Day 1

APVRS SHOW DAILY

November 22-24, 2019
Shanghai, China

The Official Conference News of APVRS 2019

by pie magazine
posterior segment • innovation • enlightenment

Highlights

4 Don't miss the important **retinal imaging sessions** throughout the congress!

5 **Discover** and **enjoy Shanghai** while you're here...we have a few suggestions...

APVRS 2019 Welcomes Congress Delegates to Shanghai!

by Joanna Lee

What better place to gain 'pearls' for ophthalmic practice than the 'Pearl of the Orient'?

Welcome to Shanghai – and the 13th Asia-Pacific Vitreo-retina Society Congress (APVRS 2019), featuring the latest back-of-the-eye updates, presented by world-renowned speakers and practitioners from Asia-Pacific and the world.

According to APVRS Scientific Program Committee Chair Prof. Dr. Paisan Ruamviboonsuk, this year witnesses the attendance of the highest number of leading retinal specialists from around the world, in all APVRS congresses ever.

Helmed by Congress Presidents Prof. Xun Xu and Prof. Xiaoxin Li, the organizing committee has put together a stellar line-up of programs with the latest updates and scientific advancements in ophthalmology.

Moreover, more than 600 abstracts have been submitted for free paper and poster presentations.

One such session is "Mystery Cases" in macular, non-macular and retinal surgery. In addition, there are numerous sessions presenting the latest research and data on a variety of topics like AMD, PCV, uveitis, intraocular tumors, diabetic retinopathy, advanced retinal imaging, pediatric retina and central serous chorioretinopathy, as well as discussions on surgical complications. Plus, don't miss out on the latest artificial intelligence (AI) research and developments concerning retinal disease and treatment.

> "The invited sessions are also quite unique this year, in the way that there are many interesting case-based medical and surgical symposia for the audience can enjoy,"
>
> – Prof. Ruamviboonsuk

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Photo of the Day

The APVRS Show Daily publishing team would like to welcome you to Shanghai. You made it. You are here!

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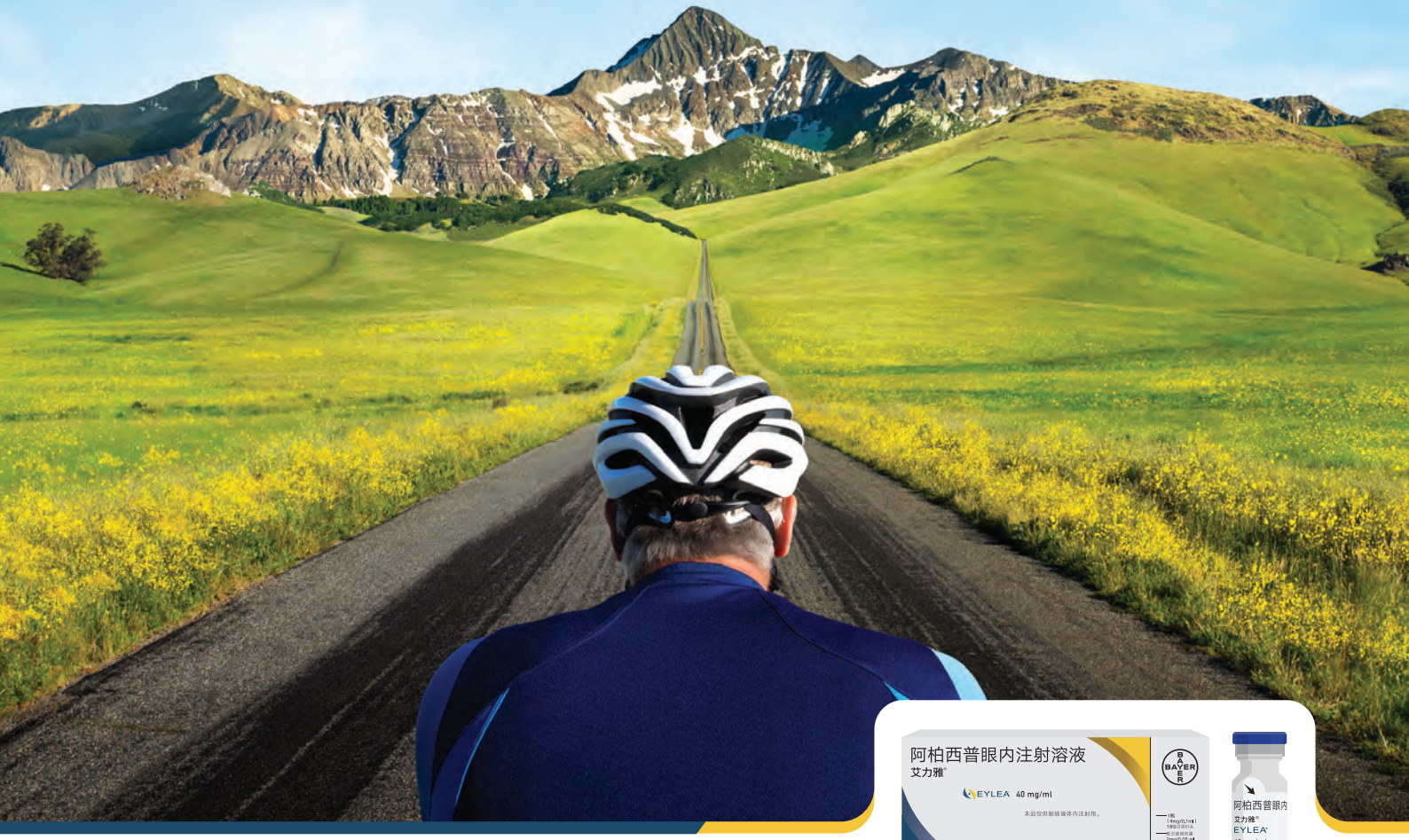
TREAT WITH FORESIGHT



Briefing Instractions

[Drug Names]Generic name: Aflibercept Intravitreous InjectionTrade name: EYLEA®English name: Aflibercept Intravitreous Injection **[Components]**Active ingredient is Aflibercept **[Indications]** Eylea is indicated for adults for the treatment of neovascular (wet) age-related macular degeneration (nAMD),diabetic macular oedema (DME)[**Dosage and method of administration**]Eylea is for intravitreal injection into the eye only. Posology The recommended dose for Eylea is 2 mg aflibercept, equivalent to 50 microlitres. *For nAMD,* Eylea treatment is initiated with one injection per month for three consecutive doses . The treatment interval is then extended to two months. Based on the physician's judgement of visual and/or anatomic outcomes, the treatment interval may be maintained at two months or further extended, using a treat-and-extend dosing regimen*For DME,*Eylea treatment is initiated with one injection per month for five consecutive doses, followed by one injection every two months. After the first 12 months of treatment with Eylea, the treatment interval may be extendedPlease read details in instructions. **[Adverse Reactions]** Serious ocular adverse reactions in the study eye related to the injection procedure have occurred in less than 1 in 1,900 intravitreal injections with Eylea and included blindness, endophthalmitis, retinal detachment, cataract traumatic, cataract, vitreous haemorrhage, vitreous detachment, and intraocular pressure increased (see [Special warnings and precautions for use]). The most frequently observed adverse reactions (in at least 5% of patients treated with Eylea) were conjunctival haemorrhage (25%), visual acuity reduced (11%), eye pain (10%)Please read details in instructions. **[Contraindications]** Hypersensitivity to the active substance aflibercept or to any of the excipients listed in [Components]. Active or suspected ocular or periocular infection. Active severe intraocular inflammation. **[Special warnings and precautions for use]** Increase in intraocular pressure Increases in intraocular pressure have been seen within 60 minutes of intravitreal injection, including those with Eylea (see [Adverse Reactions]). Special precaution is needed in patients with poorly controlled glaucoma (do not inject Eylea while the intraocular pressure is ≥ 30 mmHg). In all cases, both the intraocular pressure and the perfusion of the optic nerve head must therefore be monitored and managed appropriately. Systemic effects There are limited data on safety in the treatment of patients with DME with a history of stroke or transient ischaemic attacks or myocardial infarction within the last 6 months. Other Treatment should be withheld in patients with rhegmatogenous retinal detachment or stage 3 or 4 macular holes. In the event of a retinal break the dose should be withheld The dose should be withheld within the previous or next 28 days in the event of a performed or planned intraocular surgery. Eylea should not be used in pregnancy unless the potential benefit outweighs the potential risk to the foetus (see [Pregnancy and Lactation]). **Effects on ability to drive and use machines** Injection with Eylea has minor influence on the ability to drive and use machines due to possible temporary visual disturbances associated either with the injection or the eye examination. Patients should not drive or use machines until their visual function has recovered sufficiently.**Special precautions for disposal and other handling**For the intravitreal injection, a 30 G x ½ inch injection needle should be used.Please read details in instructions. **[Drug Classification]**Prescription drug**[Manufacturer]** Name of the Manufacturer: Vetter Pharma-Fertigung GmbH & Co. KGManufacturing address: Vetter Pharma-Fertigung Eisenbahnstr. 2-4 88085 Langenargen Germany**[The version of instructions]**Approval date: 2nd Feb. 2018 , 8th May 2018Revision date: 30th Nov. 2018, 12th Apr. 2019For completed information, please read Elyea's Instructions. Bayer

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Here's a preview of some of the symposia at APVRS 2019:

DAY 1

Diabetic Retinopathy: Epidemiology, Screening and Prevention – This session will address one of the leading causes of blindness among adults the world over, looking at the latest updates in DR epidemiology, risk factors and screening, while surveying different national screening programs in various Asian countries. Screening modalities via fundus photography and the role of artificial intelligence (AI) algorithms in DR detection will also be presented along with current strides and the ongoing challenges of combating this disease. **[November 22 | 14:30 to 16:00 | Session Room 1]**

Retinal Imaging in the Future – Imaging has been an essential component of managing retinal conditions, with the advancements of various modalities being expected to be assimilated into current clinical practice soon. Thus, delegates will find out about upcoming retinal imaging technologies that may influence the field and practice within the coming five years. **[November 22 | 08:30 to 10:00 | Session Room 4]**

DAY 2

Mystery Cases of Macular Surgery – Game to delve into mind-boggling cases in macular surgery? This session will discuss how to approach diagnosis, surgery and complications, among experienced vitreoretinal surgeons from around the world. The topics of traumatic macular injury, inflammatory circumstances, myopic maculopathy and congenital lesions are also up for dissecting, with pearls waiting to be gained. **[November 23 | 08:30 to 10:00 | Session Room 1].**

Diagnostic and Treatment Conundrums in Retinal Diseases – When rare conditions look similar with common diseases, and when the patients' response to treatment is unexpected, what do we do? This session will look at cases of how doctors could revise their diagnoses and strategies of treatment. The second segment will see discussions on complicated presentations, misdiagnosis and interesting means of diagnosis, which can help identify the causes of an issue in the first place. Delegates will also take a fresh look at the latest developments in therapeutics with a case study presentation at the end. **[November 23 | 08:30 to 10:00 | Session Room 3]**

My Best Medical Retina Cases of 2019 – One of the highlights of APVRS 2019 is this session, which brings together the best minds in retina, to address challenging and unsolved cases in the diagnosis and treatment of medical retinal diseases. Nine renowned retinal experts will divulge their findings and pearls of experience in diagnosing and treating some of the most challenging retinal cases. **[November 23 | 10:15 to 11:45 | Session Room 3]**

Advances in Gene Therapy of Retinal Diseases – There are over 200 genes which are tied to hereditary retinal conditions, such as Leber congenital amaurosis, Stargardt disease and retinitis pigmentosa. So far, there have not been any approved treatments for these disorders in which genetic heterogeneity is detected. This has led to the development of retinal gene therapy, which has subsequently resulted in the first FDA-approved gene therapy product to treat genetic disease in humans. Find out more about what's happening on the frontier of gene therapy advancements for the eye. **[November 23 | 10:15 to 11:45 | Session Room 4]**

This just in: Check out the latest updates in retina at APVRS 2019!

DAY 3

Age-related Macular Degeneration: AMD – Learn about the most current developments in exudative AMD and modalities of treatment with updates in drugs, long-term results from the IVAN study, gut metagenome related with AMD, and what's new in AMD imaging. **[November 24 | 08:30 to 10:00 | Session Room 3]**

Uveitis and Ocular Inflammation Treatment – As uveitis and scleritis arise out of various factors, non-infectious uveitis (like uveitis related to Behcet's disease or sarcoidosis), is a characteristic of the disease's systemic effects. As such, when inflammation continues, other complications develop, like cataract, secondary glaucoma, and even posterior synechiae of the iris, hindering fundus inspections. Meanwhile, there are also challenges with early diagnosis of infectious uveitis (e.g. ARN, CMV retinitis and uveitis due to tuberculosis) which show up with acute or chronic inflammation. Malignant cells are possibly the other cause of life-threatening primary ocular lymphoma. Thus, this session will zoom in on early diagnosis and the relevant treatment for refractory uveitis. **[November 24 | 08:30 to 10:00 | Session Room 5]**

APVRS 2019 Shanghai is being held in conjunction with Retina China 2020, one of the most important ophthalmological conferences in China, hosted annually by the Chinese Vitreo-retina Society (CVRS).

Apart from the buzz of ongoing action, delegates can catch some inspiration and enlightenment at the three distinguished award lectures honoring contributors to the field.

The *APVRS Tano Lecture* will be given by Prof. Paul Mitchell from Australia, who will discuss "The Growing Contribution of Wide Field OCT Angiography to the Current Understanding and Management of Diabetic Retinopathy" on November 22 from 16:30 to 17:00 in Session Room 1.

Meanwhile, the *APVRS Constable Lecture Award* will have Dr. Guy Li Jia Chen speak on "Genetics of Age-related Macular Degeneration and Polypoidal Choroidal Vasculopathy in Chinese" on November 23, at 16:00 to 16:30 in Session Room 1.

For the *APVRS International Award Lecture*, Dr. Suber S. HUANG from the United States, will provide a glimpse into the future with his topic entitled "Future Vision – Retina 2020 and Beyond" on November 23, 16:30 to 17:00 at Session Room 1.

Be sure not to miss these important sessions. See you around the Congress!

APVRS 2020

Hong Kong, China

Hong Kong Convention and Exhibition Center

18-20 DEC, 2020

The 14th Asia-Pacific Vitreo-retina Society Congress

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香港眼科學會 The Hong Kong Ophthalmological Society

Getting to Know the Dragon's Head


Yu Yuan Gardens

by Joanna Lee

'The City on the Sea' is the literal translation of 'Shanghai'. Set at the end of the epic Yangtze river, Deng Xiaoping had once described this city as this: "If China is a dragon, Shanghai is its head."

Shanghai has always led in the forefront of changes. From a humble fishing village that caught the eye of the British, French and Americans, to the 'good old days' where Shanghai flirted with the romance, music and decadence of the roaring 20's and 30's as the center of opulence and indulgence for the wealthy. After the Japanese occupation and the subsequent rise of Mao Zedong in the mid-20th century, Shanghai took a break from its sequins and pearls, in exchange for the Communist Party.

It was only later (from the 1970's), after a historic Shanghai Communique agreement between China and America, that the country begun opening its doors again to the world, embracing a market economy two decades later.

Today, it leads as the hub of business, technology, social, cultural and ideological advancements China, teeming with energy as youths and migrants from within and abroad seek their fortunes there.

What better opportunity to take a break after viewing conference slides and laptops than to feast the eyes on the gems that this cosmopolitan city offers – and this old 'Paris of the East' knows a thing or two about attractions.

Start with the Hongqiao area. Shanghai's newest commercial hub: If you're game for a wide choice of international cuisine, head down to Lao Wai Jie where the expats hang out. There's a Koreatown nearby in Gubei town as well, with many traditional Korean restaurants. The Shanghai Grand View Garden is another population attraction among tourists.

If you have more time to spare in Shanghai, and have decent walking gear, you might want to take it slow by exploring Shanghai on foot. Timeout Shanghai offers some good self-guided walking routes.

If you're heading toward Pudong airport, the famous Bund, with its spectacular vista, should be the destination of choice for those who have limited time. Take a psychedelic ride through the Bund Sightseeing Tunnel underneath the Huangpu river to view the Bund from the other side.

From the Bund is Nanjing Road, which used to be the heartbeat of the city with dining and shopping, (beware of 'tea' or 'massage' scammers and petty thieves, though). Otherwise, head to Xintiandi, a more upmarket neighborhood noted for its preserved, old Shanghainese shikumen lane houses and for some fine dining.

For those who love futuristic marvels, the Shanghai Science and Technology Museum at Century Avenue satisfies that curiosity. Others may step back in time to the Ming dynasty era at the famous Yu Yuan Gardens (or just Yu Gardens) for those who want to glimpse traditional Chinese gardens.

If you are feeling adventurous and desire to get away from the hustle and bustle of the Pudong area, you might head to the French Concession area at Wulumuqi Road to savor its cafes and colonial buildings. In other areas of Wulumuqi Road, there are even more quaint shops waiting to be discovered. [Watch out for the Avocado Lady who rules supreme at these streets!]

There's also Shanghai Circus World and Shanghai Animal Park, for those who wish to explore acrobatic excellence and fauna.

For those who plan to extend their conference trip, the breathtaking West Lake at Hangzhou beckons for a bicycle ride around its epic perimeter, while Suzhou's dreamy waterways and bridges are worth a visit – where you can trace the path of Marco Polo (who perhaps arrived here at the end of his journey on the Silk Road). The other water towns such as Zhujiajiao, Xitang and Wuzhen are also worth a speed train ride.

One final tip, always allow for extra walking time while at subway train stations and to find your way around unfamiliar places. Download Didi (the local e-hailing ride provider) if you have a local mobile phone number. Otherwise, local taxis are fine, as long as they run by meters.

We hope you'll have great memories of APVRS 2019 in Shanghai and have a safe time exploring the city!

THE FUTURE OF RETINAL IMAGING
ON SPOTLIGHT AT APVRS 2019 CONGRESS

by Olawale Salami and Gloria D. Gamat

Advanced imaging technologies have been pivotal to our current understanding of retinal diseases. Over the past decades, these imaging modalities have helped elucidate the pathogenesis of scores of retinal disorders and are becoming important clinical tools in fine-tuning diagnosis and patient management. In order to push the boundaries of these technologies further afield, experts agree that more innovation will be needed, for example, in photonics, molecular imaging technology and artificial intelligence...

Recent decades have witnessed profound progress in research and development of new retinal imaging modalities. These novel imaging modalities have revolutionized our understanding of the pathophysiology of retinal diseases, paving the way for early disease detection and better treatment outcomes. For example, enhanced retinal imaging is pushing the frontiers of basic and translational research into new treatment modalities in chorioretinal diseases.

Here, at the 13th Asia-Pacific Vitreo-retina Society Congress (APVRS 2019), advances and the future of retinal imaging takes center stage with four important symposia that delegates should not miss:

November 22| 08:30 to 10:00
Session Room 4
Ocular Imaging Symposium: Retinal Imaging in the Future
Topics: Ultra-wide Field, SS-OCT, Doppler OCT, FLIO, Adaptive Optics, Artificial Intelligence (AI) in retinal imaging
Speakers: Suqin Yu, Gemmy Cheung, Youngseok Song, Srinivas Sadda, Amani Fawzi, Daniel Ting

November 22| 14:30 to 16:00
Session Room 4
Ocular Imaging Symposium: Advanced Retinal Imaging
Topics: OCTA in CSC, OCTA in MacTel2, Machine Learning in OCTA, Artificial Intelligence (AI) as Digital Marker in Morphology-Based Function Prediction
Speakers: Karl Csaky, Ethan Priel, Taiji Sakamoto, Seung-young Yu, Sebastian Wolf, Frank G. Holz, Yi-ting Hsieh, Xiaoxin Li

November 23 | 14:30 to 16:00
Session Room 3
Ocular Imaging Symposium: Application of 2D Retinal Images
Topics: Wide-field fundus photography, autoflourescence imaging, FA/ICGA, stereoimaging
Speakers: Srinivas Sadda, Frank G. Holz, Tock Han Lim, Ethan Priel, Min Wang, Adnan Tufail, Akinori Mitani

November 23| 14:30 to 16:00
Session Room 5
Ocular Imaging Symposium: Swept-source OCT and OCT Angiography
Topics: SS-OCT, OCTA
Speakers: Taiji Sakamoto, Min Wang, Seung-young Yu, Fenghua Wang, Philip Rosenfeld, Ruikang Wang, Xiaoxin Li, Suqin Yu, Toshinori Murata, Hyung Chan Kim

As a refresher, ahead of the presentation of global experts on ocular imaging at the APVRS 2019 Congress, this short review article provides a synopsis of some state-of-the art retinal imaging modalities and sheds light on the possible clinical uses of these new imaging tools.

Optical coherence tomography (OCT)

Optical coherence tomography (OCT) uses low-coherence interferometry to produce a two-dimensional image of optical scattering from internal tissue microstructures in a way that is analogous to ultrasonic pulse-echo.[1] A low-coherence light beam is directed onto the retina and choroid, and the back-reflected light is combined with a second or reference beam, which splits off from the original light beam. The interference patterns produced construct an axial A-scan, and

Peer into the future of retinal imaging at APVRS 2019.

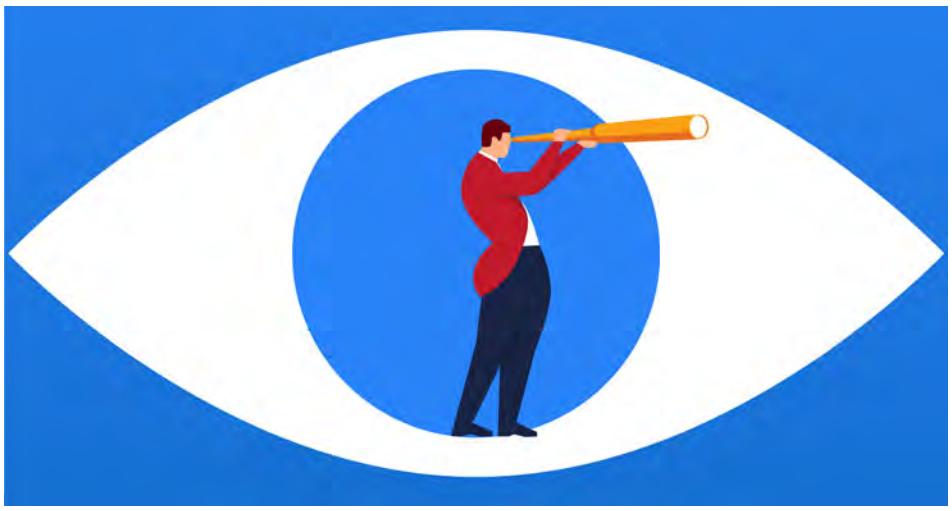
multiple A-scans from adjacent points reconstruct a cross-sectional image of the target tissue, known as a B-scan.[2]

In spectral domain OCT (SD-OCT) the reference arm is kept stationary, and the depth information is obtained by a Fourier transform of the spectrally resolved interference fringes in the detection arm of a Michelson interferometer. This approach has provided a significant advantage in signal-to-noise ratio (SNR).[3] However, SD-OCT has difficulty differentiating vascular and fibrous components of CNV because of their similar reflectivity properties.[4]

Further improvements over the initial time domain OCT versions have led to the development of swept source OCT (SS-OCT). SS-OCT has increased scan speed and a deeper penetration than previous modalities of OCT. The deeper penetration allows for the simultaneous detailed documentation of the vitreous and the choroid. These characteristics of SS-OCT enable deeper penetration, excellent axial resolution and fewer motion artifacts, to generate ultra-high definition B-scan images of the retinal microstructure.[5] Furthermore, SS-OCT is the first ophthalmic diagnostic technology to demonstrate the entire structure of the posterior precortical vitreous pocket (PPVP) in vivo.[6]

En-face optical coherence tomography is OCT in the standard fundus image perspective of the retina.[7] It incorporates all of the cross-sectional information of conventional sagittal (B-scan) OCT, but provides a full field view. En-face is the viewpoint captured by ophthalmoscopes, fundus cameras, fluorescein and ICG angiograms and microperimetry. En-face OCT utilizes high-speed Fourier domain approaches, where the en-face image is reconstructed from full 3D volumes, either by direct slicing or through axial projection in post processing. The success of modern en-face OCT lies in its immediate and easy image interpretation, which is of particular advantage in OCT angiography.[8]

Currently, OCT plays a central role in the diagnosis and management of numerous choroidal and retinal pathologies. Limited field of view and vulnerability of OCTA to artifacts are its major limitations, and age-matched vascular density normative databases, when available, will make the technology more useful as it develops and improves.[9]



Back in the day, doctors had to shrink to 'eyeball size' to get a clear look at the retina . . . (okay, not really).

OCT angiography (OCTA)

OCT angiography (OCTA) is a noninvasive imaging technique based on OCT imaging, which allows for the visualization of the retinal and choroidal microvasculature without the injection of exogenous dyes.[9] It produces high resolution images of blow flow across all the vascular layers of the retina in a rapid, non-invasive fashion.[10] Fluorescein angiography (FA), an alternate method of imaging flow, has been used in clinical practice for over 50 years.[11] Although FA permits visualization of the retinal microcirculation in exquisite detail, visualization of the choroidal circulation is more limited. Moreover, FA provides only minimal information regarding the functional consequences of vascular disease and allows, at best, only semi-quantitative assessment of retinal thickness.[11,12]

Various algorithms have been developed for OCTA devices.[13] OCTA can be separated into three categories: phase-signal-based OCTA (e.g. Doppler OCT, phase-variance OCT), intensity signal-based OCTA (e.g. speckle-variance OCT, correlation mapping OCT, OCTA ratio analysis and split-spectrum amplitude decorrelation angiography), and complex-signal-based OCTA (e.g. optical micro-angiography, multiple signal classification OMAG, and imaginary part-based correlation mapping OCT).[14]

There are numerous advantages of OCTA. In contrast to conventional fluorescent angiography, OCTA images are not associated with dye leakage-induced hyper-fluorescence.[9] Therefore OCTA can generate high-contrast, well-defined images of the microvasculature, which can be fine-tuned and analyzed by image processing software.[15] Secondly, volumetric data can be segmented and OCTA from different retinal layers can be projected to enable separate visualization of retinal capillary plexuses and the choriocapillaris, as well as visualizing vascular pathologies, including neovascularization and alterations in retinal capillary as well as choriocapillaris structure.[15] In addition, OCTA images can be viewed in cross-section to confirm the depth location of vascular pathology.

OCTA has been used to evaluate a spectrum of retinal vascular diseases, including diabetic retinopathy (DR), retinal venous occlusion (RVO), uveitis, retinal arterial occlusion and age-related macular degeneration (AMD), among others.[16,17] It facilitates rapid evaluation of the area of capillary non-perfusion and FAZ morphology in patients with RVO.[18] Furthermore, it helps visualize occult type-1 neovascular membranes in AMD, which are located under the RPE[19] and in which the identification of underlying microvascular changes with conventional angiography.[20]

Photoacoustic microscopy (PAM)

Photoacoustic ocular imaging is an emerging ophthalmic imaging technology that can noninvasively visualize ocular tissue by converting light energy into sound waves.[21] It's a new and promising imaging technology that has found applications in numerous biomedical fields.[22] It is a novel microscopic imaging modality that can provide 3D, high-resolution vasculature imaging. It can also provide functional imaging of biological tissues, such as blood vessel oxygen saturation, by using multiple wavelength

illumination.[21] PAM holds the promise of higher resolution functional ocular images, compatible to a multimodal imaging approach, to optimize or replace existing tools such as OCT.[23,24] Early phase research and development and clinical validation studies in patients will be needed to bring this exciting technology to the hands of retinal specialists, and expand the repertoire of existing retinal imaging tools.

Ophthalmic adaptive optics (AO)

Today, OCT provides high quality images for clinical assessment of the living retina. However, it suffers from poor lateral resolution due to the eye's monochromatic aberrations. Ophthalmic adaptive optics (AO) is a technique used to compensate for the eye's aberrations and provides nearly diffraction-limited resolution. The result is the ability to visualize the living retina with cellular resolution.[25]

The use of adaptive optics (AO) converts an ophthalmoscope into a microscope, allowing for visualization of, and optical access to, individual retinal cells in living human eyes, in ways not previously possible.[26] AO compensates for optical aberrations in the optics of the eye[27] and can be applied to any ophthalmoscope modality, including full-field fundus cameras, scanning laser ophthalmoscopes (SLOs), and OCT systems.[25] AO is useful not only for conventional scattered-light imaging, but also for other imaging approaches. Examples include confocal, fluorescence, and phase-sensitive imaging. To date, researchers have used AO systems to resolve cones, rods, microvasculature, red blood cells, leukocytes, RPE cells and nerve fibers in humans. In animals, fluorescence-based AO systems have also been used to resolve ganglion cells and to measure their function. AO systems are being used to make new discoveries about vision in healthy and diseased eyes. In recent years AO has been successfully integrated with some primary ophthalmic imaging devices, including AO-SLO, fluorescence AO-SLO, AO-OCT and AO-two photon imaging.

The translation of innovative imaging methods from microscopy to AO ophthalmoscopy will continue to expand the scope of imaging applications. Examples include, but are not limited to, structured illumination, fluorescence lifetime imaging, Raman spectroscopy and hyperspectral imaging. The lack of reliable automated imaging analysis tools remains a barrier for moving AO ophthalmoscopy into more mainstream clinical use. The ability of AO ophthalmoscopes to image at a cellular level over time ensures that these systems will continue to prove useful for clinical trials involving the testing of new therapies for treating eye disease.[24] AO ophthalmoscopy will continue to make steps toward the imaging of functional and metabolic activity of cells, thereby making more sensitive measures of retinal health.

Fundus autofluorescence (FAF)

Imaging techniques based on retinal autofluorescence imaging have found broad applications in ophthalmology, based on their noninvasive nature. FAF has become an essential tool for evaluating AMD geographic atrophy (GA), macular dystrophies, retinitis pigmentosa, white dot syndromes, drug toxicities and numerous other retinal disorders.[28-30] It uses the fluorescent properties of lipofuscin (LP) to generate images that provide information beyond what is acquired by utilizing more conventional imaging methods, such as FA, fundus photography, and regular OCT.[28] In addition, FAF provides information on the metabolic state and overall health of the RPE and photoreceptors.[31] Quantitative scoring of retinal autofluorescence has become an increasingly popular tool in the diagnosis and monitoring of retinal conditions and may also have utility in prognosis and risk stratification.[32]

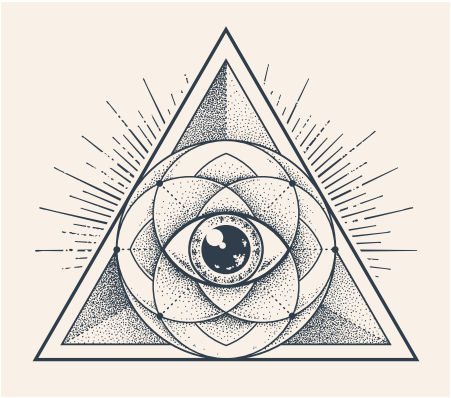
Molecular imaging

Molecular imaging plays an increasingly vital role in unravelling mechanistic pathways and in the development of new drugs for retinal diseases. Multiple modalities, including optical imaging, ultrasound, nuclear imaging, computed tomography and various techniques of MRI, are now being used to obtain fundamental new insights at the cellular and molecular level, both in basic research, in animal models and in clinical studies.[33] Molecular imaging is a potentially powerful tool for monitoring early events in retinal disease, such as apoptosis, cell injury, inflammation and hypoxia.

Molecular imaging requires high image resolution, sensitive instrument detection, specific imaging agents,

and endogenous molecular probes or exogenous contrast agents, that link the imaging signal with a molecular probe or event.[34] Molecular imaging modalities include optical imaging techniques such as fluorescence and bioluminescence imaging, reflectance-based approach (e.g. SLO, retinal multispectral imaging, OCT), PAM and magnetic resonance imaging (MRI); as well as radionuclide techniques such as positron emission tomography (PET) and single photon emission computed tomography (SPECT), ultrasonography and computed tomography (CT). Several molecular imaging instruments are available, and all have their advantages and limitations. Very promising are the developments in contrast-enhanced molecular optical imaging, for example, with the use of scattering tunable nanoparticles targeted at specific tissue or cell structures.

Molecular imaging techniques for early detection of cellular hypoxia in the retina could be of immense benefit in early disease detection, monitoring of disease progression and assessment of therapeutic responses in the patient. Recent efforts



have led to the development of two hypoxia-sensitive imaging agents based on nitroimidazoles, which can accumulate hypoxic cells in vivo.[35] These imaging agents are a promising step toward translation of hypoxia-sensitive molecular imaging agents in preclinical animal models and patients.

Synthetic nanoparticles are emerging as versatile tools in biomedical applications, particularly in the area of biomedical imaging.[36] New nanotechnology-based imaging modalities, such as photoacoustic molecular imaging and optical coherence contrast imaging, are currently in development.[37] The commercialization of nanoparticles based molecular imaging technologies is long overdue, given their enormous potential.

Clinical challenges and future directions in retinal optical imaging

New imaging tools need to be simplified to ensure prompt adoption by clinicians. In addition, there is an urgent need for computer-assisted interpretation and software to facilitate the rapid evaluation of the extensive data generated from these images. Miniaturization of retinal imaging tools could facilitate use at the lowest levels of healthcare delivery, like in developing countries where there might not always be a retinal specialist available. These could be complemented by mobile imaging platforms, such as hand-held OCT and online training programs, given the ubiquity and wide availability of smartphones. The use of machine learning algorithms and big data for retina image analysis holds immense potential for improved accuracy and shorter patient clinic stay, thereby reducing overall treatment costs.

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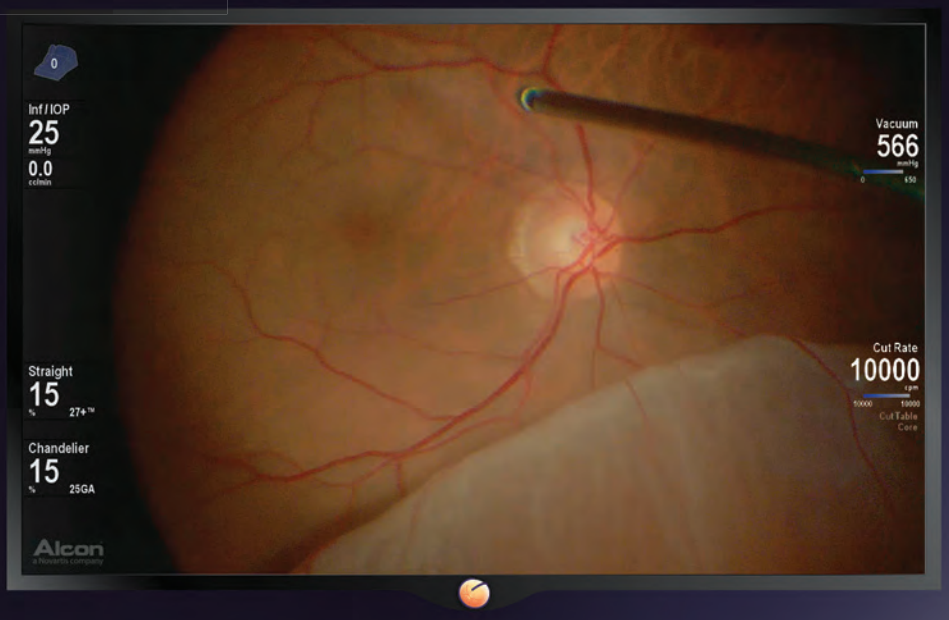

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