapeutic response was different in the two groups. After treatment, hyper-reflective dots decreased significantly but choroidal morphology did not change significantly. Functional and anatomical changes after treatment are analyzed and discussed.

Conclusion: The clinical distinction between idiopathic typical PCV and secondary polyps associated with late AMD and results of treatment, suggest a specific therapeutic approach for each group, based on multimodal imaging.
**Vascular Network Characteristics of Polypoidal Choroidal Vasculopathy in a Randomised Controlled Trial**

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**Purpose:** The EVEREST Study was the first randomised controlled trial (RCT) studying verteporfin photodynamic (PDT) / ranibizumab combination therapy for polypoidal choroidal vasculopathy (PCV). This study describes the baseline indocyanine green angiographic (ICGA) findings of the associated vascular network.

**Method:** All ICGA were captured using confocal scanning laser ophthalmoscope (CSLO) technology (Heidelberg Retinal Angiogram (HRA), Heidelberg Engineering, Germany). Dynamic images (first 30s) and still stereoscopic pairs (1, 3, 5, 10 and 20 minutes) were read and measured using Heidelberg Eye Explorer (version 1.6.2.0). The vascular network was classified as either Inter-connecting channel (ICC) or Branching Vascular Network (BVN) by studying its pattern (criss-cross vs branching respectively).

**Results:** Of the 95 cases referred to the Central Reading Center (CRC), 61 were confirmed PCV, of which 80% showed a vascular network. Of these, 20% were classified as ICC, 80% BVN. Lesions with ICC were smaller, as in total lesion area (p=0.001), vascular network area (p=0.001) and greatest linear dimension (p=0.021), were associated with fewer polyps (p<0.001), less likely to be associated with ring / cluster polyp-pattern (p=0.002), less likely to show network leakage (p=0.001) and were less likely to feature drusen in the opposite eye (p=0.032).

**Conclusion:** Among eyes with PCV recruited in EVEREST Study, 2 patterns of vascular network were observed using CSLO-ICGA. Larger image sets are needed to confirm the findings of angiographic subtypes of PCV.
Monitoring Anti-VEGF Therapy: Film, Fundus Photos & Fluid

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Purpose: To evaluate the various imaging modalities in the monitoring of anti-VEGF therapy.

Methods: A review of the strengths and weaknesses of the various imaging modalities as they apply to monitoring the response of anti-VEGF therapy. Modalities reviewed include fluorescein angiography, fundus photography and optical coherence tomography (OCT) (both time-domain and spectral-domain). A review of the use of these modalities in clinical trials, including PrONTO, CATT, VIEW, HARBOR, RISE and RIDE, BRAVO and CRUISE, COPERNICUS and GALLILEO, and the outcomes utilizing these tests will be analyzed.

Results: Clinical trials basing treatment decisions on frequent monitoring with OCT, both time-domain and spectral domain, have generated visual outcomes that rival regular (monthly or every other month) injections without reliance on imaging. The use of registered OCTs, using volume scans, ensure subtle areas of intra-retinal or subretinal fluid are detected and help to detect persistent or recurrent fluid.

Conclusions: OCT has become the standard means of monitoring treatment responses to anti-VEGF therapy. Fluorescein angiography can be helpful to characterize treatment responses when OCT is equivocal, but has become secondary to OCT as the main gauge for treatment decisions. Fundus photography has little impact on monitoring decisions.
Lamellar Hole Associated Epiretinal Proliferation (LHEP)

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**Purpose:** To describe a novel type of epiretinal proliferation found predominantly in association with a lamellar macular hole (LMH), termed as lamellar hole associated epiretinal proliferation (LHEP).

**Methods:** Retrospective observational review of spectral-domain optical coherence tomography (SD-OCT) images of 2030 eyes of 1104 patients with diagnoses including LMH, full-thickness macular hole (FTMH) and epiretinal membrane (ERM) from 2008 to 2013. The subset of eyes found to have this new form of proliferation, LHEP, was studied and qualitatively compared to those of a comparable group with conventional ERM using the SD-OCT data.

**Results:** LHEP was detected only in eyes with inner retinal defects. LHEP was found in 68 of 2030 (3.3\%) eyes, of which 88.2\% had LMH and 11.8\% had FTMH. LHEP was not seen in 1734 eyes that had ERM without inner retinal defects. LHEP was found in 60 of 197 (30.5\%) eyes with LMH and 8 of 99 (8.0\%) eyes with FTMH. On SD-OCT, LHEP appeared to originate from within the retinal defect, showed a homogenous medium reflectivity on the epiretinal surface, and conformed to the adjacent retinal anatomy. In contrast to ERM, LHEP did not induce distortion or edema of the underlying normal retinal tissue. In the region immediately around the full- or partial-thickness hole, there was a splitting of the retina in the region of Henle’s fiber layer in 98.2\% of eyes with LMH and LHEP, and 87.7\% had visible connecting tissue on SD-OCT from the base of the lamellar hole to the proliferating epiretinal tissue.

**Conclusions:** SD-OCT imaging showed a subset of patients, particularly those with LMH, had a proliferation of epiretinal tissue with medium reflectivity, with no evidence of contractile properties that appeared to proliferate from injured layers of the mid-retina. This phenotype differs from conventionally described ERMs in appearance and induced changes of the underlying retina; and given the anatomic relationships, may have distinct surgical implications.
Clinical Applications of Ultra-Widefield Imaging

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**Purpose:** Fluorescein angiography has played an important role in the diagnosis and management of macular disease, and has proven useful in imaging disease of the mid-peripheral retina. Although collage images have helped, the peripheral retina has been difficult to image. This presentation will discuss the benefits of ultra-widefield imaging, and describe the advantages of such imaging in various disease states.

**Methods:** The advantages and limitations of ultra-widefield imaging will be discussed. A review of ongoing clinical trials utilizing such imaging, and a literature review of widefield imaging will be presented. Different disease states in which widefield imaging offers the most benefit - diabetic retinopathy, venous occlusive disease, retinal detachment and vascular diseases such as Coats’ disease will be highlighted. Clinical examples of each of these will be presented.

**Results:** Ultra-widefield imaging has led to improved visualization and appreciation of peripheral retinal pathology. The method of imaging has helped clinicians manage a variety of conditions, including proliferative diabetic retinopathy and ischemic venous occlusive disease. A greater ability to detect proliferative retinopathy or other peripheral pathologies has led to innovations in treatment, such as targeted laser therapy and/or new indications for intervention.

**Conclusions:** Ultra-widefield imaging has increased the retina specialist’s ability to appreciate and manage peripheral retinal pathology. The improvement in recognition of such pathology has led to earlier and increased intervention in many of these diseases. Ongoing clinical trials are attempting to assess the benefit of such interventions.
Optical coherence tomography findings in retained emulsified silicone oil after removal surgery

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\textbf{Purposes:} To identify the presence of remaining emulsified silicone oil droplets after removal surgery with ultrasound, spectral-domain optical coherence tomography (OCT) and adaptive optics.

\textbf{Methods:} This was a retrospective review of 9 eyes of 9 patients (6 males and 3 females) who underwent vitrectomy and silicone oil tamponade. After silicone removal surgery, clinical examination, ultrasound and OCT was performed to identify if there were any remaining silicone droplets in vitreous cavity, retina or optic nerve. Adaptive optics was performed in three patients.

\textbf{Results:} The mean age of our patients was 45 years (range, 15–78 years). Silicone oil emulsification was considered in 7 eyes of 7 patients clinically. Emulsified silicone oil found in ultrasound showed obvious highly reflective dots in the vitreous cavity. During OCT imaging, it has several manifestations in retina or optic nerve: 1) Clear bubbles with/without hyper-reflective tails; 2) Hyper-reflective dots with/without hyper-reflective tails; 3) Hyper-reflective tails without observable dots or bubbles. Adaptive optics confirmed these oil droplets in three patients.

\textbf{Conclusion:} Hyper-reflective tails behind hyper-reflective dots is a peculiar optical effect. We believe “multiple scattering” could be one of the possible explanations for this artifact. Emulsified silicone oil may be imaged in many ocular tissues. Representation varies with techniques. Interpretation of these images is very important for the retinal specialist to fully understand the possible impact of emulsified silicone oil on retina and its function. At present, we believe ultrasound is the best way to demonstrate emulsified silicone oil droplets in vitreous. OCT is useful for detecting them in retina and optic nerve and adaptive optics is an additional and confirming imaging method if available.
The premacular bursa's shape revealed in vivo by swept-source optical coherence tomography

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Purpose: To resolve the controversy surrounding the shape and relationship of posterior vitreous spaces by characterizing the connections between the premacular and preoptic space and Cloquet's canal.

Methods: Heidelberg Spectralis OCT and Topcon DRI OCT-1 Atlantis 3 D OCT were used to acquire scans of the posterior vitreous of 102 eyes of 51 volunteers aged 21 - 54 without ocular pathology.

Results: A premacular space was found to extend superiorly at a variable angle in all 102 eyes beyond our scanning ability. It connected with the preoptic area of Martegiani or its extension (Cloquet's canal) at a variable distance from the optic nerve in 101 of 102 eyes forming a flat and broad superior channel. The skyward direction of this channel was found to be gravity-dependent in all 14 eyes of the 7 subjects examined in various head positions. OCT was able to identify vitreoschisis, but the above changes were found even in 28 eyes without any discernable vitreous degeneration.

Conclusions: The premacular space, also known as Worst’s premacular bursa or Kishi’s posterior precortical vitreous pocket was found to continue superiorly without detectable borders. It fuses broadly with the extension of the preoptic area of Martegiani, namely Cloquet's canal or the hyaloidal tract of Eisner. This suggests that a direct anterior-posterior connection between the retrolental and premacular and preoptic space exists already in the eyes of young adults in the absence of vitreoschisis.
Macular telangiectasia type 2, also known as idiopathic perifoveal telangiectasia and juxtafoveal retinal telangiectasis type 2A, is an acquired bilateral neurodegenerative macular disease that usually manifests itself during the fourth to sixth decades of life and is characterized by minimal dilatation of the parafoveal capillaries with graying of the retinal area involved, a lack of lipid exudation, right-angled retinal venules, refractile deposits in the superficial retina, hyperplasia of the retinal pigment epithelium (RPE), foveal atrophy and subretinal neovascularization (SRNV). Optical coherence tomography images typically demonstrate intraretinal hyporeflective spaces that are usually not related to retinal thickening or fluorescein leakage. The typical fluorescein angiographic finding is a deep intraretinal hyperfluorescent leakage in the temporal parafoveal area. With time the leakage may involve the whole parafovea, but does not extend to the center of the fovea. Long-term prognosis for central vision is variable and depends on the development of SRNV or macular atrophy. Pathogenesis remains unclear, but multimodality imaging with OCT, confocal blue reflectance and adaptive optics suggest that Müller cells and macular pigment play a central role. Currently there is no known treatment for the underlying cause of this condition, but treatment of the SRNV may be beneficial.
ICGA in Geographic Atrophy and Stargardt Disease

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Indocyanine green angiography is normally used to identify choroidal neovascularization or inflammatory disease to cases of the choroid. We conducted a study to evaluate differences in fluorescein angiography (FA) and indocyanine green angiography (ICGA), between subjects affected by Stargardt disease (STGD) and atrophic AMD. We described a new sign called “dark atrophy”, a hypocyanescence by ICGA from the areas of atrophy in Stargardt and late-onset Stargardt disease and not in GA. This finding, along with SD-OCT evidence of intact choroid, suggests a possible selective damage of the choriocapillaris in STGD. It could be used to better identify patients for new clinical trials on GA.
Poster Presentation

A Transient Additional Band in Spectral Domain OCT Observed in Acute Retinal Ischemic Conditions

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Purpose: To investigate alterations in the neurosensory retinal structure secondary to acute retinal ischemic conditions. The observations were documented by spectral domain optical coherence tomography (SD-OCT) and fundus autofluorescence (FAF) imaging.

Methods: SD-OCT images and FAF were used to observe the retinal structure. 5 subjects (59 – 76 years) with acute monocular visual impairment due to retinal ischemia were included. The main focus of attention was set on the transition of the outer nuclear layer (ONL) to outer plexiform layer (OPL). SD-OCT images were acquired with a combined SD-OCT and scanning laser ophthalmoscope (SLO) imaging system using a linear cross hair scan and a 6 line radial scan of 6 mm length.

Results: SD-OCT revealed an additional highly reflective band located between ONL and OPL. Morphological characteristics of this hyperdense band were a decreasing intensity with distance to the fovea, partially segmental occurrence and a timely limited incidence. FAF showed areas of increased and decreased signal intensity within the vessel arcade at the posterior pole. The regions of decreased FAF corresponded to peri-venous regions.

Conclusions: The additional hyperreflective band observed in SD-OCT could represent a marker for retinal ischemia in subjects without the presence of a complete arterial occlusion. The mid-retinal localization of the band between ONL and OPL represents the locus of transition from retinal to choroidal oxygen supply where oxygen diffusion is weakest. Histopathologically the observed alterations could represent activated microglial tissue induced by the hypoxia driven upregulation of inflammatory molecules aimed at ischemia repair. These speculations need to be confirmed by histopathological studies. Nevertheless our findings underline the connection of function and morphology and contribute to the diagnostic understanding of the retinal reflectivity.

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Poster Presentation

Changes in Choroidal Thickness in Adult Onset Foveomacular Vittelliform Dystrophy versus AMD

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**Purpose:** To compare Choroidal Thickness between eyes with adult onset foveomacular vitelliform dystrophy (AOFVD), and eyes with age-related macular degeneration (AMD).

**Design:** Observational, comparative case series; 5 groups, 38 eyes each

**Methods:** Choroidal Thickness was measured in EDI-OCT with Spectralis* Sub-foveal choroidal thickness was analyzed with measurement of the vertical distance from the Bruch’s membrane to the innermost choroid/sclera junction, at 500µm intervals up to 1500µm, from temporal to nasal and from superior to inferior to the center of the fovea Measurements were performed by 2 trained observers. Main Outcome Measures: Choroidal Thickness in each group.

**Results:** The difference between subfoveal ct in AOFVD (325,7 + -85,9 µm) versus CT in Exudative AMD (158,5 + -55,9 µm) and CT in Atrophic AMD (157,5+ -67µm) was statistically significant (p<0.003 and p <0.0001). The difference between the CT of the affected eye versus the fellow eye in AOFVD (317,7 + - 90 µm) is low and not statistically significant (p=0.232, r=-0.199). Choroidal thickness at each of the other 12 points showed a similar tendency.

**Conclusions:** This study demonstrates thickening of choroid in the eyes with AOFVD, in contrast with choroidal thinning observed in eyes with AMD. These findings suggest involvement of different pathogenic mechanisms in AOFVD from those in exudative AMD.

Choroidal thickness measurement could become criteria for diagnosis between exudative AMD and advanced stage of AOFVD with fluid accumulation and for any eventual decision of treatment with indication for anti VEGF Injection.
Poster Presentation

Choroidal Thickness in Eyes with Posterior Recurrence of Vogt-Koyanagi-Harada Disease after High-dose Steroid Therapy

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Purpose: To determine the choroidal thickness of eyes during a posterior recurrence of Vogt-Koyanagi-Harada (VKH) disease after high-dose steroid therapy.

Methods: A posterior recurrence was defined as a posterior inflammation which appeared at least 3 months after an initial high-dose steroid therapy and required a higher dose of systemic steroid therapy. All eyes had enhanced depth imaging optical coherence tomography (EDI-OCT), and the subfoveal choroidal thickness was measured before and after the posterior recurrence in the EDI-OCT images.

Results: The manifestations of the recurrence were serous retinal detachment, macular edema, vitreous opacity, and choroidal folds. The subfoveal choroidal thickness was 749 ± 60 µm (mean ± standard error of the mean (SEM)) at the time of the recurrence, which was significantly thicker than that measured before the recurrence (348 ± 18 µm, P<0.001, Wilcoxon rank-sum test). The eyes were treated with a higher dose of steroids, and the choroidal thickness was reduced to 351 ± 31 µm (P<0.001) in 2 weeks and to 352 ± 50 µm (P<0.001) at 1 month.

Conclusions: The choroidal thickness is significantly larger in the VKH eyes with a posterior recurrence and became smaller after an increased dose of steroid. Objective measurement of the choroidal thickness using EDI-OCT may be useful for monitoring the dose and effectiveness of steroids during the course of the treatment in VKH.
Poster Presentation

Pseudodrusen Subtypes-Multimodal Imaging Characteristics

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Purpose: To classify pseudodrusen appearance caused by subretinal drusenoid deposits according to the multimodal imaging information and to evaluate their distribution.

Methods: Retrospective, observational case series. The color fundus photographs and infrared scanning laser ophthalmoscope images (IR-SLO) of patients with pseudodrusen were evaluated along with spectral domain optical coherence tomography, and the results were tabulated. Distinct types of pseudodrusen could be differentiated.

Results: There were 140 eyes of 93 patients with a mean age of 82.4 years, and 23 were males and 70 were females. The multimodal imaging information showed 3 subtypes of pseudodrusen. One principal type was seen to be an orderly array of discrete dot-like accumulations principally located in the perifovea and these were called dot pseudodrusen. They appeared as yellow-white spots in color photography and discrete and hyporeflective dots, often with target configuration, in IR-SLO. The second type was interconnected ribbons or bands of material located most prominently in the perifovea and these were called ribbon pseudodrusen. This subtype appeared as interlocking bands that were slightly yellower than the dot subtype in color photography and were faintly hyporeflective in IR-SLO imaging. Dot pseudodrusen were seen in 127 (96.1%) and ribbon pseudodrusen in 53 eyes (40.2%). Dot pseudodrusen were detected more commonly with IR-SLO imaging than with color fundus photography (P=.014) and ribbon pseudodrusen were much more seen in color photographs than in IR-SLO (P<.001). The third type of pseudodrusen were small irregularly spaced, and frequently confluent, globules principally located peripheral to the perifoveal region. They appeared as small yellow-white accumulation in color images and hyperreflective spots in IR-SLO images. Eight eyes had the third type pseudodrusen.

Conclusion: Pseudodrusen seen by clinical examination may be classified into at least 3 categories. These findings suggest that each type of pseudodrusen could be composed of differing components; therefore, they may confer differing risk for progression to advanced age-related macular disease. Using only one modality, such as only infrared imaging or only color photography, would lead to missing specific subtypes of pseudodrusen.
Purpose: To determine if outer retinal damage and photopigment loss may, in some settings, cause increased fundus autofluorescence (FAF) by producing a window defect that increases the excitation of and unmasks the FAF emitted from the underlying preserved RPE.

Methods: Eyes with various retinal diseases causing focal outer retinal damage, but preserved underlying RPE were assessed using spectral-domain optical coherence tomography (SD-OCT) and FAF. Two eyes were evaluated before and after photobleaching. After dark adaptation for 20 minutes, diseased areas showing hyperautofluorescence were illuminated with the excitation light source for 60 seconds to achieve photobleaching.

Results: Four eyes with multiple evanescent white dot syndrome (MEWDS), multifocal chorioiditis (MFC) or resolved central serous chorioretinopathy were included. The retinal areas with disruption of the ellipsoid zone over an intact RPE band on SD-OCT corresponded to areas of hyperautofluorescence. After bleaching, the FAF signal of the background increased more than the FAF signal of the diseased areas, therefore decreasing contrast, and making the lesions originally hyperautofluorescent almost disappear.

Conclusions: Outer retinal disruption may result in hyperautofluorescence due an unmasking of normal background RPE autofluorescence. This mechanism may help explain hyperautofluorescence in a variety of settings including several of the white dot syndromes, the active margin of acute zonal occult outer retinopathy, resolved CSC, rhegmatogeous retinal detachment after repair, and the hyperautofluorescent ring in retinitis pigmentosa. In addition to other causes of hyperautofluorescence, reduced optical pigment density resulting from outer retinal disruption should be considered as a possible contributor to the hyperautofluorescence seen in entities producing photoreceptor damage with relative RPE sparing.
Poster Presentation

Outer Retinal Corrugations in Age-related Macular Degeneration

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Purpose: To describe outer retinal findings in eyes with severe atrophy associated with age-related macular degeneration (AMD) using spectral-domain optical coherence tomography (SD-OCT) and suggest candidate histopathologic correlates.

Methods: We retrospectively reviewed medical records of AMD patients with severe atrophy due to either choroidal neovascularization (CNV) or geographic atrophy (GA). Outer retinal findings were evaluated from SD-OCT images, and compared with histopathologic findings in one donor eye with GA stained with periodic acid-Schiff-hematoxylin. Some OCT images had volume rendering using MIPAV.

Results: In 18 eyes of 13 patients (mean age, 82.7 ± 7.9 years) with AMD, a sheet of moderately reflective material was identified above the Bruch membrane line within the atrophic area in the SD-OCT images. At its external border the material was contiguous with the outer portion of the retinal pigment epithelium (RPE) band. Below the material was a relatively hyporeflective space. The material seen was thrown into folds in more widespread cases following CNV. Histopathology revealed a rippled layer of basal laminar deposits (BlamD) in an area of RPE atrophy.

Conclusions: We have described a new entity, termed outer retinal corrugations, which may correspond to histological BlamD, an extracellular deposit that persists in eyes with AMD. The visualization of the material suggests that at least in some AMD eyes the OCT-designated RPE band may be more than just RPE. This finding in eyes with CNV does not necessarily mean there is exudation.
Poster Presentation

Subretinal Hyperreflective Exudation Associated with Neovascular Age-Related Macular Degeneration

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Purpose: To describe the multimodal imaging findings of subretinal hyperreflective exudation (SHE) observed in association with choroidal neovascularization (CNV) and to distinguish SHE from other forms subretinal hyperreflective material (SHM) seen in patients with age-related macular degeneration (AMD) and other macular disorders.

Methods: A retrospective Study 45 eyes of 41 patients with SHE associated with types 1, 2, and 3 treatment-naïve CNV secondary to neovascular AMD (NVAMD). Patients were examined using multimodal imaging including spectral domain optical coherence tomography (SD-OCT), near-infrared reflectance imaging, fluorescein angiography (FA), fundus autofluorescence (FAF), indocyanine green angiography (ICGA), and color photography. Clinical and imaging characteristics were evaluated at baseline, after initiation of intravitreal anti-vascular endothelial growth factor (VEGF) therapy, and during the resolution of SHE.

Results: Mean ± standard deviation (SD) age at first detection of SHE was 77.2±10.1 years. The mean ± SD follow-up was 2.1±0.6 years. Fluorescein angiography (FA) in all 41 eyes showed leakage and/or staining of underlying CNV but not of the SHE itself. On FA, SHE was transparent in 28 eyes and blocking in 7 eyes. In 31 eyes, SHE showed isoautofluorescence on FAF and in 8 eyes SHE showed varying degrees of hyperautofluorescence. ICGA was performed in 7 eyes and demonstrated hyperfluorescence of SHE in 6 eyes. In 7 eyes, SHE was the only evidence of neovascular activity. All eyes having follow-up (42 eyes) showed resolution of the subretinal material with partial or full reconstitution of the ellipsoid zone following a median of 2 injections range (1-16 injections). SHE persisted for median of 9 weeks (range 4-60 weeks) after the initiation of treatment. Mean visual acuity prior to treatment was 0.619 (20/83) and improved to 0.380 (20/48) (p=0.03) after resolution of SHE.

Conclusions: SHE differs from other types of subretinal hyperreflective material based on findings from multimodal imaging. This novel type of SHM likely represents a sign of active NVAMD distinct from subretinal fluid, hemorrhage, neovascular tissue, lipid, pigment hyperplasia, subretinal fibrosis, and the SHM observed with acquired vitelliform lesions. Intravitreal anti-VEGF agents can be used to successfully resolve SHE, often resulting in better visual outcomes in eyes manifesting this form of exudation.
Poster Presentation

Distinct Characteristics of Inferonasal Fundus Autofluorescence Patterns in Stargardt Disease and Retinitis Pigmentosa

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Purpose: To report distinct characteristics of fundus autofluorescence (AF) patterns inferior to the optic disc in recessive Stargardt disease (STGD1) and retinitis pigmentosa (RP).

Methods: Short-wavelength (SW) and near-infrared (NIR) AF images were acquired from patients with STGD1 and RP. In SW- and NIR-AF images of STGD1 patients, gray levels (GL) on both sides of the demarcation line were measured.

Results: In STGD1, a demarcation line, which has been assigned to the closed optic fissure, was visible on SW-AF and NIR-AF inferior to the optic disc. In healthy subjects, this demarcation line is only visible by SW-AF. At 20° inferior to the disc center, AF levels on the nasal side were 25% (±11%) lower than on the temporal side in SW-AF images and 18% (±11%) lower in NIR-AF images. For both STGD1 and RP, the inferonasal quadrant exhibited distinct SW- and NIR-AF patterns compared to other fundus areas. Disease-related AF changes such as flecks appeared to respect the demarcation line as a boundary.

Conclusions: Disease-related AF patterns originating in RPE in STGD1 and RP appear to respect the demarcation line in the inferonasal quadrant of the fundus as a border. The visibility of the inferonasal demarcation line by NIR-AF in STGD1 but not in healthy eyes may indicate that increased levels of RPE lipofuscin modulate the melanin-related NIR-AF signal. This feature of NIR-AF images may aid in the diagnosis of STGD1 patients.
Poster Presentation

The Incidence of Neovascular Subtypes in Newly Diagnosed Wet Age-Related Macular Degeneration

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Purpose: To determine the frequencies of neovascular lesion subtypes in newly diagnosed neovascular age-related macular degeneration (AMD) and to determine whether these frequencies differ when grading is based on fluorescein angiography (FA) or both FA and optical coherence tomography (OCT).

Methods: We retrospectively analyzed a consecutive series of patients treated by a single physician with intravitreal anti-vascular endothelial growth factor (anti-VEGF) therapy for the diagnosis of neovascular AMD from January 2006 through January 2012 in order to identify newly diagnosed treatment-naïve cases. Inclusion criteria included: age over 50 years; best corrected visual acuity of 20/40 to 20/800, new onset of treatment-naive CNV, and absence of permanent structural damage to the central fovea. Two independent graders classified the lesions based on FA [poorly defined (occult), well-defined (classic), or retinal angiomatous proliferation (RAP)] and with both FA and OCT [type 1 (sub-RPE), 2 (subretinal) or type 3 (intraretinal) neovascularization]; a third grader evaluated the lesion in the presence of significant discrepancies. Analysis between agreement in lesion subtype by FA alone or FA/OCT was performed using Chi-squared for two categorical variables. For each subtype of CNV, the association between demographic factors was also assessed. Analysis was performed using Stata 11 software (StataCorp, College Station, TX).

Results: Among 748 AMD patients treated with anti-VEGF therapy, a total of 531 eyes were treatment- naïve and 266 fit the inclusion criteria. The average age at first injection was 81.4 years. 67.7% were women and 32.3% men. 95.5% were Caucasian, 2.6% Hispanic, 1.5% Asian and 0.4% Black. Based on FA classification alone, 49.6% had occult, 12.0% classic, 28.6% RAP, and 9.8% had mixed CNV lesions. In comparison, using FA/OCT, we found 39.9% type 1, 9.0% type 2, 34.2% type 3 (RAP), and 16.9% mixed.

Conclusions: With both forms of grading, we found a much higher incidence of type 3 (RAP) lesions and lower incidence of type 2 (classic) lesions than found in prior studies. Combined FA/OCT grading identifies a higher frequency of mixed CNV lesions as the addition of OCT appears useful in clarifying the location of the neovascular tissue in relation to the RPE.
Poster Presentation

Multimodal Imaging Findings In Deep Capillary Ischemia

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Purposes: To evaluate the multimodal imaging findings in deep pre-capillary retinal arteriole occlusion (DPRAO).

Methods: This was a retrospective review of 5 eyes of 4 patients who noted the sudden onset of paracentral scotomas caused by DPRAO. Multimodal imaging including color and red-free (RF) photographs, near infrared reflectance (NIR), fluorescence angiography (FA), and spectral domain optical coherence tomography (OCT) was analyzed and correlated with microperimetry. Imaging findings in DPRAO were compared with those of a cotton-wool spot (CWS) caused by superficial pre-capillary retinal arteriole occlusion (SPRAO).

Results: Unlike SPRAO, the imaging findings in DPRAO were subtler during both the acute and chronic phase, but specific OCT findings could readily differentiate these entities. Acute SPRAO showed inner retinal whitening, edema and increased reflectivity, while acute DPRAO showed increased reflectivity of middle retinal layers. Chronic DPRAOs showed retinal thinning with middle layer atrophy, while chronic SPRAOs showed inner layer atrophy. Microperimetry in 1 patient showed a paracentral dense scotoma that corresponded well to the OCT findings.

Conclusion: DPRAO may represent a nonspecific finding of retinal ischemia similar to a CWS. Among the various multimodal imaging techniques, OCT appeared to be the most sensitive and specific in detecting DPRAO in both the acute and chronic phases.
**Poster Presentation**

**En face enhanced depth imaging optical coherence tomography of polypoidal choroidal vasculopathy**

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**Purpose:** To analyze retinal and choroidal changes in polypoidal choroidal vasculopathy (PCV) using en face enhanced depth imaging (EDI) spectral-domain optical coherence tomography (SD-OCT).

**Methods:** Thirty consecutive patients presenting with PCV were included in this retrospective and descriptive study at the Centre Hospitalier Intercommunual de Créteil (Créteil, France). All patients were examined using SD OCT with EDI, fluorescein angiography (FA) and indocyanine green angiography (ICGA). The 3D reconstruction of 197 transverse sections with SD OCT at 30 μm intervals, each comprised of nine averaged B-scans, provided a virtual macular brick through which 496 sections in the coronal plane resulted in a C-scan (“En face” OCT image). En face imaging (C-scans) were compared with ICGA and FA images.

**Results:** Thirty eyes of 30 consecutive patients were studied. In all 30 eyes, ICGA and FA allowed visualization of the PCV. Polyps were detected easily in all cases with en face OCT, usually more numerous than with ICGA, as roundish structures visible deeper than pigment epithelium layer, and attached to its posterior face. Hyperreflective dots were visible in most cases with the retinal layers, associated to a well-defined dark area suggesting serous exudation. The abnormal choroidal network was rarely clearly identified, even when well detected with ICGA. At the Bruch membrane level, polyps were associated to a localized back shadowing, and were no more visible at the choriocapillaries layer. Large choroidal vessels were visible, mainly at the polypoidal lesion periphery, and not directly behind.

**Conclusion:** En face OCT imaging using SD OCT is an easy, reproducible, non-invasive and effective tool to visualize and to understand retinal and choroidal changes PCV. It provides complementary morphological information, describes new semiological entities and might substitute other exams in the future, without dye injection.
Poster Presentation

High-resolution enhanced depth imaging optical coherence tomography in Alport’s syndrome

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Purpose: to assess the qualitative and quantitative tomographic characteristics of the macular area of patients diagnosed with Alport’s syndrome.

Methods: High-resolution enhanced depth imaging optical coherence tomography (OCT) images and their correlation with the multimodal fundus imaging findings were analyzed in cases of Alport syndrome.

Results: Six eyes of three consecutive patients diagnosed with Alport syndrome were examined. The most peculiar finding in all cases was a severe increase in the diameter of the foveal pit with loss of the inner retinal layers in the juxtafoveal temporal macula; the inner macular surface showed an enhanced hyperreflectivity and wrinkling without evidence of epirretinal membrane. The evident drusen-like deposits in the color fundus photographs did not have a clear correlate in the OCT images. The outer retina hyperreflective layers and the choroid appeared to be normal.

Conclusions: Patients with Alport’s syndrome should be evaluated by retinal specialist in order to assess the status of the macula. An increased incidence of macular hole formation has also been reported in these patients. The inner retina structural changes may be of prognostic value in addition to the typical lens alterations.
Poster Presentation

The macula in angioid streaks: typical and atypical findings

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Purpose: To analyze the spectrum of macular manifestations in cases of angioid streaks.

Methods: Enhanced depth imaging optical coherence tomography (OCT) images of cases with angioid streaks were qualitatively examined.

Results: Fourteen eyes of seven patients with angiod streaks were included. The spectrum of tomographic manifestations included: choroidal neovascularization, geographic atrophy of the retinal pigment epithelium, and serous macular detachment. In addition, a melange of typical findings including diffuse vitelliform deposits, pockets of subretinal fluid, and intraretinal pigment migrations were evidenced.

Conclusions: Patients with angioid streaks may exhibit a variety of tomographic changes that may account for their visual impairment and may also be related to a particular prognosis.
Purpose: To describe Early Autofluorescence Findings of Relentless Placoid Chorioretinitis

Methods: FAF-SD-OCT (Spectralis HRA-OCT, Heidelberg Engineering, Heidelberg Germany) examinations were performed at presentation, after 1 week, 2 weeks and 4 weeks.

Results: Fundus autofluorescence (FAF) images showed a new pattern of ‘cockade lesion’ with three zones of different autofluorescence (AF). The first zone is a central black round area of strong hypo-AF; the second is a hyper-AF strip surrounded by a medium hyper-AF band that is the third zone. OCT findings in the first zone were characterized by a well demarcated dome-shaped elevation of the inner and outer segment (IS/OS) junction with sub-retinal fluid, absence of the IS-OS and rarefaction of the retinal pigment epithelium (RPE); in the second zone the hyper-AF strip corresponded to focal alterations of the RPE; in the third zone the medium hyper-AF band corresponded to thickening of the IS/OS band and hyper-reflectivity of the outer nuclear layer (ONL).

Conclusions: We supposed that the cockade pattern on FAF can be explained by OCT findings showing three different zones of inflammation involving the RPE and the outer retinal layers.
Assessing the Cone Photoreceptor Mosaic in Eyes with Pseudodrusen and Soft Drusen in vivo Using Adaptive Optics Imaging

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\textbf{Purpose:} To investigate the cone photoreceptor mosaic in eyes with pseudodrusen as evidenced by the presence of subretinal drusenoid deposits (SDD) and conventional drusen using adaptive optics (AO) imaging integrated into a multimodal imaging approach.

\textbf{Methods:} Consecutive patients were examined using near-infra-red reflectance (IR) confocal scanning laser ophthalmoscopy (SLO) and eye-tracked spectral-domain optical coherence tomography (SD-OCT) and flood-illuminated retinal AO camera of non-confluent pseudodrusen or conventional drusen. Correlations were made between the IR-SLO, SD-OCT and the AO images. Cone density analysis was performed on AO images within 50 x 50 µm windows in 5 regions of interest overlying and in 5 located between SDD or conventional drusen with the same retinal eccentricity.

\textbf{Results:} Eleven patients (11 eyes) with pseudodrusen and 6 patients (11 eyes) with conventional drusen were evaluated. The mean (±standard deviation) cone density was 8,964 (±2,793) cones/mm\textsuperscript{2} between the SDD and 863 (±388) cones/mm\textsuperscript{2} over the SDD, a 90.4\% numerical reduction. By comparison the mean cone packing density was 9,838 (±3,723) cones/mm\textsuperscript{2} on conventional drusen and 12,595 (±3,323) cones/mm\textsuperscript{2} between them, a 21.9\% numerical reduction. The difference in cone density reduction between the two lesion types was highly significant (P<<0.001).

\textbf{Conclusions:} The pseudodrusen in these eyes correlated with subretinal deposition of material in multiple imaging modalities. Reduced visibility of cones overlying SDD in the AO images can be due to a change in their orientation, an alteration of their cellular architecture, or absence of the cones themselves. All of these explanations imply that decreased cone photoreceptor function is possible, suggesting eyes with pseudodrusen appearance may experience decreased retinal function in age-related macular degeneration independent of choroidal neovascularization or retinal pigment epithelial atrophy.
Poster Presentation

Expanded Clinical Spectrum of Enhanced S-cone Syndrome

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Purpose: To expand the clinical spectrum of Enhanced S-cone syndrome (ESCS) caused by mutations in the NR2E3 gene.

Methods: We studied the fundus phenotype in patients with ESCS and NR2E3 mutations. All patients had a complete eye exam including dilated funduscop[y, and color fundus photography. Fundus autofluorescence images (FAF), Spectralis® optical coherence tomography (OCT), and full-field ERGs were performed in a subset of patients.

Results: New clinical observations in ESCS were torpedo-like lesions predominantly present along the superior arcade. Large subretinal circumferential fibrotic scars were noted in the posterior pole or around the nerve. All patients with subretinal fibroses had fine yellow dots interspersed with fine nummular pigmentary disturbances in areas of relatively normal-appearing retina. FAF demonstrated hypoautofluorescence in areas of hyperpigmentation or fibrosis seen on funduscop[y. In the periphery different patterns of autofluorescence were present. On OCT there was retinal disorganization except at the fovea where there was a retained inner segment ellipsoid band. Subretinal fibrosis and outer retinal tubulation were also present.

Conclusions: This study showed that the clinical spectrum of ESCS could be expanded. Additional fundus features noted were circumferential subretinal fibrosis in the macula with sparing of the fovea or around the nerve head; torpedo-like lesions along the vascular arcades; and yellow retinal dots.
**Poster Presentation**

Foveal changes during ocular movements in normal eyes. A prospective study. Kinetics of posterior pole during ocular movements in various diseases: a videomorphing technique

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**Purpose:** To reveal the structural changes of the fovea and the posterior pole during ocular movements (OM) and specifically from the temporal gaze to nasal gaze. Videomorphing is proposed to study the kinetics of posterior pole during OM in various diseases.

**Methods:** A prospective controlled study. The right normal eye of healthy individuals was enrolled. SD OCT cube scans were used. The central fovea thickness (CFT) was chosen as the primary measurement. The measurements were obtained at the primary positions and at the temporal and nasal gaze. Four CFT values were recorded: the CFTtemp at the temporal gaze with a vertex1 distance, the CFTnasal at the nasal gaze with a vertex2 distance, the CFT1 at the vertex1 and the straightforward position and the CFT2 at the vertex2 and the straightforward position. The absolute difference between the CFT temp-CFT nasal was compared with the absolute difference between CFT1-CFT2 at the straightforward position of every patient. Paired t-test was used. Videomorphing of the OCT images with the same method was used to animate the posterior pole deformation during horizontal OM in healthy individuals, in patients with dry and wet AMD, with CSC and with high myopia.

**Results:** 20 patients were included. The |CFT1-CFT2| ranged from 1μm to 4μm with mean value 1.6μm. |CFTtemp-CFTnasal| ranged from 1μm to 10μm with mean 5.8μm.(p=0.0013). Videomorphing revealed oscillation of the posterior pole during OM with specific characteristics for every disease.

**Conclusions:** CFT showed significant fluctuation during ocular movements. Animation of posterior pole deformation during OM show different characteristics between normal eyes, AMD, CSC and high myopic eyes.
Poster Presentation

Geographic Atrophy in Patients Receiving Anti-Vascular Endothelial Growth Factor for Neovascular Age-Related Macular Degeneration

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Purpose: To examine factors associated with the occurrence and growth of geographic atrophy (GA) in eyes with treatment naïve neovascular age-related macular degeneration (AMD) receiving intravitreal anti-VEGF injections.

Methods: Patients with treatment naïve neovascular AMD who initiated anti-VEGF therapy and fit the following criteria were identified: age over 50 years; visual acuity of 20/20 to 20/800; absence of permanent structural damage to the central fovea; and a minimum of 12-months of follow-up. Two independent graders identified areas of GA at baseline and the last follow up. Neovascular lesion types were classified based on fluorescein angiography and SD-OCT as types 1 (sub retinal pigment epithelium), 2 (subretinal), 3 (intraretinal), or mixed.

Results: 91 patients (94 eyes) with mean follow up of 28.5 (± 10.7) months and 17.4 (± 9.0) injections were studied. There were 52 eyes (55.3%) that experienced GA growth. The odds of developing GA were significantly increased by number of injections (p=0.02) and CNV lesion type (p<0.001). GA growth for type 2, 3, and mixed lesions were 2.5 to 2.8 times more likely than for type 1 lesions. GA growth over time was influenced by the GA size as well as the lesion type. Other factors were not significant in affecting GA growth.

Conclusions: Eyes with type 1 lesions were less likely to develop GA than others. GA progression was slowest in eyes with type 1 lesions. The number of anti-VEGF injections was associated with the development of GA but not with the rate of growth.
The clinical spectrum of MEWDS has expanded over recent years. In its original description, MEWDS cases were unilateral and monophasic. Since then, additional variations have been described, including bilaterality (simultaneous or sequential) and recurrence of disease. Overlap may be seen with multifocal choroiditis and AZOOR. Thereafter, because the sequential ocular findings in MEWDS may vary in presentation and duration, multimodal examination has constantly showing new information on this fascinating disease.

**Purpose:** To describe unusual clinical findings in cases of patients who were diagnosed with MEWDS at the onset of their disease. According to observation of some of these clinical findings and correlated retinal imaging, a proposed mechanism of disease presentation is described for MEWDS as well.

**Methods:** Retinal imaging, including fluorescein angiography, indocyanine green imaging, fundus autofluorescence, and optical coherence tomography, was used to further characterize and describe the clinical findings in these MEWDS cases.

**Results:** All patients presented with classic MEWDS except one with only tiny dots at the foveolar area. The majority demonstrated classic foveal granularity and mild disk swelling and/or peripapillary whitening. FA, AF and ICG were useful to correlate the appearance of the white dots in the fundus. OCT confirmed different types of disruption or loss of the inner segment/outer segment photoreceptor line in all cases.

**Conclusions:** Diffuse and localized forms of primary outer retinal alteration may exist in MEWDS. The variability of these alterations may explain the associated involvement of the RPE and choroid in some cases. Evolving multimodal imaging examination has contributed for a better understanding of MEWDS in recent years.