APRIL 2016 # 29

the Ophthalmologist

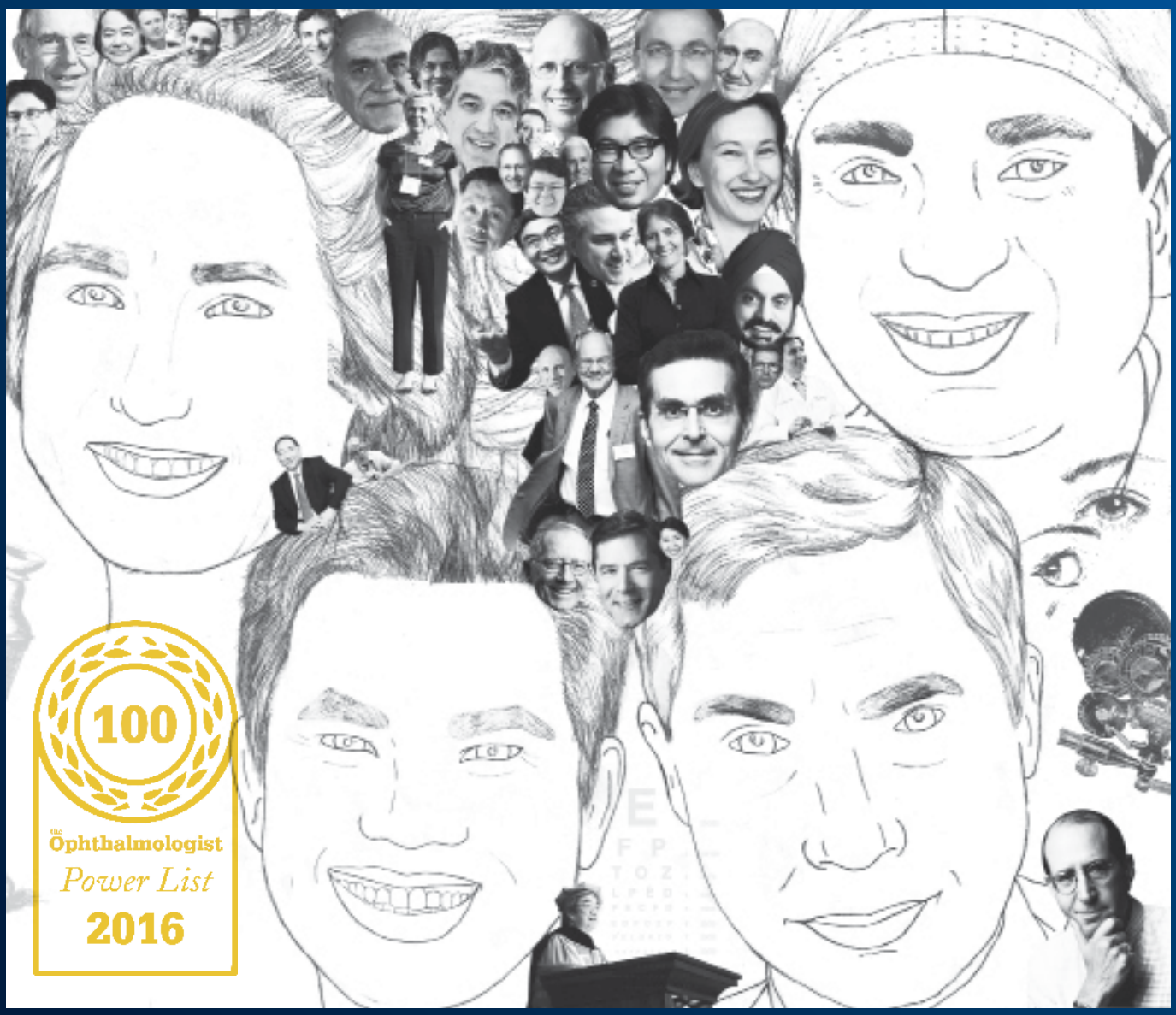
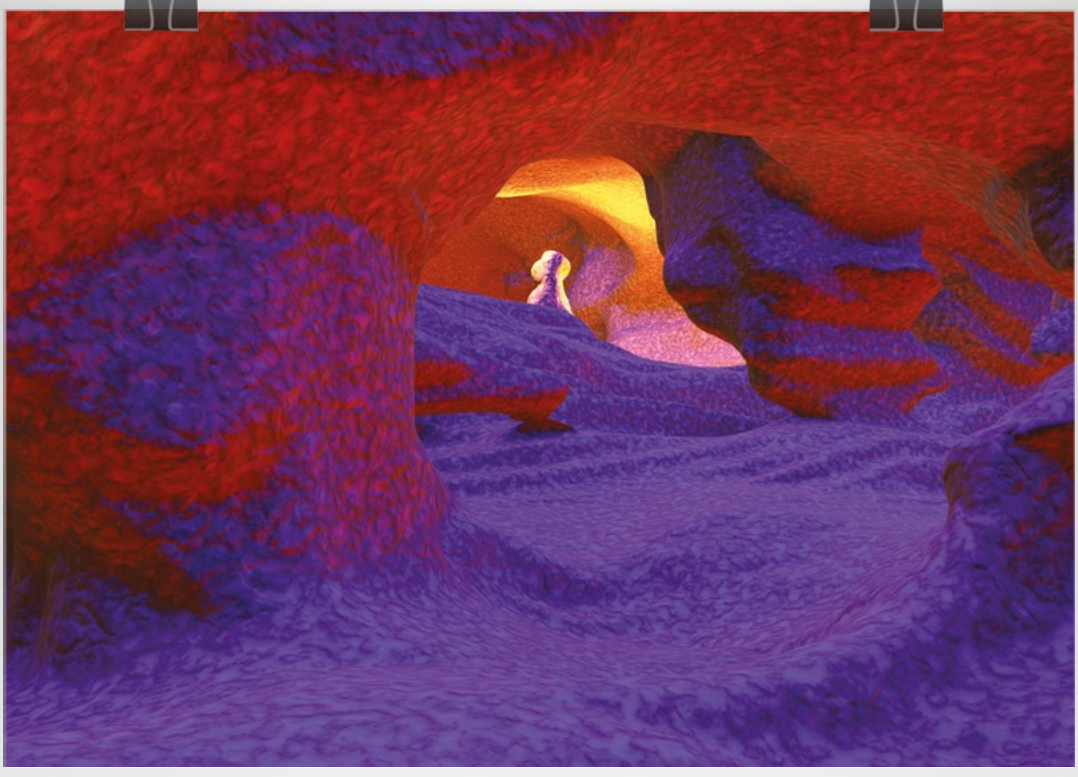


Image of the Month



Titled "Wiring the human brain", this Wellcome Trust award-winning image was taken by Alfred Anwander of the Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany. Alfred is a neuroscientist who works on mapping connections in the brain. He has a background in engineering and image processing, and likes to use the beauty of the brain to create images and videos that showcase modern neuroscience to the public. The image shows a 3D model of the outer choroidal vessels, artificially illuminated and textured. The 3D reconstruction was achieved by removing speckle-noise from 256 swept-source optical coherence tomography cross-sections of a healthy human eye.

Image courtesy of the Wellcome Image Awards.

Do you have an image you'd like to see featured in The Ophthalmologist?
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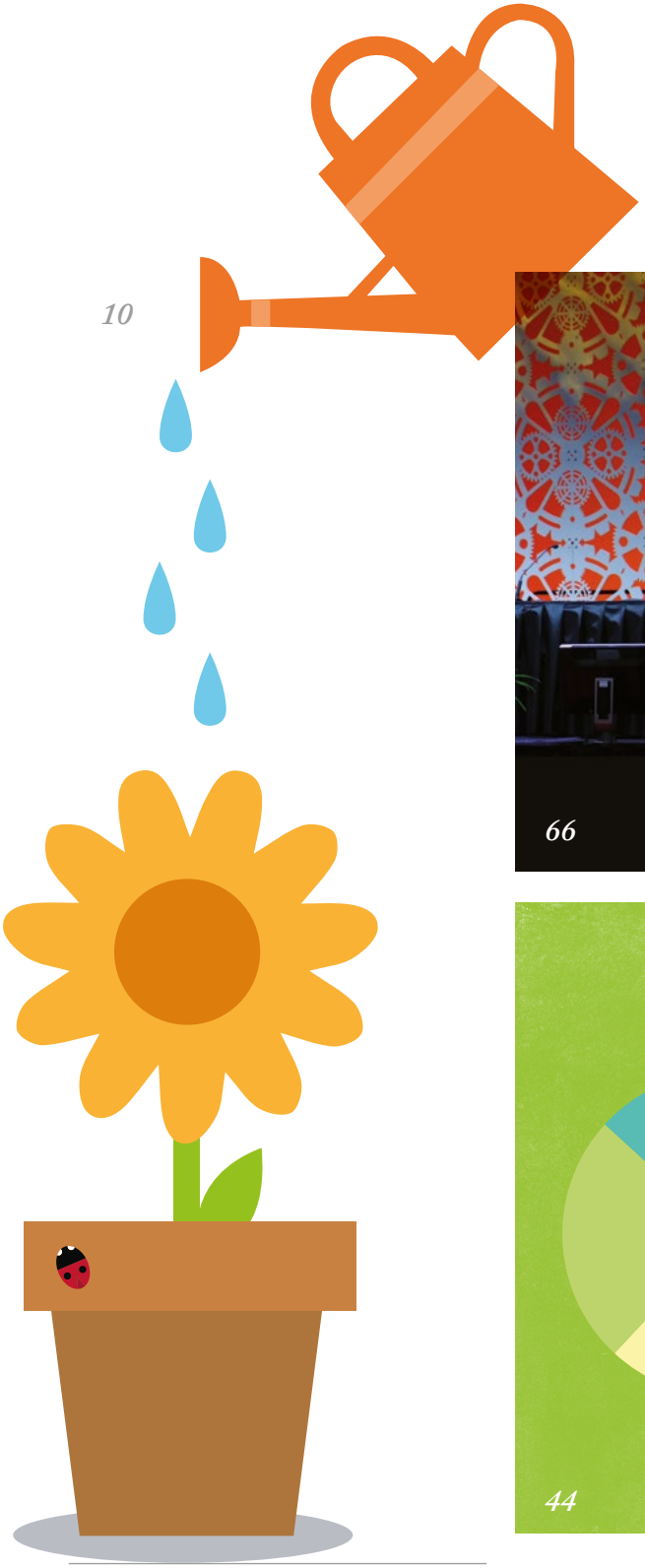
A tribute to Klaus Voormann's Revolver album cover for The Beatles.



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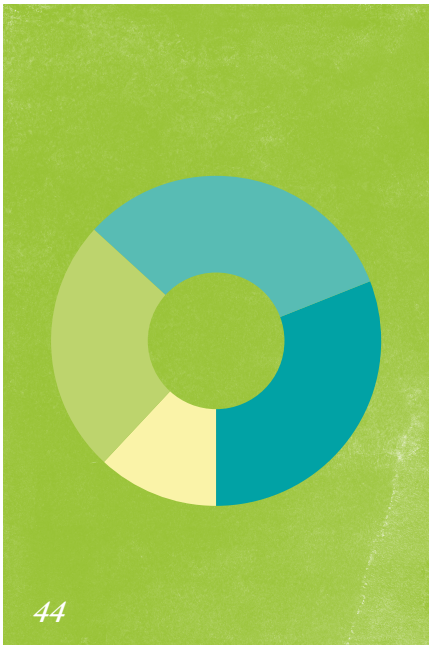

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Profession

Sitting Down With

the Ophthalmologist

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Everything We Do Is Driven By You

What shaped the 2016 Power List? Let's examine the trends

I am a fan of early 1980s comedy. Richard Pryor, George Carlin, and the early works of Bill Hicks and Eddie Murphy. What does this have to do with the 2016 Power List? Well, as with my comedy idols, I'm not afraid to push the boundaries every so often. But in particular, the latter's deconstruction of Janet Jackson's "What have you done for me lately?" came to mind when looking at this year's names and rankings. Especially when I compared them with those of our inaugural list, which was published just two years ago.

Back in 2014, The Ophthalmologist was a nascent publication, just seven issues old when we published the first Power List, and even we were surprised by the sheer amount of engagement we received from our readers. Fast forward two years, the number of nominations had tripled, and the number of readers making nominations multiplied by almost five! And yet, many of the names are the same on both lists – the main difference being their ranking. Pondering the differences in the rankings made me think that there was an element of "What have you done for me lately?" in the mix.

The top 10 sees three glaucoma specialists – including one in the number one spot – and all three are furiously advancing our understanding of the disease. Most of the team behind the invention of OCT imaging are present (a few are in the top 10) – and that's a technology that keeps giving. In 2014, OCT angiography was still in the realm of research; today, you can buy the devices commercially from at least two suppliers, and its inventors keep pushing forward the state of the art.

The top 10 also contains two retina specialists – one research behemoth, and the other having led some of the biggest and most informative medical clinical trials to date – which have only just been published in the last 18 months. Not forgetting the cataract and refractive surgeons, there are two in the top 10, both are ophthalmologists that have advanced the field immensely over the last decade, but crucially, very recently too.

Finally, the top 10 contains one ocular oncologist – a person who has been an author on over 50 PubMed-listed publications per year for the last five years, and a further 15 already this year. Someone who I'm sure you'll agree is most worthy of a place on the list.

On reflection, this year's Power List proves two things to me: first, that ophthalmology is one of the fastest-moving, most productive areas of medicine; and second, that you, our readers, are keeping your eye on the literature and you're clear on the work and the opinions you respect. Thank you to all who voted, and let's recognize the achievements of those on the list; what they've done for us – not just lately – certainly deserves celebration.

Mark Hillen
Editor

Upfront

Reporting on the innovations in medicine and surgery, the research policies and personalities that shape ophthalmology practice.

We welcome suggestions on anything that's impactful on ophthalmology; please email
mark.hillen@texerepublishing.com

Grow your Own

In routine cataract surgery today, lens epithelial cells aren't the enemy, technique might be. The answer: lens regeneration

In cataract surgery today, lens epithelial cells (LECs) are the enemy. You prep the patient with anesthetic, make the side-port incision and inject some viscoelastic, make your second incision and perform the capsulorhexis, followed by phaco, then irrigate/aspirate, place the IOL in the capsular bag, remove the viscoelastic, and you're done. And hopefully the patient's vision improves. That is, unless LECs get in the way and bring on posterior capsule opacification (PCO). The mechanism by which PCO occurs is well-characterized: LECs that remain within the capsule can migrate to the posterior capsule where they undergo aberrant differentiation into fiber-like cells (or transdifferentiation into fibroblast-like cells), where they obscure the central visual axis, causing that hazy vision that patients complain about. A lot of effort goes into preventing this: square-edged IOL design, anterior capsule polishing during the procedure… but what if we've got it all wrong? That the LECs aren't the problem, but it's the way the cataract surgery is actually performed? Recent research published in Nature makes very interesting reading.

LECs are fascinating. They self-renew, cover the lens' anterior surface, and begin to differentiate into lens fibers at the equator – and appear to have protective capabilities against oxidative damage and external injury. A team led by Lin (1) noticed that LEC proliferation rates decrease with age, but when you remove the entirety of the lens from the capsular bag, LECs proliferate like crazy. Using some elegant immunohistochemical and transgenic mouse experiments, the researchers discovered that *Pax6* and *Bmi1* – genes that are well-characterized in embryonic eye development and postnatal stem cell maintenance, respectively – play important roles in postnatal lens fiber cell development (Pax6), and maintenance of postnatal stem cell populations (Bmi1). It turns out that the loss of Bmi1 in the eyes of mice disrupts LEC proliferation, thereby promoting cataract formation.

These discoveries alone are valuable additions to the scientific literature, and hint at a role for LECs in in situ lens regeneration. But Lin et al. went on to describe – in the same paper – a way of actually regenerating the lens: a completely new take on capsulorhexis.

A typical capsulorhexis involves making an opening right in the center of the anterior capsule – and this results not only in a large wound area, but the destruction of a large number of LECs (Figure 1a). In the paper, Lin and coworkers proposed a minimally invasive alternative, by placing a much smaller 'rhexis outside of the central visual axis (Figure 1b). The approach was first evaluated in rabbits, with the small capsulorhexis being swiftly followed by careful hydrodissection of the lens cortex from the anterior capsule. This was then removed via irrigation and aspiration from a phacoemulsification device (although no phaco energy was used), and the limbus wound was closed with a single suture. Seven weeks later, the rabbits had regrown a transparent lens that was "comparable to a normal, healthy lens" – including its refractive power. The experiment was repeated in infant macaques, aged 1–3 months – with the same result. And the obvious question: it works in animals, but can it work in humans? Apparently, yes.

The eyes of infant macaques are similar to those of human infants aged

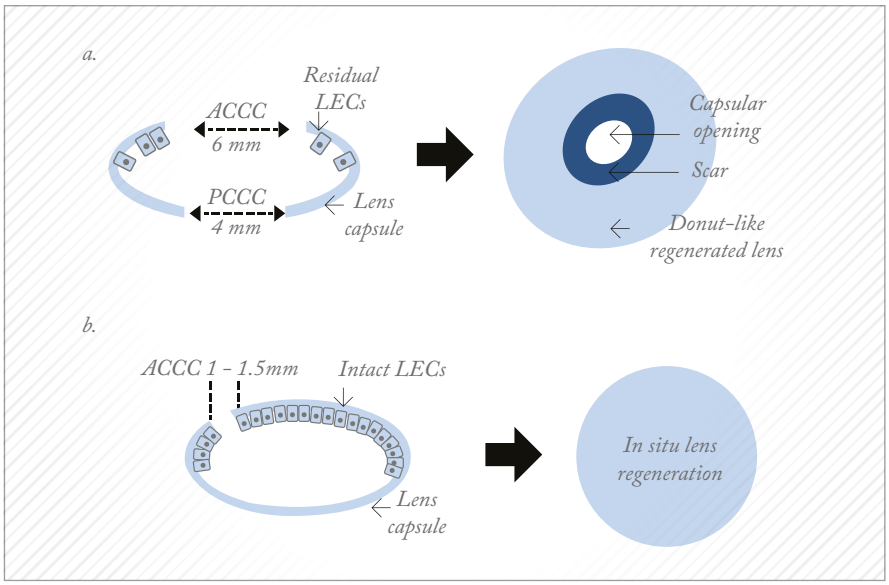


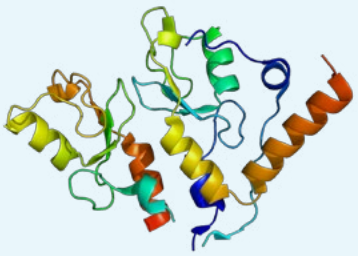
Figure 1. Standard practice and proposed minimally invasive pediatric cataract surgery methods. a. Today's pediatric cataract surgery: an anterior CCC (ACCC) creates a 6 mm-diameter opening in the center of the anterior capsule (removing a significant number of LECs) prior to lens removal. Further, a posterior CCC and anterior vitrectomy are often performed at a later date. b. Schematic representation of the new minimally invasive method: a 1–1.5 mm ACCC is performed in the periphery, and the lens is hydrodissected and aspirated in situ. CCC, continuous curvilinear capsulorhexis.

4–12 months. If children are born with congenital cataract, they require the removal of their cloudy lenses, and as with adults, a capsulorhexis in the center of the visual axis is made, and the cataractous lens removed. Children aged 2 years and younger don't receive an IOL and are left aphakic until at least 2 years of age. Even so, there are still numerous complications associated with this procedure, including visual axis opacification, secondary glaucoma, surgery-related complications, and other challenges that can lead to poor visual outcomes. If Lin et al.'s technique worked in infants, it would have profoundly positive consequences for the treatment of congenital cataract.

It does. When the team compared their minimally invasive technique on 12 infants (aged 0–24 months; 24 eyes) with standard-of-care lens removal (25 infants; 50 eyes), they were able to see the lens regenerate in the first group, post-operatively with a slit lamp. The capsular openings healed within one month of surgery; regenerated biconvex lenses had formed by three months post-procedure, and by eight months, the regrown lens was described as being "comparable to a native lens" – with an accommodative response of 2.5 D (significantly greater [$p<0.001$] than 0.1 D achieved in aphakic controls) that resulted in greatly improved visual acuity relative to baseline, pre-surgery levels ($p<0.001$). Furthermore, minimally invasive cataract surgery was associated with significantly fewer complications compared with standard-of-care surgery (17 vs. 92 percent) – all because the procedure spared the children's own stem cells.

One of the study's leaders, Kang Zhang, a professor of ophthalmology and chief of Ophthalmic Genetics at UCSD, said, "We believe that our new approach will result in a paradigm

Bmi1
The stem cell self-renewal molecule



Bmi1 is a polycomb ring finger oncogene. It regulates p16 and p19, two genes that inhibit the cell cycle. The BMI1 protein appears to play a role in DNA repair, but its other key role is that it's necessary for efficient self-renewing cell divisions of adult hematopoietic, peripheral and central nervous system stem cells. It's also thought to be an anti-aging gene in neurons, as it acts to suppress the activity of p53.

Pax6
The gene that builds an eye

Pax6 was first identified from patients with aniridia – on investigation, patients had significant deletions to the gene that codes for it. It's a transcription factor, and in embryonic development, it's responsible for the formation and maturation of eyes and other sensory organs, certain neural and epidermal tissues. Other *Pax6* mutations can cause (in humans) keratitis, optic nerve keratitis and coloboma, morning glory disc anomaly, and cataract with late-onset corneal dystrophy. Pax6's big claim to fame comes from fruit fly experiments: Drosophila lacking the *Pax6* gene develop no eyes, but ectopic expression of Pax6 protein leads to ectopic eye development.

shift in cataract surgery and may offer patients a safer and better treatment option in the future."

But will it? What of older patients with senile cataract – the ones who undergo the vast majority of the ~22 million cataract surgery procedures each year?

As mentioned above, LECs proliferate at an increased rate following injury, so it is possible that this approach could work in older patients too, although it's likely that it would be at a pace that's considerably slower than in infants (although the identification of both Pax6 and Bmi1 as drivers of LEC renewal might one day open some doors to speeding the process). But there are also a number of additional problems that would need to be addressed: removing hard cataracts commonly requires the use of phaco energy – something that can damage LECs. This begs the question: is there a role for femtosecond lasers here? Florian Kretz thinks so. "A femtosecond laser would be able to not only make the eccentric 'rhexis, but also (given the right optics and patient interface) might show great value in pre-fragmenting and softening the nucleus, thereby making the procedure far easier to perform in elderly patients".

Nevertheless, the aged capsule is almost certainly going to be thicker and less elastic in elderly patients than infants, and this may pose a challenge for an adult lens regeneration approach. Accommodation would still be compromised, and with it, any promise of a patient being "spectacle-free" after the procedure. It's also an interesting after-care scenario: even assuming that the procedure works as well in people aged 70 as it does in infants aged 7 months, you still have a situation where elderly patients are effectively aphakic for a not insubstantial period of time. Their refraction and visual acuity will continuously change – meaning that their spectacle lens prescription will have to change regularly to keep up. This is in stark contrast to most standard cataract procedures, where almost all patients experience an extremely rapid improvement in vision.

Finally, this isn't a panacea for all cataract procedures – Kretz notes that it's unlikely to help with posterior polar cataracts, and subcapsular cataracts might prove a pathology too far for this new approach to address, and if there's a genetic cause for these cataracts, the regrown lens may still opacify. Despite all of that, this is undoubtedly a stunning piece of research, and already a great advance in pediatric ophthalmology – and something that in children at least, requires no new devices (or regulatory approvals). The procedure is now being performed on older pairs of eyes: the world (and a multi-billion dollar industry) awaits the results. *MH*

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Grow Your Own Part II

Smart stem cell culture methods appear to enable functional, cornea-like corneal epithelial cell sheets

For a human embryo, making an eye is a complex process. It begins during the fourth week of development, is driven by the master control gene, *Pax6*, requires cells that derive from two of the three major embryonic lineages (Figure 1), and requires a multitude of genes, many of which are transcription factors, to interact in increasingly complex ways to build the structures that will form a functioning eye. Understandably, it's much harder to do that in vitro – but researchers have managed to develop retina-like structures, which contain cells that express markers of both the neural retina and the retinal pigment epithelium (RPE), by combining multiple embryonic stem (ES) or induced pluripotent stem (iPS) cell sources, with gel scaffolds (1–5). The problem is, those successes haven't been replicated with ocular surface cells. Until now…

In a recent paper published by Hayashi and coworkers in Nature, researchers took a different approach: using human iPS cells to create what they call a "self-formed ectodermal autonomous multi-zone" (SEAM) of ocular cells (6). SEAM mimics the development of the eye, and each zone has cells of different embryonic lineage – ocular surface ectoderm, lens, neuro-retina, and retinal pigment epithelium – and represents a particularly promising approach for the study of ocular morphogenesis (Figure 2). However, the researchers have gone one better: using this SEAM approach, they've managed to take cells from the ocular surface (ectodermal zone), sort and expand them in vitro, and grow corneal epithelium sheets that, when transplanted into rabbits with experimentally-induced total epithelial limbal stem-cell deficiency, the transplanted epithelial cell sheet restored a heathy corneal barrier function, and continued to express cornea-specific proteins. The authors claim that they are "now in [a] position to initiate first-in-human clinical trials of anterior eye transplantation to restore visual function".

In the accompanying Nature editorial (7), Julie Daniels, a professor of regenerative medicine and cellular therapy at the University College

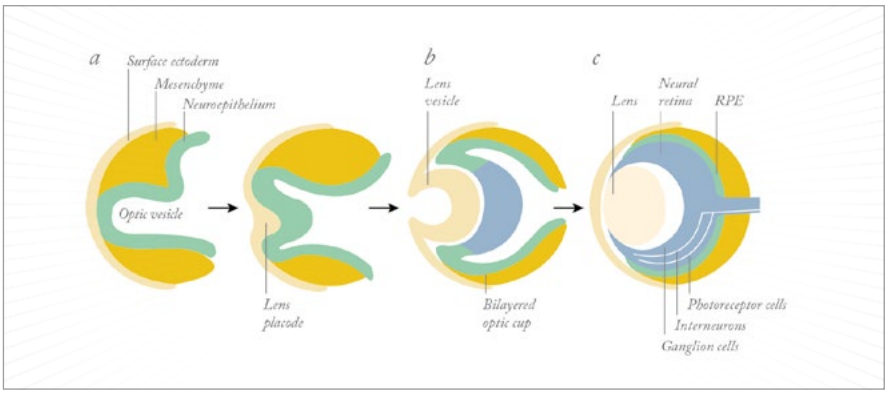

Figure 1. Key stages in embryonic eye development. During the fourth weeks of human embryo development, the surface ectoderm thickens and invaginates with the neuroepithelium of the optic vesicle (a) The inner layer of the two-layered optic cup (b) eventually generates the neural retina (c), whereas the outer layer (b) leads to RPE cell development (c).

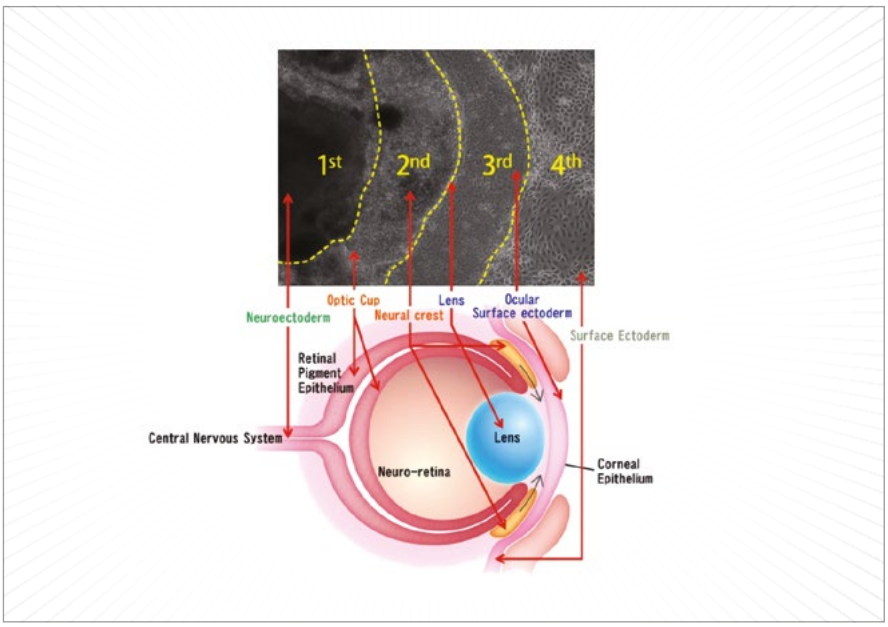

Figure 2. The SEAM approach: human iPS cells grow over several weeks and spontaneously form four concentric zones, each having the characteristic of a different ocular structure, thus mimicking whole-eye development. Video available online at: youtu.be/Rw1odkI0Nw8. Credit: Kohji Nishida.

London Institute of Ophthalmology, emphasized what this research means for patients and eye research:

- Making corneal epithelial sheets using their stem cell-based method would be prohibitively expensive under current good manufacturing practices
- The SEAM model should speed the discovery of the fundamental mechanisms that underlie the development of each cell type, and may reveal molecules that promote the proliferation of each ocular cell type in aging adults
- A better understanding of this might eventually enable manipulation of stem cells within the eyes – much like the lens regeneration work reported by Lin et al. (8).

Although corneal transplants and stem cell therapies like Holoclar are successfully used to treat a range of corneal pathologies, today, there are still many cases where the only option is a keratoprosthesis. Hayashi et al.'s work may one day herald a change to that statement. *MH*

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Business in Brief

Valeant's CEO steps down, Bayer and Regeneron team up again, and the FDA issue marketing approval for Triggerfish

- Valeant's CEO Michael Pearson stepped down amid accounting problems at the Canadian pharmaceutical company, such as revenue forecast misstatements and a congressional probe into drug price hiking. Bill Ackman, Pershing Square Capital Management's CEO has been appointed to Valeant's board of directors, joining his colleague Stephen Fraidin (Pershing Square's vice chairman).
- However, Valeant's officers, including Ackman, have received cease trade orders from one of Canada's securities regulators, Autorité des marchés financiers, tied to the company's failure to meet deadlines for filing its annual report and other documents.
- Bayer and Regeneron join forces to develop a new combination therapy that consists of Bayer's aflibercept, plus Regeneron's angiopoietin2 antibody, nesvacumab. The combination, administered via a single intravitreal injection, is currently under Phase II clinical evaluation for wet AMD (NCT02713204), and DME (NCT02712008) – this is in addition to their existing Phase II evaluation of aflibercept plus REGN2176-3 (a PDGF-β antibody) in patients with wet AMD (NCT02418754, NCT02061865).
- The FDA has issued de novo marketing approval to SensiMed's eye volume monitoring (a surrogate marker of IOP) contact lens, Triggerfish, for adults aged ≥22 years, under the supervision of a healthcare professional.
- Retina Implant AG has secured €26 million in private funding – from both existing and new investors – and will be used to establish new clinical centers around the world, and to help the company initiate reimbursement applications for its Alpha IMS subretinal microchip in key markets.
- The Pfizer-Allergan merger is off – see page 38 for more.

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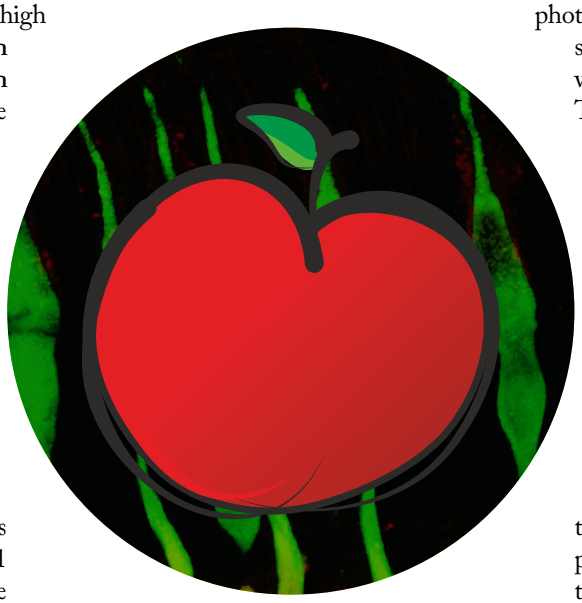
Photoreceptor Death, Thanks to a Low-Fat Diet

Retinal angiomatous proliferation (RAP) is driven by oxygen deprivation, right? The road to retinal VEGF expression might be driven, in part, by energy deficiency

Photoreceptors have a phenomenally high metabolic rate – they're the reason that the retina uses more oxygen per unit mass than any other tissue in the body. The current dogma is that the mitochondria-packed photoreceptors consume copious amounts of glucose to satisfy their metabolic demand… and the failure to supply those demands leads to neovascularization of the macula.

That dogma is being challenged, though – and it started with just a few observations. Children with De Vivo disease have an autosomal dominant developmental disorder. It's caused by a deficiency of the GLUT1 glucose transporter that is responsible for the low level of basal glucose uptake that is required to sustain respiration in all cells. These children experience developmental delays, microcephaly, and many seizures and other neurological phenomena. It goes to show the importance of glucose for brain function – but there's one odd finding: their vision is completely normal. Might there be alternative energy substrates for the retina?

That was the question that Joyal et al. (1) asked, noting that lipid β-oxidation occurs in other tissues with high metabolic demand – like the heart and skeletal muscle – and the enzymes responsible for this are also expressed in the eye (2). Transgenic mice were the obvious starting point for their investigation, so they examined *Vldlr*$^{-/-}$ mutants. The very-low-density lipoprotein receptor (Vldlr) is expressed in many tissues with a high metabolic rate, and facilitates the uptake of triglyceride-derived fatty acid into cells, whereupon lipid β-oxidation occurs, feeding Krebs cycle, and generating energy. The vldlr protein also happens to be present in photoreceptors; VLDLR deletion in humans causes maculopathy, and *Vldlr*$^{-/-}$ mice develop RAP-like retinal vascular lesions.



Using these mice, they found a link between energy metabolism and neovascular disease – a combination of elegant photoreceptor-specific gene silencing techniques, 3D scanning electron microscopy of photoreceptor mitochondria and some gene microarray experiments established that photoreceptors perform lipid β-oxidation, and require Vldr to do so – and that this was under the control of a "free fatty acid sensor", Ffar1, that curbs glucose uptake when fatty acid levels are high, by suppressing *Glut1* expression. To quote the study's senior investigator, Louis Smith of Boston Children's Hospital, "When blood lipids are elevated, the lipid sensor [Ffar1] says, 'we don't need glucose, we have enough lipids here,' and it shuts off glucose uptake."

In *Vldlr*$^{-/-}$ mice, Ffar1 activation leads to "starving" photoreceptors. When the researchers characterized what happened next, they found that this led to a reduction in the levels of the Krebs cycle intermediate α-ketoglutarate (α-KG), which promotes the stabilization of hypoxia-induced factor 1α (Hif1α)… which led to the photoreceptors of these *Vldlr*$^{-/-}$ mice to secrete our old friend VEGF-A, and with it, macular neovascularization. The authors concluded, "Dysregulated lipid and glucose photoreceptor energy metabolism may therefore be a driving force in macular telangiectasia, neovascular AMD and other retinal diseases" (1).

This clearly has therapeutic potential. It's becoming increasingly clear that rising metabolic dysfunction is a function of the aging retina, and a characteristic of many disease states. What this work suggests is that, if lipid sensors work in human photoreceptors as they do in mice, then Ffar1 could be a new therapeutic target that is, crucially, upstream of VEGF. Helpfully, Ffar inhibitor drugs exist today, and are currently under clinical trial evaluation for the treatment of diabetes. Watch this space. *MH*

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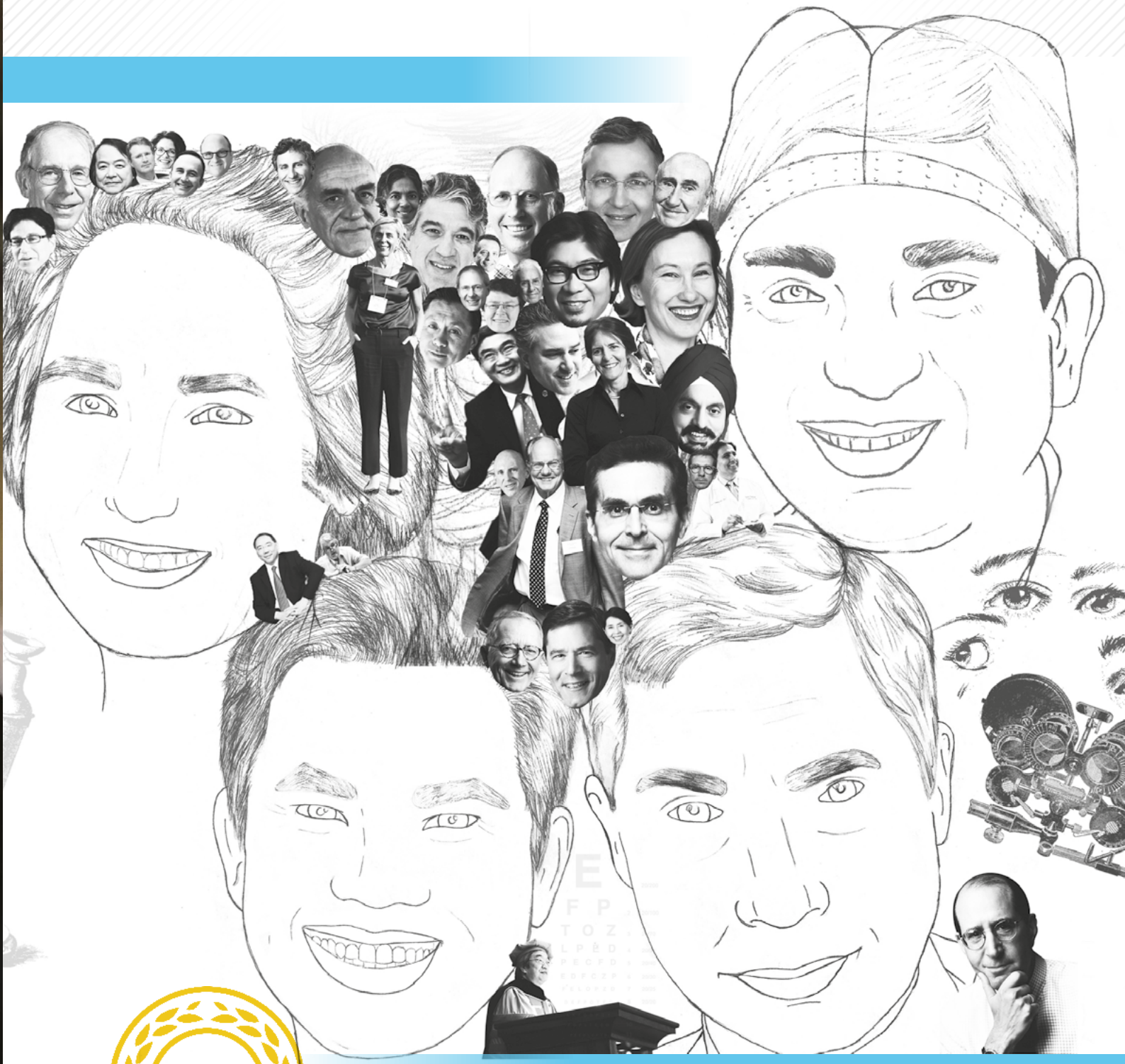


100

the Ophthalmologist

Power List

2016

Welcome to The Power List 2016 – our second foray into the Top 100 most influential people in the world of ophthalmology. Though we realize our list can (and should) never be definitive, who can argue that the faces within – both familiar and new – do not beautifully highlight the brilliance and diversity found within the field? Here, we celebrate 100 reasons to be proud of ophthalmology.

Tony Adamis

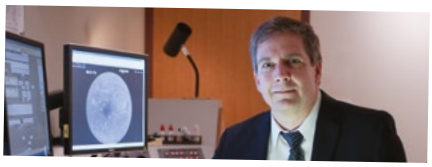
CEO and President, Jerini Ophthalmic Inc.

Anthony Adamis has had two careers in ophthalmology: one as a clinician and a second as an industry executive. One of the team who discovered the role that VEGF plays in retinal neovascularization, Adamis also participated in the development and launch of pegaptanib, the first anti-VEGF agent approved for use in ophthalmology. He was also part of the team who discovered that, in ocular models of neovascular growth, the addition of an anti-PDGF agent to anti-VEGF therapy is more effective than an anti-VEGF agent alone in enhancing vessel regression.

Ike Ahmed

Chief of Ophthalmology at Trillium Health Partners, Mississauga, Ontario; Assistant Professor, University of Toronto; Adjunct Professor, Ophthalmology & Visual Sciences, University of Utah

The 2014 Binkhorst Medal recipient, Ike Ahmed, is a world-renowned ophthalmologist in the fields of glaucoma, complex cataract surgery and IOL complications. The man who coined the term "MIGS" – micro-invasive glaucoma surgery – he and his peers have opened a new flank in the battle to reduce intraocular pressure, ushering in a new generation of surgical approaches and devices into ophthalmology.



Lloyd Aiello

Associate Chief, Massachusetts Eye and Ear, Longwood, Medical Director, Massachusetts Eye and Ear Joslin Diabetes Center, Boston

Aiello has dedicated his career to trying to eliminate the visual loss that results from diabetic retinopathy, with his research group working to determine the biochemistry and molecular mechanisms that underlie early diabetic retinopathy and other retinal vascular disorders, and then using that knowledge to develop and test novel therapeutic interventions through rigorous translational and clinical trial research.

Eduardo Alfonso

Chairman and Director of the Bascom Palmer Eye Institute, Miami, Florida

Physician, surgeon, professor and researcher, Alfonso is an internationally known expert in ocular infectious diseases. In 2006, he documented an increase in the incidence of an aggressive form of fungal corneal infection that was related to soft contact lens use – findings that drew considerable media attention, and significantly reduced the number of new infections. His research interests include bacterial and fungal sensitivity, and the development and clinical application of keratoprostheses.

Bala Ambati

Professor of Ophthalmology, Moran Eye Center, University of Utah

Bala holds the distinction of being the world's youngest person to graduate from medical school – at the age of 17 – and since specializing in ophthalmology, has gone on to receive many awards, including the Ludwig von Sallmann Clinician-Scientist Award from the ARVO Foundation in 2014, and was ranked #1 on our Top 40 under 40 list in 2015. His research encompasses four key topics: angiogenesis and vascular zoning, novel drug delivery formulations, intracellular therapeutics, and advanced ocular imaging methods.

Jayakrishna Ambati

Professor of Physiology and Professor and Vice-Chair of Ophthalmology and Visual Sciences at the University of Kentucky

Jayakrishna's principal research interest is to identify the molecular mechanisms that underlie the development of AMD, determine the triggers that convert this disease from an atrophic to a neovascular phenotype, and develop novel therapeutics to prevent and treat the disease. His lab was the first to demonstrate the presence of in situ complement activation in the retina and choroid of patients with AMD, and his groundbreaking research on the mechanisms that control cell death and vascular growth has led to fundamental insights into the factors that lead to AMD development. His group also developed a new therapy for the treatment of dry AMD, which they are planning to test in clinical trials.

Renato Ambrósio

Director of Cornea and Refractive Surgery, Instituto de Olhos Renato Ambrósio, Rio de Janeiro, and Associate Professor, Federal University of São Paulo

A major contributor to the introduction of corneal imaging technology, Ambrósio has extensively studied corneal topography, tomography, and hysteresis in an effort to better understand and predict the corneal response to refractive surgery. If you have a Pentacam, he's the 'A' in BAD – the Belin-Ambrósio Deviation display. Renato also holds multiple academic appointments, and his work has helped establish the true nature of corneal pathologies, from keratoconus to post-LASIK dry eye. He is a strong proponent of pre-surgical anterior segment OCT to drive better outcomes.

Gerd Auffarth

Professor and Chairman of the Department of Ophthalmology, Ruprecht-Karls University of Heidelberg; Director of the IVCRC and the David J. Apple International Laboratory of Ocular Pathology at the University-Eye Clinic of Heidelberg

Gerd is one of the world's leading experts on intraocular lenses: their design, in terms of optics, haptics, and materials, and their surgical implantation, their safety and occasionally, their pathology too. If an IOL has to be explanted, and if there's an issue with it, it's more likely than not it will be sent to the D.J. Apple lab (that Gerd leads) for analysis – his group is responsible for the post-market surveillance of many of the IOLs available today.

Tin Aung

Senior Consultant and Head, Glaucoma Service, Singapore National Eye Centre Deputy Director, Singapore Eye Research Institute. Associate Professor, Department of Ophthalmology, National University of Singapore

A clinician-scientist, Tin Aung leads a glaucoma research group in addition to his managerial responsibilities. His research interests include angle closure glaucoma and the molecular genetics of eye diseases; he is also active in clinical research, having conducted studies on therapeutics, imaging, screening, clinical course, and surgical outcomes of glaucoma.

Usha Chakravarthy

Professor, Institute for Ophthalmology and Vision Science, Queen's University, Belfast

A particularly prominent retinal surgeon, Usha Chakravarthy has been involved in many of the major international clinical trials with therapeutics, including the IVAN, INTREPID, EUREYE, INDEYE, and VISION studies, as well as being a co-author of multiple Cochrane Review articles, plus the Royal College of Ophthalmologists guidelines for the treatment of AMD. She continues to work at the forefront of AMD research, investigating issues such as the long-term effectiveness of anti-VEGF regimens, and the factors that affect patients' response to anti-VEGF therapy.

Jean Bennett

F.M Kirby Professor of Ophthalmology, Perelman School of Medicine, University of Pennsylvania, Philadelphia

Jean Bennett's laboratory focuses on the molecular genetics of a number of inherited retinal degenerative diseases, including retinitis pigmentosa and AMD, with the objective of developing therapeutic interventions. She has successfully used viral vectors to deliver transgenes to specific retinal cells, and thereby provided proof-of-principle for ocular gene therapy. She has developed a number of strategies for gene therapy-mediated treatments for retinal disease, some of which are currently undergoing clinical trial.

David Chang

Clinical Professor at the University of California, San Francisco

A past president of ASCRS and current chair of the AAO Cataract Preferred Practice Pattern Committee, David Chang is the cataract/refractive surgeon who wrote what many consider to be the definitive textbook on the subject. Chang's career is one of many firsts: he was the first in the US to implant a postoperatively light-adjustable IOL, and the first to implant the Synchrony accommodating IOL. As one of the most prominent international experts, Chang regularly lectures on cataract surgery techniques and the newest lens implants both in the US and internationally.

Graham Barrett

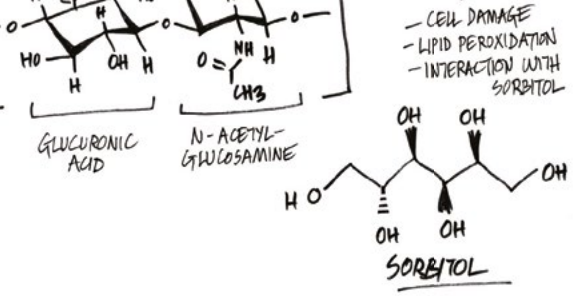
Professor, Lions Eye Institute, Perth, Australia

Barrett is the first Australian ophthalmologist to win the prestigious Binkhorst, Ridley, Susruta, and Choyce Awards, in the same year! He devised the popular Barrett Toric Calculator in his quest to improve surgical outcomes and reduce refractive surprises in patients receiving toric IOLs, and is a popular speaker at international congresses on all things IOL: from planning, conducting, and speculating on the future of the art.

Stanley Chang

Chairman of the Department of Ophthalmology and K.K. Tse and Ku Teh Ying Professor of Ophthalmology at Columbia University Medical Center, New York

Chang has developed and pioneered several revolutionary surgical approaches to treat complicated forms of retinal detachment. He was the first to use perfluoropropane gas in the management of retinal detachments caused by scar tissue proliferation on the retina (now the most frequently used gas in vitreoretinal surgery). He developed perfluorocarbon liquids, and their use in retinal surgery, and in collaboration with Avi Grinblat, he developed a panoramic viewing system that is now used by retina surgeons worldwide.



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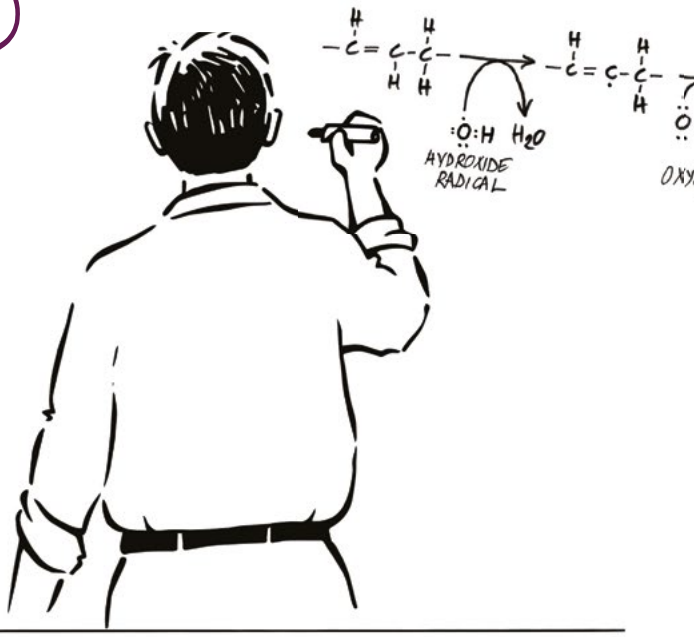

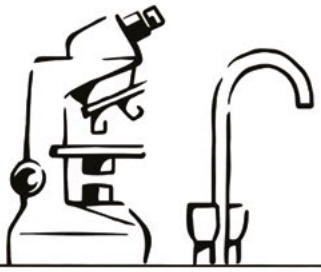

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Stephen Charles

Consultant Ophthalmologist and Vitreoretinal surgeon, Lead Clinician, Medical and Surgical Retina Service, Central Manchester University Hospitals

Stephen Charles has a longstanding interest in medical education and training – he organized the internationally recognized Vitreoretinal Fellowship program at Manchester Royal Eye Hospital for 11 years, and remains involved in training vitreoretinal surgeons from not only the UK and Europe, but also from far afield as Malaysia, Australia and New Zealand. He regularly gives lectures on vitreoretinal surgery, and is also a regular speaker on ophthalmology training courses.

David Garway-Heath

IGA Professor of Ophthalmology for Glaucoma and Allied Studies, University of London; Consultant Ophthalmologist, Moorfields Eye Hospital, London

Research by David (Ted) Garway-Heath has provided many new tools that are in widespread use today. These include the Moorfields Motion Displacement Test; The Moorfields Regression Analysis, a software program for imaging performance in tomography; and the Garway-Heath Map, used in research to establish the correlation between visual field and optic nerve hypoplasia changes. In addition, his work on the UK Glaucoma Treatment Study showed that it was possible to reduce considerably the period needed to identify treatment effects, thus increasing the likelihood of bringing new drugs more quickly and more cost-effectively to patients.

Emily Chew

Deputy Director, Division of Epidemiology and Clinical Applications and Deputy Clinical Director at the National Eye Institute, National Institutes of Health, Bethesda, Maryland

Chew is chair of the AREDS2 study and participates in the Actions to Control Cardiovascular Risk in Diabetes trial. Her interest in the ocular complications of von Hippel-Lindau disease has also led her to collaborate with researchers in order to increase the number of clinical trials investigating this rare disease. A medical retinal specialist with extensive experience in the design and implementation of clinical trials across all phases, her principal research interests are diabetic- and age-related eye diseases.

Burkhard Dick

Professor of Ophthalmology and Chairman, University Eye Hospital Bochum

Throughout his career, Burkhard has covered the full spectrum of eye surgery, and regularly performs cataract surgeries, LASIK procedures, phakic IOL implantations, glaucoma operations, corneal transplants and pars plana vitrectomies. One of the first surgeons in Europe to adopt the femtosecond laser for cataract surgery, Burkhard is a world authority on its use. The author of several books and more than 300 articles, he is an active member of numerous ophthalmologic associations, and has received a number of international awards such as the Waring Medal in 2014, and the Visionary Award of AECOS in 2015.

Peter Coffey

Institute of Ophthalmology, University College London

Coffey's key achievements include being an author of a seminal retinal transplantation publication, and being the principal author and co-author, respectively, of two landmark papers that described the use of human stem cells to halt visual deterioration in animal models of AMD. His work includes the use of human embryonic stem cells for treatment of macular degeneration and retinitis pigmentosa, and the development of a stem cell-based therapy for dry AMD. He is currently the director of the London Project at Moorfields Eye Hospital, which performs clinical trials of stem cell therapies for the treatment of AMD.

Claes Dohlman

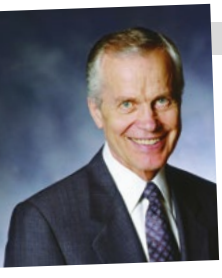
Director, Boston Keratoprosthesis Research and Development, and Emeritus Professor of Ophthalmology, Harvard Medical School, Boston, Massachusetts

Considered the "father of modern corneal science", Claes Dohlman spent the majority of his career in Boston, where he started the world's first organized cornea service with clinical and surgical training. His work is considered "classic" literature on understanding corneal biology, and his investigations of corneal physiology laid the groundwork for modern clinical practice in dry eye disease, corneal burn management, wound healing, and more. He developed the Boston keratoprosthesis, an effective (and revolutionary) treatment option for severe corneal diseases. Now aged 93, he continues to work full-time to improve patient outcomes with the prosthesis.

Harminder Dua

Chair and Professor of Ophthalmology, University of Nottingham

An active clinician, teacher and prolific researcher, Harminder Dua's most well-known contribution to the world of ophthalmology was his group's discovery of a new pre-Descemet's corneal layer back in 2013. He served as co-Editor-in-Chief of the British Journal of Ophthalmology, and is a past president of both EuCornea and the Royal College of Ophthalmologists. His research and innovations have changed clinical practice across the world, and the discovery of Dua's Layer in the cornea has already informed three new surgical techniques, made lamellar corneal transplantation safer, and improved our understanding of the core of the trabecular meshwork – which is actually an outgrowth of his eponymous corneal layer.



Howard Gimbel

Chairman and Professor at the Department of Ophthalmology at Loma Linda University, San Bernadino, California

Howard Gimbel is best known for the co-invention of the continuous curvilinear capsulorhexis, which has proven crucial to modern cataract surgery. In 1984, Gimbel introduced radial keratotomy to Canada, and was the first surgeon in the country to introduce outpatient eye surgery, and to acquire the Excimer laser for use in refractive surgery. He also proposed the "divide and conquer" approach to phacoemulsification and cataract removal. Gimbel has an appreciation for fine music, and enjoys singing in choral groups and playing the musical saw and trombone.

Daniel Durrie

Founder and President, Durrie Vision, Overland Park, Kansas

Durrie founded the Lions Eye Bank of Nebraska in 1979, and has served on the board of directors of the International Society of Refractive Surgery. As founder and president of Durrie Vision, he aimed to create a world-class surgery center providing the most advanced technologies possible. Research has played a pivotal role in his career, and his center was one of the few in the US chosen to conduct FDA clinical trials. Durrie was also involved either as an investigator or as a medical monitor on nearly every clinical trial that led to FDA approval of a laser technology and procedures used in laser vision correction today. He has participated in over 150 FDA clinical studies, and trains surgeons from around the world on new surgical procedures and techniques.

David Friedman

Professor and Director, Dana Center for Preventive Ophthalmology, Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, Maryland

Friedman is known for his contributions to the study of the mechanisms, epidemiology and prevention of angle-closure glaucoma. He has also greatly advanced the knowledge of patient medication adherence, being the principal investigator of the first trial to show that interventions, such as better educating patients and implementing systems to remind them to take medication, can successfully improve use of eye medicines. Friedman is the recipient of various awards from the National Institutes of Health, Research to Prevent Blindness and the American Geriatric Society, and co-edited what many consider to be the definitive book on angle-closure glaucoma.

Napoleone Ferrara

Distinguished Professor of Pathology in the UC San Diego School of Medicine, California

Napoleone Ferrara was involved in the isolation and cloning of VEGF and demonstrated its role in angiogenesis. His work helped lead to the development and initial approval of bevacizumab for use in colorectal cancer. He was also involved in the clinical development of ranibizumab as a potential therapy for wet AMD. Today, his lab investigates non-VEGF-related angiogenesis mechanisms which may lead to therapies effective in anti-VEGF non-responders, in particular the role of the microenvironment and of factors produced by immune cells and fibroblasts in resistance to VEGF inhibitors.

James Fujimoto

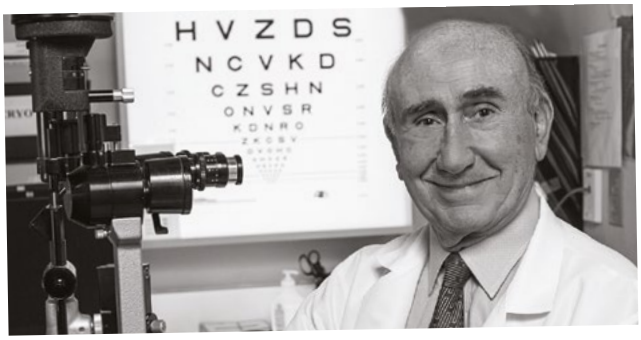
Elihu Thomson Professor of Electrical Engineering and Computer Science, MIT; Adjunct Professor of Ophthalmology, Tufts University School of Medicine, Medford, Massachusetts

James Fujimoto's primary research focus is biomedical imaging with OCT and advanced laser technologies. His research team was responsible for the invention and development of OCT, and today they push the boundaries of high-speed and high-resolution imaging, functional Doppler flow and angiography, as well as polarization-sensitive imaging methods. Fujimoto's current research involves biomedical imaging, OCT, advanced laser technologies and applications in diverse areas including ophthalmology, endoscopy, cancer detection, surgical guidance and developmental biology.

Paul Foster

Professor of Ophthalmic Epidemiology and Glaucoma Studies, UCL Institute of Ophthalmology; Consultant, Moorfields Eye Hospital, London

Paul published the first high-quality reports of glaucoma prevalence and risk factors in East Asia, being the first to identify the large burden of angle-closure glaucoma cases in China. He also pioneered population screening and preventive laser surgery for angle-closure glaucoma, performing the first randomized trial of the technique in rural Asia. His work has culminated in a series of large-scale trials in Mongolia, Singapore and India, with the ultimate aim of making a significant impact on blindness worldwide. Through his ongoing research into the molecular genetics of glaucoma and refractive error, he hopes to uncover further prospects for identifying etiological mechanisms and novel therapeutic options.



Evangelos Gragoudas

Director, Retina Services, Massachusetts Eye and Ear, Boston, Massachusetts

A world authority on the diagnosis and management of intraocular tumors, Evangelos Gragoudas pioneered the use of proton beam irradiation therapy in the treatment of uveal melanoma. Along with Joan Miller and Anthony Adamis, Gragoudas was one of the first to describe the role of VEGF in pathologic retinal neovascularization. With a long-standing interest in retinal disorders, Gragoudas helped identify vascular-targeting therapies for neovascular diseases of the eye, and he was instrumental in developing photodynamic therapy using verteporfin, which became the first FDA-approved treatment for AMD.

Farhad Hafezi

Medical Director, the ELZA Institute, Zurich; Professor of Ophthalmology, Medical Faculty, University of Geneva

As a post-doc, Farhad Hafezi identified a gene that can completely inhibit light-induced retinal damage in mice. Today his clinical focus is on corneal and refractive laser surgery, and he is a pioneer of corneal collagen cross-linking (CXL) for the treatment of corneal ectatic disorders like keratoconus. Hafezi was instrumental in building IROC in Zurich, where CXL technology underwent clinical development, and is considered a leading expert on the development and translation of this technique, and its multiple applications in the field. A recipient of the Casebeer and ARVO Foundation/Carl Camras Translational Research Award awards, Hafezi founded the charitable Light for Sight Foundation, along with his wife, Nikki.

Warren Hill

Director, East Valley Ophthalmology, Mesa, Arizona

Hill has devoted the majority of his professional activities to determining the best-practice procedures for challenging anterior segment surgery cases, and educating his fellow ophthalmologists about them; he's also world famous amongst cataract surgeons for his work on IOL power calculations. He has delivered more than 550 papers and 12 named lectureships to ophthalmic societies both in the United States, and internationally in 36 countries and on six continents. He is a consultant to industry in the field of IOL mathematics design, and optical biometry.

Shigeru Kinoshita

Professor and Chairman of Ophthalmology at Kyoto Prefectural University of Medicine, Kyoto

Shigeru Kinoshita established, along with Richard Thoft, the concept of centripetal movement of corneal epithelium. This shed new light on the importance of the limbal epithelium and contributed to the development of corneal stem cell theory. Over the last 30 years, his primary interests have been focused on the research and development of new therapeutic modalities for the cornea. To this end, Kinoshita's group has established systems to transplant cultivated mucosal epithelial stem cells and cultivated corneal endothelium.

Jack Holladay

Clinical Professor of Ophthalmology, Baylor College of Medicine, Houston, Texas

In addition to his teaching responsibilities and private practice, Holladay invented the Brightness Acuity Tester, and has also developed the Holladay "IOL Consultant", the Holladay 1, 2 and refractive IOL formulas and "Refractive Surgery Consultant" software programs, all of which are used daily by the many cataract surgeons around the world. It helps that his first degree was in electrical engineering, and he obtained a Master's degree in Computer Science before enrolling in Medical School on his journey towards becoming an ophthalmologist.

Roger Hitchings

Professor Emeritus of Glaucoma and Allied Sciences, University of London

Roger's research interests lie in optic nerve imaging, visual field assessment, glaucoma surgery and normal tension glaucoma. He was behind the study that evaluated the effect of topically applied medications on the conjunctiva and the success of glaucoma surgery, and established the Clinical Trials Unit and the associated Reading Centre at Moorfields Eye Hospital, with the latter being one of the UK's key centers for evaluating outcomes in ophthalmic clinical trials. Hitchings developed the glaucoma department at Moorfields into the largest in the UK, and one of the largest in the world.

Mark Humayun

Co-Director USC Gayle and Edward Roski Eye Institute; Professor of Ophthalmology and Biomedical Engineering; Professor of Cell and Neurobiology at the Keck School of Medicine, University of Southern California, Los Angeles

An ophthalmologist, engineer and inventor, Humayun is the only ophthalmologist ever to be elected a member of both U.S. National Academies of Medicine and Engineering, and is best known for his work on retinal implants. Humayun was a co-inventor of the Argus II retinal implant and participated in the first US clinical trial, placing it into the eyes of patients with end-stage retinitis pigmentosa. In 2015, he received the National Medal of Technology and Innovation from Barack Obama – the US' highest award for technological achievement. He has more than 100 patents and patent applications, and was nominated by R&D Magazine as Innovator of the Year in 2005.

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Martine Jager

Head of the Laboratory of Ophthalmology and Professor of Ophthalmology at Leiden University; Adjunct Scientist at the Schepens Eye Research Institute, Boston, Massachusetts

A past president of ARVO (and ARVO's first non-American), and a recipient of their Joanne G. Angle Award, Martine Jager's research interests include immunology and the development of uveal melanoma and ocular surface disease; she has written more than 130 peer-reviewed articles on these topics. After completing a PhD in immunology at the University of Leiden, Jager was an ophthalmology resident at the University of Amsterdam and a clinical fellow at Miami's Bascom Palmer Eye Institute.

Malik Kahook

Professor of Ophthalmology, Slater Family Endowed Chair, Director, Glaucoma Service and Glaucoma Fellowship, University of Colorado, Denver

With over 30 patents filed, Kahook's research is focused on novel devices and surgical instruments for glaucoma and cataract surgery, and advanced imaging techniques. He is Director of Clinical and Translational Research at the University of Colorado, and is also the editor of Essentials of Glaucoma Surgery, MIGS: Advances in Glaucoma Surgery, and author of over 250 papers, chapters and abstracts. He was named New Inventor of the Year 2009 and Inventor of the Year 2010 at the University of Colorado.

L. Jay Katz

Director, Glaucoma Service, Wills Eye Hospital, Philadelphia, Pennsylvania

Katz has wide-ranging interests in glaucoma, including drug evaluation, the roles of laser and medical management, optic nerve scanning methodologies, and new instrumentation for eye pressure measurement. The author of more than 170 journal articles and 34 book chapters, Katz has delivered hundreds of lectures, teaching sessions and courses. He has been an investigator in landmark multicenter trials in glaucoma such as the Glaucoma Laser Trial (GLT), the Advanced Glaucoma Intervention Study (AGIS), and the Collaborative Initial Glaucoma Treatment Study (CIGTS).

A. John Kanellopoulos

Director, Laservision Eye Institute, Athens, and Clinical Professor, Department of Ophthalmology, NYU School of Medicine, New York

A pioneer of corneal and refractive surgery, and a CXL expert, Kanellopoulos developed the Athens protocol for keratoconus and ectasia, which combines laser normalization of the irregular cornea with cross-linking. He also introduced higher fluency cross-linking and prophylactic cross-linking with LASIK, a precursor to LASIK Xtra, and demonstrated how CXL helps in infectious keratitis, corneal melts and pseudophakic keratopathy. He's currently also at the forefront of ocular surface disease treatment modalities, and is one of the most highly-regarded ophthalmic surgeons in the world.

Peter Kaiser

Professor of Ophthalmology, Cleveland Clinic Lerner College of Medicine, Cleveland, Ohio, and Senior Vice President of Product Development at Ohr Pharmaceutical

Actively involved in retinal clinical research, Kaiser has been the study chairman of seven major, multi-center international clinical trials and is a principal investigator in many others. Some of his innovations include the development of new vitreoretinal surgical techniques, pioneering the use of spectral domain OCT for the diagnosis and management of vitreoretinal disease, and being the first physician to use a modified RNA interfering molecule to treat AMD – a true colossus of the retina.

Paul Kaufman

Chair, Department of Ophthalmology, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin

Paul Kaufman is a prominent glaucoma researcher, whose work has helped to shine light on mechanisms behind aqueous humor formation and drainage, and age-related loss of near vision. He has previously served as President and Executive Vice President of ARVO, and is a former President of the International Society for Eye Research. His current research centers on studies of the physiology, morphology, biology, biomechanics and aging of the aqueous humor formation and drainage, in order to understand the pathophysiology – and develop new therapies for – glaucoma and presbyopia.

Gregory Hageman
John A Moran Presidential Professor, Department of Ophthalmology and Visual Sciences, University of Utah School of Medicine, and Director, Moran Center for Translational Medicine, Salt Lake City, Utah

Hageman joined the Moran Eye Center in 2009, bringing with him the largest known research laboratory transfer in the university's history – 8,000 human eyes donated for research over his career. He and his colleagues have generated a definitive body of evidence that implicates a role for immune-mediated processes, specifically that of the complement system, in AMD pathogenesis and progression. Early pathobiologic investigations of eyes from human donors led to the identification of numerous complement proteins, complement activators, and complement regulatory proteins in drusen, the hallmark pathological biomarkers of the disease. More recent genetic studies led to the discovery that common variants in several complement genes confer significant risk for, or protection from, the development of AMD late in life. A former director of the Human Genome Project called this breakthrough, "The first major translational research discovery to come from the Human Genome Project."

Henry Klassen
Associate Professor and Director, Stem Cell and Retinal Regeneration Program, Ophthalmology, University of California, Irvine

Klassen is a pioneer in the field of stem cell research, and has focused on regenerating damaged retinal tissue in order to restore sight for the last quarter of a century. Just last year, a first-of-its-kind stem cell-based therapy for retinitis pigmentosa developed in his lab received all necessary approvals and moved in to the important clinical trial phase. Klassen's objective is to use stem cells in order to rescue and rejuvenate rods and cones in the degenerating retina, and he hopes, will eventually be able to reverse the course of retinitis pigmentosa, even at relatively advanced stages.

Thomas Kohnen

Chairman and Director, Department of Ophthalmology, Goethe-University, Frankfurt

Thomas Kohnen has over 25 years of clinical and research experience in cataract and refractive surgery, has performed or supervised over 35,000 procedures, authored more than 300 peer-reviewed publications, and he also managed to obtain a Health Economics degree during that period. His opinions and insight are widely sought, as reflected by his many podium appearances at international congresses. He is also a member of the editorial boards of many ophthalmology journals, and has received many awards over the years, including the AAO's Achievement Award in 2002.

Doug Koch

Professor and Allen, Mosbacher, and Law Chair of Ophthalmology, Baylor College of Medicine, Houston, Texas

A recipient of several prestigious honors, including the AAO Lifetime Achievement award, Koch's work focuses on improving the outcomes of cataract surgery and refractive surgery procedures, such as LASIK and PRK. He specializes in the management of complex conditions including cataract and IOL problems, iris repair and replacement, and management of LASIK and PRK problems, and conducts research and teaches internationally in these areas.

Caroline Klaver

Professor of Epidemiology and the Genetics of Eye Diseases, Ophthalmologist and Epidemiologist, Erasmus MC, Rotterdam

Klaver is leading an international study on the influence of genes and the environment on four key abnormalities: myopia, AMD, retinal dystrophy and glaucoma, called The Rotterdam Study. She participates in a wide range of projects, such as Generation R, a longitudinal general health study of 10,000 children in Rotterdam, from early pregnancy onwards. She has instigated a number of epidemiological investigations herself, and has initiated a major international research project: Consortium on Refractive Error and Myopia (CREAM). Her work has resulted in groundbreaking insights in the field of macular degeneration, and looks to do similar with myopia.

George Kymionis

Clinical Lecturer in Ophthalmology, University of Crete

Kymionis has published over 85 scientific papers and has received a series of awards and scholarships throughout his academic career. He has participated in a large number of congresses (both national and international), has contributed chapters to over 10 textbooks, and, according to a nominator, is "the most cited corneal surgeon in Europe." Some of his key studies include investigating ocular rigidity in people with AMD or who have undergone refractive surgery, and his current research interests include corneal disease and stem cells in corneal pathology.

Dennis Lam

President, Hong Kong C-MER International Eye Care Group Limited, Head of State Key Ophthalmic Laboratory of Zhongshan University

Lam's research interests span the entirety of the eye. His contributions to the scientific literature range from the big (epidemiological studies), to the small (gene analysis at the molecular level). Lam is the founder of the Project Vision Charitable Foundation, an organization that aims to eliminate cataract blindness in China. He is the founding President of the Asia-Pacific Society of Eye Genetics, and a Past President of the College of Ophthalmologists of Hong Kong.

Richard Lindstrom

Founder and attending surgeon of Minnesota Eye Consultants, and Adjunct Professor Emeritus at the University Of Minnesota Department Of Ophthalmology, Minneapolis, Minnesota

An ophthalmologist and entrepreneur extraordinaire, Lindstrom holds more than 30 patents, having developed a number of refractive solutions, intraocular lenses and surgical instruments. He serves on the Boards of Directors of several companies, is a past president of ASCRS and ISRS, and is also a member of the ASCRS Executive Committee as Member at Large. He has been at the forefront of ophthalmology's evolutionary changes throughout his career, and is deservedly recognized as a world-leading researcher, teacher, inventor, and acclaimed physician and surgeon.

William Link

Managing Director of Versant Ventures

A mechanical engineer by training, Link is one of the biggest names in the eyecare business. Founder of both Chiron Vision and American Medical Optics, Bill served as President of American Medical Optics, and later on the Board of its successor company, Advanced Medical Optics. Bill was a partner at Brentwood Venture Capital, where he invested in a number of companies including eyeonics, Genyx, IntraLase, Intra Therapeutics, and OraMetrix. Now MD of Versant Ventures, his investments include: AcuFocus, Cameron Health, ForSight, Glaukos, Inogen, LenSx, Neurotech, Oculeve, Rox Medical, Second Sight, and Wavetec.

Anat Loewenstein

Chair of the Department of Ophthalmology, Tel Aviv Medical Centre, Professor of Ophthalmology and Vice Dean, Tel Aviv University

An expert in retinal toxicity with a strong research interest in the early detection of retinal disease. Anat served as a Medical Officer with the Israel Defense Forces for four years, and served as the principal investigator of many clinical trials of anti-VEGF agents and steroid implants for the treatment of retinal disorders such as AMD, DME and RVO. A popular speaker at many international conventions, and co-chair (with Neil Bressler) of the "Controversies in Ophthalmology" congress, her contribution to, and influence in the field of medical and surgical retina cannot be underestimated.

Robert MacLaren

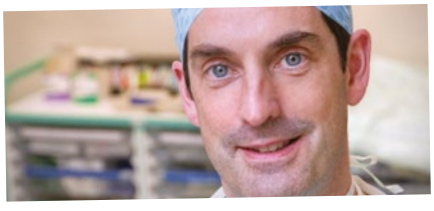
Professor of Ophthalmology, University of Oxford

The focus of MacLaren's research has been to apply basic science to understand the mechanisms of retinal degeneration, in order to find ways to intervene in (and possibly reverse) currently incurable forms of blindness. This research follows two broad themes: replacement of the RPE and/or replacement of photoreceptors. Robert is also one of the pioneers of robot-assisted ophthalmic surgery, and is one of the first surgeons in the world to implant an epiretinal prosthesis. According to a nominator, he is "one of the stars of ophthalmic translational medicine, and a truly gifted surgeon to boot."

Albert Maguire

Professor of Ophthalmology at the Hospital of the University of Pennsylvania and the Presbyterian Medical Center, Philadelphia

A pioneer of retinal gene therapy, Albert Maguire led a trial that inserted the *RPE65* gene into the RPE to treat Leber congenital amaurosis. He is a colleague (and husband) of Jean Bennett (qv). Recognized regularly by "Best Doctors in America", Maguire is also a noted educator. His research interests include not only cellular and molecular therapeutics for ocular disease, but also the medical and surgical management of pediatric vitreoretinal disease.



Keith Martin

Professor of Ophthalmology, Cambridge University

Keith Martin is a medical researcher specializing in the treatment of glaucoma and, according to a nominator, "one of the leading clinician scientists of his generation." He is the first Professor of Ophthalmology at the University of Cambridge, and he established the Glaucoma Research Laboratory there in 2005 in order to study the mechanisms of retinal ganglion cell death in glaucoma, and to develop new treatments using stem cell, gene therapy and RPE cell transplantation approaches.

John Marshall

Professor of Ophthalmology at the Institute of Ophthalmology, University College London, London

John Marshall invented and patented the Excimer laser, and today more than 35 million laser vision correction procedures have been performed worldwide. He created the world's first Diode laser for treating the eye problems of diabetes, glaucoma and aging. Over the past 40 years he has held posts chairing the medical advisory boards of many international companies, holds many academic positions across a great number of top academic institutions, and has worked on many national and international committees concerned with protecting the public against the possible damaging effects of lasers and other artificial light sources – perhaps most notably, addressing the United Nations to obtain a Geneva Convention banning the use of anti-personnel laser weapons.

References: 1. Medeiros FA, Meira-Freitas D, Lisboa R, Kuang TM, Zangwill LM, Weinreb RN. Corneal hysteresis as a risk factor for glaucoma progression: a prospective longitudinal study. Ophthalmology. 2013 Aug;120(8):1533-40. **2.** Ehrlich JR, Radcliffe NM, Shimmyo M. Goldmann applanation tonometry compared with corneal-compensated intraocular pressure in the evaluation of primary open-angle Glaucoma. BMC Ophthalmol. 2012 Sep 25;12:52. **3.** Aashish Anand, MD, Carlos Gustavo De Moraes, MD, Christopher C Teng, MD, Celso Tello, MD, Jeffrey M Liebmann, MD Robert Ritch, MD. Lower Corneal Hysteresis Predicts Laterality in Asymmetric Open Angle Glaucoma, IOVS Papers in Press. Published on June 23, 2010 as Manuscript iovs.10-5580.

Joan Miller

Chief and Chair of the Department of Ophthalmology, Massachusetts Eye and Ear, Mass General Hospital and Harvard Medical School, Boston

Not only a pioneer of photodynamic therapy using verteporfin, Joan Miller also helped to define the role of VEGF in retinal vascular disease, helping to form the scientific basis of angiogenesis inhibitor drug use in the eye – something that she and six of her Harvard Medical School colleagues received the 2014 António Champalimaud Vision Award for. Today she continues to investigate the molecular pathophysiology of vision loss and to develop improved therapies for retinal disease.

Robert Osher

Professor of Ophthalmology at the College of Medicine of the University of Cincinnati and Medical Director Emeritus of Cincinnati Eye Institute, Ohio

Robert Osher has designed many contemporary IOLs and surgical instruments, and numerous new surgical techniques to go with them – or improve upon what was state-of-the-art. Many of these have been captured in video, and Osher's surgical videos have won more than 25 first-prize honors at international congresses, including three Grand Prizes at the ASCRS and ESCRS congresses. Outside his interest in cataract surgery, Osher has been a proud coach of more than 70 youth baseball and basketball teams – reaching the National Championships in each sport – and has published 17 children's stories, raising money with the proceeds for local and national charitable organizations.

Paul Mitchell

Director of the Centre for Vision Research at the Westmead Millennium Research Institute, Sydney

As a leading expert on macular degeneration, Paul Mitchell focuses on the management of AMD, diabetic and other vascular retinopathies, and investigations into how the eye is affected by systemic disease. He conducted the world-renowned Blue Mountains Eye Study, which has provided unique and greatly important information about the incidence of ocular disease in an Australian population, which helped demonstrate the association between smoking and macular degeneration. Mitchell received the 2004 Association of International Glaucoma Societies award, and in 2007 he became trustee for the Clinical & Epidemiologic Research section of ARVO.

Dan Reinstein

Medical Director, London Vision Clinic

Reinstein is an accomplished research scientist in the field of laser eye surgery and has made major contributions to the field. He holds numerous patents on many of the techniques and technologies that relate to laser eye surgery and high-frequency ultrasound bioengineering. During his work at Weill Cornell Medical College, he began the development of the Artemis scanner, a diagnostic technology for measuring and studying the individual corneal layers, as well as the ocular dimensions of the anterior segment. He has also been closely involved in the development of SMILE, and was one of the early adopters of corneal collagen cross-linking. Reinstein has played the saxophone for over 35 years, and despite his busy career, continues to perform as a jazz musician on a regular basis.

Thomas Neuhann

Founder and medical director, ALZ Eye Laser Center, Munich

Along with Howard Gimbel (qv), Neuhann was responsible for the introduction of the capsulorhexis – a sea change in cataract surgery at the time. He was also involved in the development of the trabeculectomy, the integration of diagnostic and safety procedures like iris recognition into LASIK procedures, and also special methods for the correction of complex visual defects. In addition to operating the ALZ Eye Center, Neuhann also leads an eye bank he founded in Munich, and conducts around 300 corneal transplants annually.

Douglas Rhee

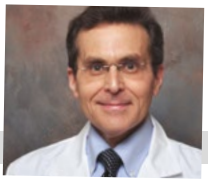
Chairman of Ophthalmology and Director of the Eye Institute at University Hospitals, Cleveland, Ohio

Rhee is a leading educator of ophthalmologists, serving on various scientific and curriculum committees of both academic institutions and learned societies. A surgical innovator who loves to introduce new technologies to his practice, he has also contributed to the understanding of rare syndromes, like his discovery that plateau iris syndrome is a familial condition in around half of all cases. According to a nominator, "Rhee maintains a busy clinical practice, and plays a key role in inventing cutting edge surgical interventions. At the same time, he is training and inspiring future generations of ophthalmologists." He was also one of the first to describe the rare condition of topiramate-induced bilateral acute angle closure glaucoma.

Robert Ritch

Shelley and Steven Einhorn Distinguished Chair in Ophthalmology; Surgeon Director Emeritus and Chief of Glaucoma Services at the New York Eye & Ear Infirmary, New York

Robert Ritch has devoted his career to broadening the understanding of the underlying etiologies and mechanisms of glaucoma, and developing innovative ways to treat the disease. While still a fellow in 1978, he performed the first laser iridotomy in New York and initiated the first course on laser treatment of glaucoma at the AAO – understandably, as he developed argon laser peripheral iridoplasty for the treatment of angle closure. An ebullient speaker that can engage audiences for hours on a topic he clearly loves, Ritch has educated thousands worldwide on the diagnosis and treatment of angle closure.



Philip J. Rosenfeld

Professor of Ophthalmology, Bascom Palmer Eye Institute, University of Miami Miller School of Medicine, Miami, Florida

Rosenfeld, a retina specialist with a particular interest in the treatment and study of macular degeneration, has been a principal investigator of many of the pivotal clinical trials of anti-VEGF agents (and photodynamic therapy) for the treatment of retinal disease. Of his research into the ophthalmic application of bevacizumab, a nominator said, "Rosenfeld is the pioneer in its use. Now the most commonly used anti-VEGF in the world, its low cost and benefits have provided vision-saving therapy to millions." He has received the AAO's Senior Achievement and Secretariat Awards, the Macula Society's Richard and Hinda Rosenthal Foundation Award, the Heed Award, the ASRS' Founders Award and the J. Donald Gass Award from the Retina Society amongst many.

Brent Saunders

CEO, Allergan

Saunders has significant healthcare industry expertise, and is a previous CEO of Bausch + Lomb, he has also held a number of leadership positions at Schering-Plough and was named head of integration for the company's merger with Merck & Co. Saunders' dealmaking is the stuff of legend: he then went on to lead Actavis' takeover of Allergan, and as CEO of the new entity (dubbed Allergan), Saunders was about to pull off the world's largest-ever inversion deal: Dublin-based Allergan buying the much larger, New York-based Pfizer, but that deal is now off – as the US government changed the tax laws on inversions.

Ursula Schmidt-Erfurth

Professor and Chair of the Department of Ophthalmology at the University Eye Hospital, Vienna

Ursula Schmidt-Erfurth founded the Vienna Study and Vienna Reading Centers, which respectively run clinical trials and perform the digital image analysis for them. In addition to leading one of the largest European academic institutions in ophthalmology, Schmidt-Erfurth has a keen interest in the development of novel diagnostic techniques such a retinal imaging, and novel treatment strategies, including intravitreal pharmacotherapy.

Joel Schuman

Distinguished Professor of Ophthalmology, UPMC Eye Center, University of Pittsburgh, Pennsylvania

In 2001, Schuman and his team were the first to identify a molecular marker for human glaucoma, and, along with his colleagues Eric Swanson, James Fujimoto, Carmen Puliafito and David Huang, he invented OCT technology – receiving the Champalimaud Award for it. An NEI-funded principal investigator since 1995, his current research interests include imaging of the eye, laser-tissue interactions, aqueous outflow, and ocular pharmacology.

Theo Seiler

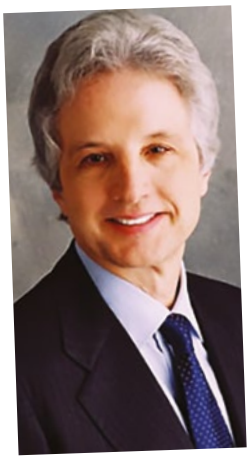
Founder of the Institute of Refractive and Ophthalmic Surgery (IROC), Zürich

Theo Seiler's doctorates in physics and medicine enabled him to become a pioneer of modern refractive surgery. Among his achievements are the development of the first clinical dye laser and the invention of corneal crosslinking, he also performed the first ever PTK, PRK and wavefront-laser guided surgical techniques on the human eye, and was also the first to combine LASIK and rapid CXL. Seiler is a specialist in corneal and refractive therapy, physiologic optics, lasers in ophthalmology, and anterior segment surgery.

Paul Sieving

Director, National Eye Institute, National Institutes of Health, Bethesda, Maryland

Paul Sieving was the founder of the Center for Retinal and Macular Degenerations at the University of Michigan, and spent almost 16 years in Ann Arbor, before moving to Bethesda in Maryland to become the Director of the National Eye Institute, where he also runs a research group. Sieving is known internationally for studies of human progressive blinding genetic retinal neurodegenerations, including retinitis pigmentosa, and rodent models of these conditions. His laboratory study of pharmacological approaches to slowing retinal degeneration in transgenic animal models led to the first human clinical trial of ciliary neurotrophic factor (CNTF) for retinitis pigmentosa. He developed a mouse model of X-linked retinoschisis and is embarking on human ocular gene therapy for this condition.



Stephen Slade

Slade and Baker Vision Center, Houston, Texas

Slade has had many firsts in his career: aside from pioneering LASIK eye surgery, he also has the longest experience with bladeless LASIK in the world. He was the first US surgeon to perform custom LASIK ablation based in topography, and to implant a lens for presbyopia. Slade has produced many articles, book chapters, holds multiple patents, and has authored nine textbooks on refractive surgery.

Alfred Sommer

Dean Emeritus, Bloomberg School of Public Health, and University Distinguished Service Professor, Johns Hopkins University, Baltimore, Maryland

Sommer is an ophthalmologist and epidemiologist who identified one of the most cost-effective health interventions in the world: vitamin A supplementation. His work in the 1970s and 1980s revealed that dosing severely vitamin A deficient children with an inexpensive, large-dose vitamin A capsule twice a year reduces child mortality by as much as 34 percent, and cut the incidence of measles-associated pediatric blindness. He has been described as a "global health champion". His long-term, continuing research involves the cause, magnitude, consequences, and control of vitamin A deficiency and, most recently, those of related micronutrients.

Bradley Straatsma

Professor of Ophthalmology Emeritus at the Jules Stein Eye Institute at the University of California, Los Angeles, California

Bradley Straatsma is widely acclaimed as a pioneer in the study of peripheral retinal disease, investigations of tumors and research on ophthalmic conditions such as diabetic retinopathy and cataract. His long career saw him achieve great things, and he has held many leadership positions over the years – notably, Straatsma was the last president of the American Academy of Ophthalmology and Otolaryngology, and oversaw its division which led the formation of the AAO. He has more than 550 scientific publications to his name, and has received over 75 honors and awards to date.

Giovanni Staurenghi

Professor of Ophthalmology, University of Milan

Staurenghi's research, publications and lectures have had an important bearing on our understanding of retinal degeneration. His work has a particular focus on retinal disease – both the imaging of it, and its treatment – with both pharmacological and laser interventions. Staurenghi's work extends to clinical trials; he is currently involved in more than 25 of them. A prolific author on both eye anatomy and disease, Staurenghi is a fellow of ARVO, AAO and EURETINA, and an editorial board member of the journal, IOVS.

Donald Tan

Director of the Singapore National Eye Centre; Partner and Senior Consultant Ophthalmic Surgeon at Eye & Retina Surgeons (ERS), Camden Medical Centre

Tan's many contributions to ophthalmology include new forms of selective lamellar keratoplasty, femtosecond corneal and refractive surgery, the osteo-odonto keratoprosthesis, surgical devices for lamellar corneal transplantation, and multiple interventional myopia clinical trials. The founder of the Asia Cornea society, Tan also holds 12 patents that range from stem cell culture technology to novel inserters for DSAEK surgery.

Edwin Stone

Professor and Director of the Molecular Ophthalmology Laboratory, University of Iowa Carver College of Medicine, Iowa City

Stone's research focus is on finding and characterizing the genes involved in macular degeneration, glaucoma, and heritable photoreceptor degenerative diseases. He is working to remove the technical, legal and financial barriers that come between genetic discoveries and the patients that would benefit from them, by creating a nonprofit genetic testing lab that provides low-cost tests for more than 20 different inherited eye diseases. With his colleagues, he has mapped or cloned many human disease genes, including genes implicated in glaucoma, macular disease, dominant stromal corneal dystrophy, Wagner disease, erosive vitreoretinopathy, the enhanced S cone syndrome, and achromatopsia.

Marie-José Tassignon

Chief and Chair of the Department of Ophthalmology of the Antwerp University Hospital, Antwerp

A past president of ESASO and ESCRS, Marie-José Tassignon has pioneered bag-in-the-lens cataract surgery that avoids PCO, the main complication of the traditional lens-in-the-bag implantation technique. She is also a keen proponent of the need for ophthalmologists to understand the eye's physiology and its optics. Unlike many other departments of ophthalmology, Tassignon has attracted engineers, physicists and paramedical researchers to complement the medical staff at the Antwerp Department of Ophthalmology.

William Trattler

Centre for Excellence in Eye Care, Miami, Florida

An ophthalmologist at the leading edge of developments in cataract and refractive surgery, he also has a research interest in ocular surface disease and meibomian gland dysfunction. In addition to his private practice, Trattler is a Volunteer Assistant Professor of Ophthalmology at the University of Miami's Bascom Palmer Eye Institute, and has been invited to lecture at numerous conferences both in the US, where he has helped stimulate discussions (sometimes controversial), all with the goal of advancing the safety and visual outcomes of refractive surgery.

Richard Wormald

Consultant Ophthalmologist, Head of Epidemiology, Moorfields Eye Hospital, London

With over three decades of clinical experience, Wormald has contributed much to the understanding of the epidemiology of eye disease, having performed and advised upon systematic reviews, clinical trials and more. He has experience as a medical advisory trustee for two major international NGOs for the prevention of blindness – Sight Savers International and the Fred Hollows Foundation. A popular speaker, Wormald is also a prolific author, having written more than 120 research papers; Richard is also the Coordinating editor of the Cochrane eyes and vision group.

Abhay Vasavada

Director of Raghudeep Eye Clinic and Iladevi Cataract & IOL Research Centre, Ahmedabad, Gujarat

A cataract/refractive surgeon and Fellow of the Royal College of Surgeons, Abhay Vasavada has expertise in the successful resolution of complicated cataract and pediatric cases. This knowledge is in great demand: Vasavada is a renowned educator and is regularly asked to share his experiences by performing live surgery. He started Raghudeep Eye Clinic as a cataract specialty center in 1984 in Ahmedabad, India.

Kang Zhang

Professor of Ophthalmology, Chief of Ophthalmic Genetics, University of California San Diego, California

Zhang's clinical and research focuses are on novel disease gene targets and treatment, gene and stem cell based therapies in AMD, diabetic retinopathy, and inherited retinal degeneration. The Kang Zhang Laboratory uses genetic analyses to gain insights into the molecular mechanisms that underpin macular degeneration and other eye diseases. He holds numerous grants from the National Institute of Health and other foundations, as well as multiple patents.

Ningli Wang

Director and the Vice President of the Eye Center of Beijing Tongren Hospital, Beijing

While serving as director and the vice president of one of the two largest eye centers in China, Wang has transformed it to include a growing academic program. Wang is also devoted to ophthalmic practice, teaching, training, blindness prevention and academic research. His contributions include the trans-lamina cribrosa pressure difference theory of open-angle glaucoma, which was called a "milestone paper" in the field.

Gerhard Zinser

Co-founder and a Managing Director of Heidelberg Engineering

Gerhard Zinser has contributed to many key advances in imaging technology, including confocal microscopy, scanning lasers and optics, OCT and software image analysis. The resulting diagnostic instruments have changed clinical practice for retinal disease, glaucoma and corneal pathologies. According to a nominator, "He is responsible for several of the major diagnostic imaging innovations in ophthalmology. Further, he is actively involved in cutting-edge research and in sponsoring innovative activities that will translate into major products in the coming decade."

20 Robert Weinreb

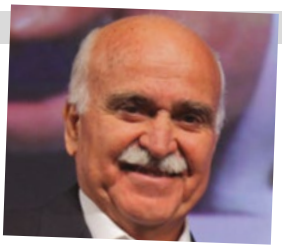
Chairman and Distinguished Professor of Ophthalmology at the University of California, Director of the Shiley Eye Institute, and Director of the Hamilton Glaucoma Center, California

As a clinician, surgeon and scientist, Robert Weinreb maintains diverse medical and research interests. He oversees all clinical activities at the Shiley Eye Institute and within the Department of Ophthalmology. As the Director of the Hamilton Glaucoma Center, a state-of-the-art laboratory and clinical research facility, Weinreb oversees a team of scientists and staff dedicated to glaucoma research and treatment. His principal research interests include glaucoma surgery, optic neuropathy, ocular senescence, and optic disk imaging – Weinreb is a pioneer of retinal tomography (and of many more retinal imaging modalities too). He is also a prolific educator; many of his (more than 100) postdoctoral fellows in glaucoma have gone on to hold department chairs and other distinguished academic positions in the United States and throughout the world.

19 Daniel Albert

Frederick Allison Davis Professor of Ophthalmology and Visual Sciences and Director of the Eye Pathology Laboratory at the University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin

Co-founder of the McPherson Eye Research Institute, Daniel Albert's research focuses on ocular tumors, specifically melanoma and retinoblastoma, using transgenic mice to investigate the molecular biology of these tumors. His investigations into the anti-tumor properties of vitamin D compounds, and the finding that they can cause apoptosis and block tumor angiogenesis to inhibit growth of retinoblastoma cells in vitro, has left Albert hopeful that an effective therapeutic intervention will emerge. More recently, he has studied resveratrol, which he has found to inhibit and sometimes block tumor growth in animal models of cancer; based on his work, formulations of resveratrol and effective ways to deliver the drug could serve as an efficacious treatment for uveal melanoma and for the prevention or treatment of metastatic disease. Beyond his laboratory and clinical work, Albert is a renowned ophthalmic historian, having published widely in the field, including texts that encompass the breadth of ophthalmic history.



18 Ioannis Pallikaris

Founder and Director of the Institute of Vision and Optics, University of Crete

Ioannis Pallikaris is perhaps best known as the ophthalmologist who described and named LASIK, was the first to perform the LASIK procedure on a human eye, and went on to develop Epi-LASIK. He described the Photoablatable Lenticular Modulator (PALM) technique for corneal resurfacing, and co-invented the Tracey ray-tracing device for clinical aberrometry. A prolific entrepreneur and innovator, he is also an enthusiastic educator who has over 30 years of teaching experience in both Greece and Switzerland, at undergraduate and post-graduate levels. He has written many textbooks, and received numerous awards for his work, including an AAO Lifetime Achievement Award and the ESCRS Binkhorst Medal. His current research interests include corneal and iris biology, ocular imaging, corneal implants and inlays, and corneal collagen cross-linking.

17 Frank Holz

Chairman and Professor, Department of Ophthalmology, University of Bonn

Frank Holz is a researcher whose many interests include the pathogenesis, prognostic factors, biomarkers and therapy of AMD, phenotyping retinal diseases using innovative imaging technologies, the development and implementation of molecular imaging for macular and retinal diseases, and understanding the cell biology of retinal pigment epithelial cells in atrophic and neovascular ocular diseases. He has also been involved in several high profile clinical trials involving innovative therapies for macular disease. Holz has made significant advances in the understanding of macular telangiectasia, including characterizing the natural history in many patients and identifying early markers of the disease, along with better imaging methods for following disease progression. For the last three decades, he has been at the forefront of clinical research using the most advanced retinal imaging modalities, and is one of the early adopters of OCT-angiography (and one of the world's leading authorities on its use). He is Editor-in-Chief of the journal of the German Ophthalmological Society (DOG), Der Ophthalmologe, and a past president of DOG.

16 Robert Nussenblatt

Chief of the Laboratory of Immunology at the National Eye Institute, National Institutes of Health, Bethesda, Maryland

Robert Nussenblatt is a leading ocular immunologist, and established a section on ocular immunology that later became the NEI Laboratory of Immunology. Nussenblatt has directed the clinical fellowship program for ophthalmologists for over 20 years, and he has served as clinical director and scientific director for the NEI. His primary research interests are uveitis and the role of inflammation in AMD, but he also investigates new therapeutic approaches to treating human ocular disease, including the use of natural products, and also the role epigenetics plays in the development (or not) of disease. He is the author of a standard text on uveitis, an Editor of multiple ophthalmology publications, and holds several patents on ophthalmological procedures.

15 Claude Burgoyne

Van Buskirk Chair for Ophthalmic Research, Director, Optic Nerve Head Research Laboratory, Devers Eye Institute, Portland, Oregon

An optic nerve head imaging legend, Claude Burgoyne currently investigates the effects of aging and experimental glaucoma on the load-bearing connective tissues of the primate optic nerve head within SD-OCT 3D histormophometric reconstructions. Building upon this capability, his laboratory is now using SD-OCT of the deep tissues of the optic nerve head to visualize and quantify 3D OCT optic nerve head reconstructions, with a long-term goal of predicting how an individual optic nerve head will respond to a given level of intraocular pressure. In 2015, Burgoyne was awarded the American Glaucoma Society Clinician-Scientist Award.

14 Lawrence Yannuzzi

Professor of Clinical Ophthalmology at Columbia University College of Physicians and Surgeons, New York; Founder and President of the Macula Foundation

Lawrence Yannuzzi is a retinal angiography pioneer. He and his colleagues are credited with describing – and naming – idiopathic polypoidal choroidal vasculopathy. Yannuzzi has published extensively on retinal diseases, including diabetic retinopathy and AMD and has made many contributions to imaging, drug development, and therapeutic modalities. He was the first to use oral non-steroid anti-inflammatory medication for the treatment of cystoid macular edema, and went on to develop topical therapies for the disease. He also pioneered the use of ICG angiography for the management of retinal diseases, and wrote and published the bestselling book "Retina Atlas". He is recognized as a devoted and excellent educator, and a prolific organizer of retina meetings worldwide.

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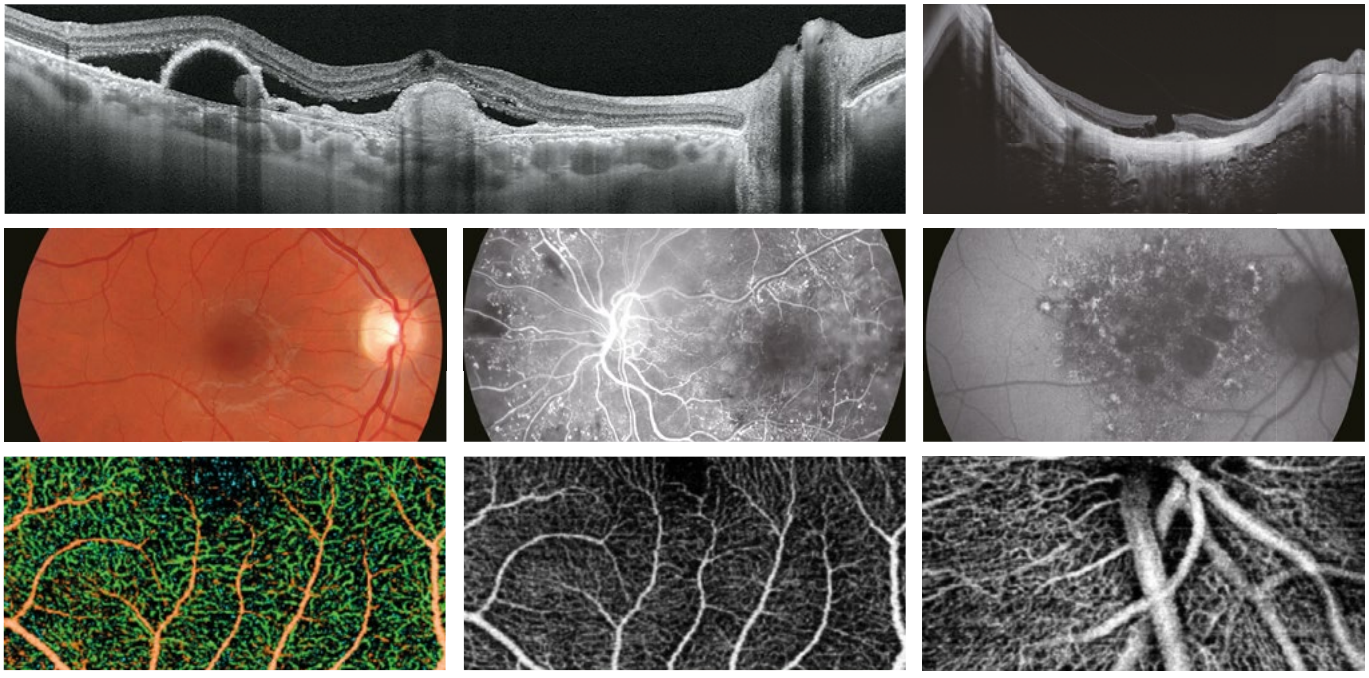

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Product Name: IKERVIS® 1 mg/mL eye drops, emulsion. **Composition:** One ml of emulsion contains 1 mg of ciclosporin and 0.05mg cetalkonium chloride as an excipient. Please refer to the Summary of Product Characteristics (SmPC) for a full list of excipients. **Indication:** Treatment of severe keratitis in adult patients with dry eye disease, which has not improved despite treatment with tear substitutes. **Dosage and administration:** IKERVIS® treatment must be initiated by an ophthalmologist or a healthcare professional qualified in ophthalmology. The recommended dose is one drop of IKERVIS® once daily to be applied to the affected eye(s) at bedtime. Response to treatment should be reassessed at least every 6 months. To reduce systemic absorption, advise patients to use nasolacrimal occlusion and to close the eyelids for 2 minutes after instillation. If more than one topical ophthalmic product is used, 15 minutes should separate their administration. IKERVIS should be administered last. **Contraindications:** Hypersensitivity to any of the ingredients. Active or suspected ocular or peri-ocular infection. **Warnings and Precautions:** Use with caution in patients with a history of ocular herpes . Contact lenses: Patients wearing contact lenses have not been studied. Monitor carefully inpatients with severe keratitis . Contact lenses should be removed before instillation of the eye drops at bedtime and may be reinserted at wake-up time. Concomitant therapy: Use with caution in patients with glaucoma, especially in those receiving concomitant beta-blockers which are known to decrease tear secretion. Immune system effects: Medicinal products which affect the immune system, including ciclosporin, may affect host defences against infections and malignancies. Contains cetalkonium chloride which may cause eye irritation. **Interactions with other medicinal products:** Coadministration with eye-drops containing corticosteroids may potentiate effects on the immune system. **Pregnancy and Breast Feeding:** Not recommended in women of childbearing potential not using effective contraception or during pregnancy unless the potential benefit to the mother outweighs the potential risk to the foetus. Benefits of treatment must be weighed against the benefits of breast feeding. **Driving and using machines:** Moderate influence on the ability to drive and use machines. If blurred vision occurs on instillation, the patient should be advised to not drive or use machines until their vision has cleared. **Undesirable Effects:** Consult SmPC for full details. The most common adverse reactions in clinical studies were eye pain, eye irritation, lacrimation, ocular hyperaemia and eyelid erythema. Patients receiving immunosuppressive therapies including ciclosporin, are at an increased risk of infections. **Special Precautions for Storage:** Do not freeze. After opening of the aluminium pouches, the single-dose containers should be kept in the pouches in order to protect from light and avoid evaporation. Discardany opened individual single-dose container with any remaining emulsion immediately after use. **Package quantities and basic NHS cost:** 30 x 0.3ml single-dose containers £72.00. **Product Licence Holder:** Santen Oy, Niittyhaankatu 20, 33720 Tampere, Finland (PL 16058/0012) (EU/1/15/990/001 & 002) **Date of Authorisation:** March 2015 **Legal Category:** POM **Date of last revision of Prescribing Information:** 07/07/2015 IKERVIS® is a registered trademark of Santen Pharmaceuticals Co., Ltd. Job code: STN 0617 IKV 00004b

Adverse events should be reported. Reporting forms and information can be found at www.mhra.gov.uk/yellowcard. Adverse events should also be reported to Santen UK Limited (Email medinfo@santen.co.uk or telephone: 0845 075 4863).

[1] Lallemand F et al. J Drug Deliv 2012: 604204 [2] SANSIKA study, Santen Data on File 0001
[3] SANSIKA study, Santen Data on File 0002

Date of preparation: September 2015 **Job code:** STN 0717 IKV 00019(eu)

13 Jerry Shields

Professor, Thomas Jefferson University; Co-Director, Wills Eye Hospital Ocular Oncology Service, Philadelphia, Pennsylvania

Shields established the Wills Eye Ocular Oncology service in 1974. He has published more than 800 articles, with his main interest being choroidal melanoma and retinoblastoma. He has pioneered the use of many new ocular anticancer therapies, and was instrumental in popularizing plaque radiotherapy for the treatment of choroidal melanoma. With his colleagues, he has improved the techniques of local irradiation, local surgical resection, laser photocoagulation, and thermotherapy. His research resulted in improvements in the diagnosis and treatment of many benign and malignant tumor types, such as tumors of the ciliary body epithelium, pigment epithelium, and leiomyomas. He has authored or co-authored more than 1,200 articles and textbook chapters, and has authored or co-authored 13 major textbooks related to ocular tumors. He continues to be a leader in eye cancer research, both nationally and internationally.

12 Hugh Taylor

Melbourne Laureate Professor at the University of Melbourne

Hugh Taylor has a long and distinguished clinical and research career. His primate model of trachoma provided seminal insights into the pathogenesis of the disease and how to control it, and his contributions to the field of preventive ophthalmology include other seminal works on the value of using ivermectin as chemotherapy for onchocerciasis. He also discovered the link between ultraviolet radiation exposure and cataract formation. Taylor has worked tirelessly on blindness prevention strategies in both developed and developing countries, and has served on several advisory committees and boards for that purpose. He has consulted for the World Health organization for over 30 years, and in 2001, was made a Companion in the Order of Australia "for his contributions to the prevention of river blindness, through research and education related to the prevention of eye disease and to eye health in indigenous communities." His current work focuses on Aboriginal eye health and the elimination of trachoma. He is a Board Member of the International Council of Ophthalmology and Vision 2020 Australia, and a member of the Academia Ophthalmologica Internationalis.

11 Gerrit Melles

Cornea Specialist/Director at Netherlands Institute for Innovative Ocular Surgery (NIIOS), Rotterdam

Melles is a legend of corneal surgery, pioneering and developing techniques for corneal tissue preparation and transplantation, such as DALK (Deep Anterior Lamellar Keratoplasty), DLEK (Deep Lamellar Endothelial Keratoplasty), DSEK/ DSAEK (Descemet Stripping (Automated) Endothelial Keratoplasty), DMEK (Descemet Membrane Endothelial Keratoplasty), DMET (Descemet Membrane Endothelial Transfer) and Bowman layer transplantation. According to a nominator, "He is the father of lamellar keratoplasty, especially DMEK, which is a milestone in ophthalmology." His objective is to treat corneal disorders with minimally invasive techniques. He has also developed several instruments and medical devices to facilitate these surgical procedures, as well as vital dyes (Vision Blue and Membrane Blue), and has invented a device, SurgiCube, that provides sterile air flow over a patient enabling certain procedures to be performed under sterile conditions, but outside of an operating theater. Melles has received several awards including the Barraquer Award in recognition of his contribution to ophthalmology.

10 Jorge Alió

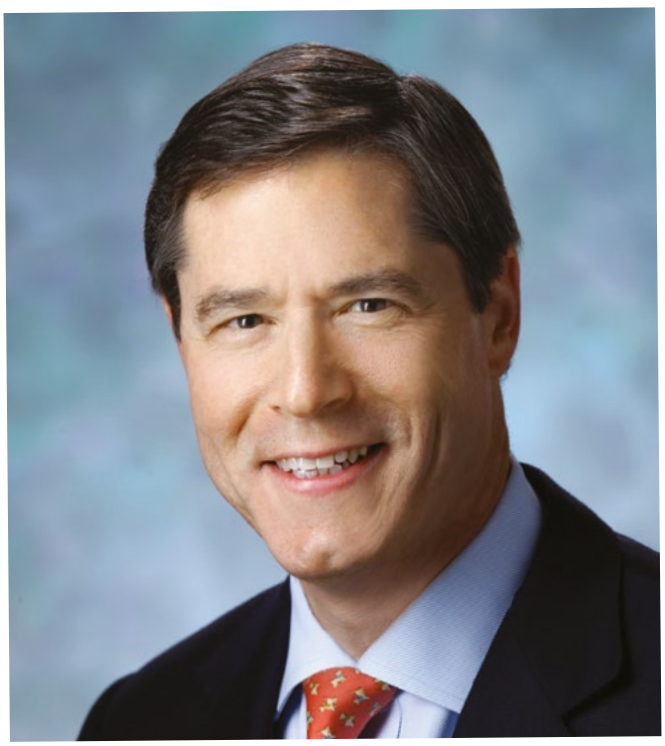
Professor and Chairman of Ophthalmology, University of Alicante, and Medical Director of Vissum Corporation

A leading authority in refractive surgery (although originally a vitreoretinal surgeon), Jorge Alió is at the forefront of much of the research in this field. He is the medical director of Vissum, Europe's largest eye institute and research facility, an ESCRS board member and co-founder (with his wife) of an eponymous foundation dedicated to blindness prevention both in Spain and internationally, including building an eye hospital in Mauritania. Alió has received many international awards for his clinical and research work in ocular neovascularization and inflammation, preventative ophthalmology, refractive surgery and anterior segment surgery. He ascribes much of his success to his mentors over the years – Steve Trokel, Dick Lindstrom, George Waring, among many greats – and notes that he's "the last disciple of Charlie Kelman". Alió also runs an art competition for Spanish artists whose work relates to vision, and the project is now being extended globally.

9 Neil Bressler

Chief of the Retina Division and the inaugural James P. Gills Professor of Ophthalmology, Wilmer Eye Institute, John Hopkins University School of Medicine, Baltimore, Maryland

Neil Bressler has contributed to major clinical trials of common retinal diseases, including age-related macular degeneration and diabetic retinopathy. He also has chaired the National Eye Institutes Data and Safety Monitoring Committee for intramural clinical trials and the FDA Ophthalmic Devices Panel, and is currently Editor-in-Chief of JAMA Ophthalmology. He previously chaired the U.S. Food and Drug Administration's Ophthalmic Devices Panel, and from 2006 to 2012, he chaired the National Institutes of Health's Diabetic Retinopathy Clinical Research Network (DRCR.net), where he was responsible for guidelines, policies, and protocol development and implementation – and many of the DRCR.net's trials, established under Bressler's leadership, have greatly influenced clinical practice today. It's not all work: we hear that Bressler's enthusiasm for live woodwind music (especially the clarinet) has led him to join the board of trustees for the Interlochen Center for the Arts, a boarding school and summer camp for children interested in the arts.



8 Carmen Puliafito

Dean, Keck School of Medicine, University of Southern California, Los Angeles, California

Carmen Puliafito is a co-inventor of one of the truly revolutionary technologies in ophthalmology: OCT, and was one of the 2012 Champalimaud Vision Award recipients for this great achievement. Further, he was the first to describe the use of semiconductor diode lasers for retinal photocoagulation, and the first surgeon to perform digital indocyanine green angiography. He's also an excimer laser pioneer, having been involved in some of the basic science research behind photoablation, optical breakdown and photodisruption. Puliafito also laid some of the ground work for LASIK, publishing one of the first peer-reviewed papers on ablation of the cornea. With two US patents and six published books, he continues to work to advance OCT technology. As a sports fan, he has completed the Boston Marathon; indeed, he has a sporting sense of humor: in 1999, after some bad calls against the Red Sox (baseball) team during the World Series, he offered free laser vision correction to any American League umpire who might need it.

7 Harry Quigley

A. Edward Maumenee Professor of Ophthalmology, Director, Glaucoma Center of Excellence, Wilmer Eye Institute, Johns Hopkins University, Baltimore, Maryland

Harry Quigley is a founding member of the American Glaucoma Society (serving as its first Secretary), and has been both the former CEO of ARVO and the Editor-in-Chief of IOVS. His glaucoma research has enabled ophthalmologists to diagnose glaucoma earlier, and he has developed both instruments and methods that have improved the identification of ocular tissue damaged by glaucoma. As a consultant to the World Health Organization, he participated in many pioneering studies of the epidemiology, morbidity and progression rate of glaucoma (and other eye diseases) in American, African, Asian and Hispanic populations. In the laboratory, he has demonstrated successful gene therapy approaches to protect retinal ganglion cells from experimental glaucoma, and has established non-human primate, rodent and murine glaucoma models which has immeasurably advanced research on this topic. His current research interests include gene and stem cell therapies for ophthalmic disease.

6 Alan Bird

Emeritus Professor and Consultant at the Institute of Ophthalmology at the Moorfields Eye Hospital, London

Best known for his work on retinitis pigmentosa and research into inherited retinal degeneration, Bird studied neurology and neurosurgery, but later turned to ophthalmology. While at the Institute of Ophthalmology, he worked with numerous fellows in a variety of multidisciplinary activities involving electrophysiology, specialized imaging, psychophysics, immunology, and pathology – which resulted in the development of new technologies to define the clinical characteristics of retinal disease. His studies have also correlated abnormal gene expression with metabolic dysfunction at the cellular level, which has led to a clearer understanding of retinal degenerative diseases, and has had significant implications for clinical management of these disorders, including better genetic counseling for patients and the development of new treatment approaches, including gene therapy. He has received many awards, including the Duke Elder, Doyne and Bowman medals and the Prix Chauvin, and the Helen Keller Prize for Vision Research. Bird has undertaken extensive international work: in Africa tackling river blindness, and in Jamaica, examining the retinal changes that occur in patients with sickle cell disease.

5 Peng Khaw

Professor of Glaucoma and Ocular Healing at the UCL Institute of Ophthalmology, London; Fight for Sight Ambassador, and Director of the NIHR Moorfields BRC.

Peng Khaw is one of the most prominent glaucoma surgeons in the world, having pioneered numerous treatments, surgical techniques and anti-scarring regimens that are now used around the world. His team's work led to the introduction of intraoperative antimetabolites, and he introduced the Moorfields Safer Surgery System, something that's dramatically reduced bleb-related complications. He has continued to refine surgical techniques; his introduction of new approaches – such as adjustable sutures of scleral flaps following trabeculectomy – has helped many glaucoma specialists safely titrate IOP reductions after surgery. He and his team are at the forefront of investigations into the metabolic aspects of glaucoma, the understanding of which is already beginning to explain the symptoms patients with glaucoma report, and is hoped will help identify new therapeutic avenues for the treatment of this pernicious, vision-robbing disease.

Khaw was involved in raising £100 million to fund not only research work, but the building of new clinical and research space, including the Moorfields' International Children's Eye Centre, and a translational research clinical center to "fast track" new glaucoma therapies. Khaw was knighted in the 2013 Queen's Birthday Honors list for services to ophthalmology, one of only two ophthalmologists to receive this honor in the last century.

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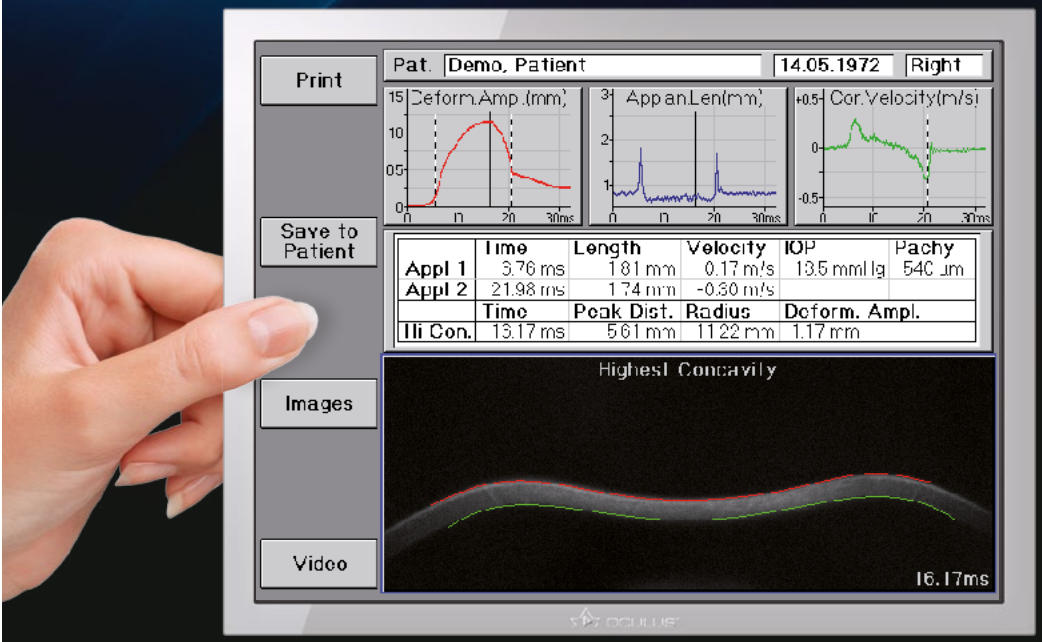
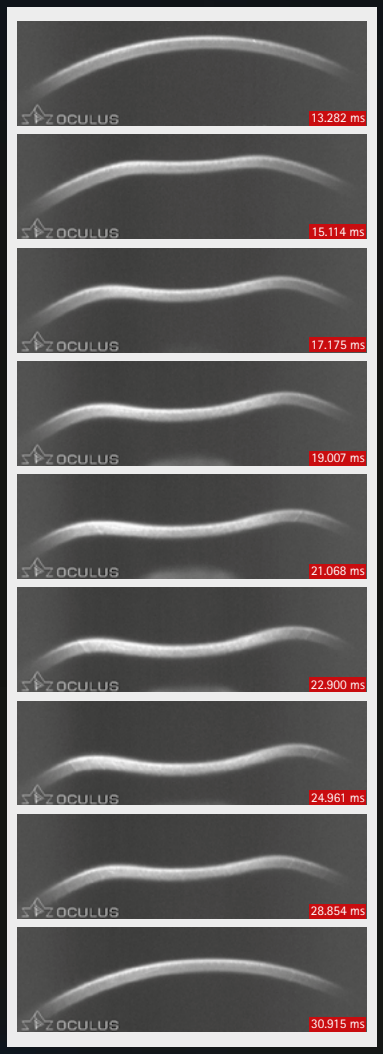
Corneal response due to an air pulse, captured in high speed





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4

David Huang

Weeks Professor of Ophthalmic Research, Professor of Ophthalmology and Biomedical Engineering, Oregon Health & Science University, Portland, Oregon

Co-inventor of optical coherence tomography and first author of the seminal article on the topic, which has been cited more than 3,300 times, David Huang has received many honors, including the AAO's Achievement Award, ARVO's Friedenwald Award, and was one of the 2012 Champalimaud Vision Award recipients. Since its invention, OCT has proven to be both a revolutionary and versatile diagnostic technique, and Huang continues to explore new applications for the technology – including OCT angiography, and better biometry and imaging of both the anterior and posterior segments of the eye.

His other interests include refractive surgery and laser technologies, and his background in both ophthalmology and engineering has given him an understanding of laser surgery from both a clinical and an engineering perspective. He has patented many inventions, and his current research interests include improving the safety of corneal laser surgery, developing new laser surgery options for patients with corneal disease, and a smartphone app-based amblyopia screening method, GoCheckKids.

3

Carol Shields

Co-Director of the Oncology Service, Wills Eye Hospital, and Professor of Ophthalmology at Thomas Jefferson University in Philadelphia, Pennsylvania

With her husband Jerry (qv) and their associates, Shields runs Wills Eye Hospital's Oncology Service that, every year, manages over half of all the eye cancer cases in the USA and many more from around the world. These often complex cases include but are not limited to uveal melanoma, retinoblastoma and numerous other intraocular, orbital and adnexal tumors. Carol and Jerry are pioneers in the field of eye cancer – having written the key textbooks used worldwide and created the number one method and acronym for diagnosing eye tumors. In 2011, Shields was the recipient of the AAO's Life Achievement Honor Award, and has received many others, including the Donders Medal from the Netherlands Ophthalmological Society. A prominent student-athlete in her undergraduate days, she was inducted into the Academic All-American Hall of Fame in 2011 for her athletic and professional success. She has authored or co-authored nine textbooks, over 1,000 articles, nearly 300 textbook chapters, and given almost 600 lectureships. On being the 2014 Paul A. Chandler Visiting Professor at Harvard Medical School's Department of Ophthalmology, the Bostonians lauded her "expertise in ocular oncology that spans a range of specialties, including oculoplastics, retina, and cornea."

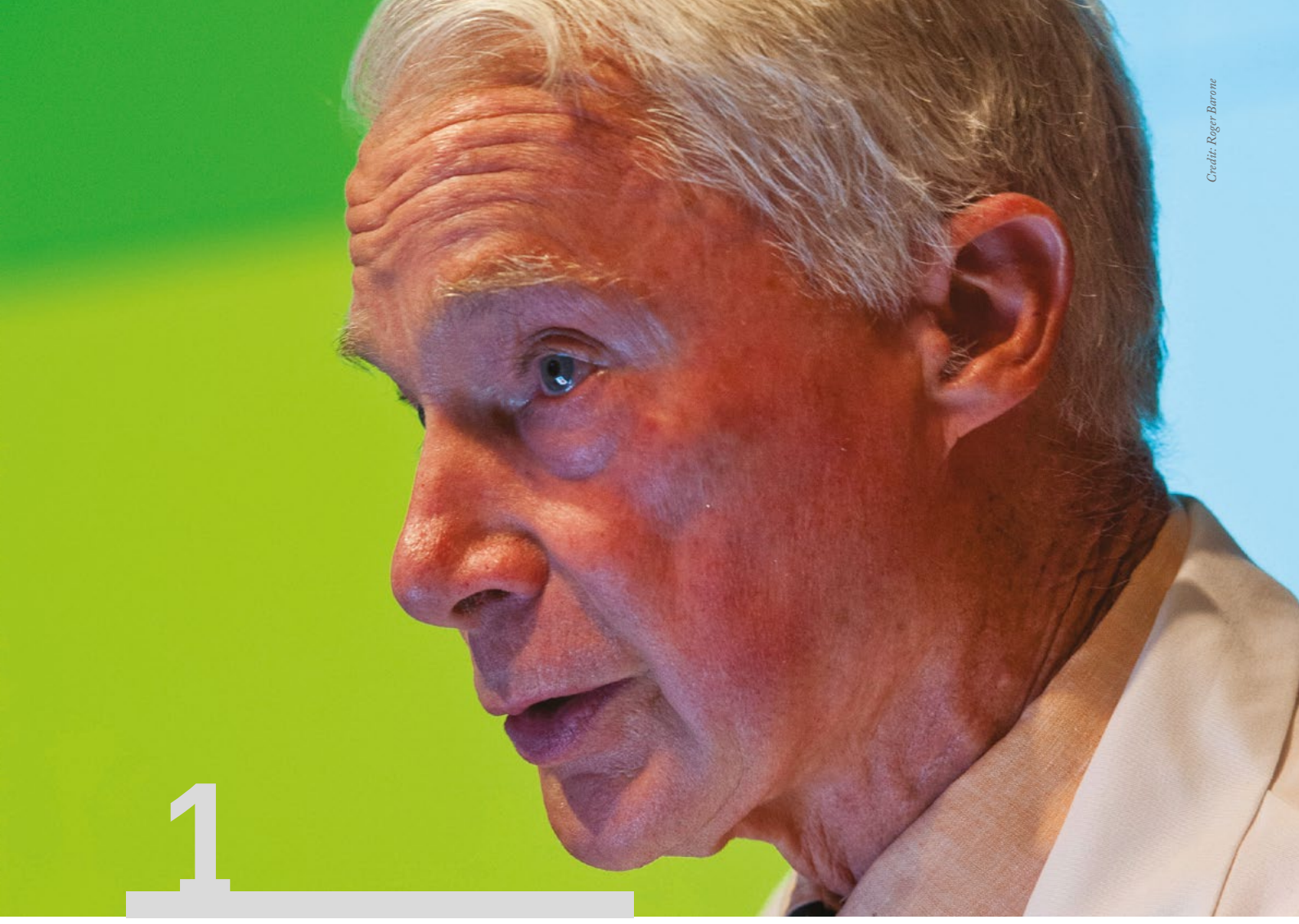
2

Amar Agarwal

Chairman, Dr. Agarwal's Group of Eye Hospitals, Chennai

Amar Agarwal is a pioneer of microincisional cataract surgery. He was first to remove cataracts through a 0.7 mm tip; first to develop no-anesthesia cataract surgery; first to implant a glued IOL; first to implant a mirror telescopic IOL in AMD, and first to use Trypan blue as an epiretinal membrane stain. He coined the term "aberropia" to describe uncompensated HOA profiles following refractive surgery, and produced a modified Malyugin ring for miotic pupil cataract surgeries with posterior capsular defects. Most recently, he and Harminder Dua (qv) pioneered Pre-Descemet's Endothelial Keratoplasty, which allows for the use of younger corneal donors than previous techniques, greatly increasing the donor tissue pool. He's also chairman of Dr. Agarwal's Eye Hospital group – a major chain of eye hospitals, headquartered in Chennai, with more than 40 other branches across India, and a further 12 overseas.

His passion is surgery: his surgical videos have won numerous awards at the ASCRS, AAO and ESCRS film festivals, and he has written more than 50 books, many of which have been published in multiple languages. He has received the Casebeer, Barraquer and Kelman Awards, among many. Agarwal also organizes the popular Ophthalmic Premier League sessions during AAO, IIRSI, AIOC, and WOC.



Credit: Roger Barone

1

George Spaeth

Louis J. Esposito Research Professor, and Director Emeritus, Glaucoma Service, Wills Eye Hospital, Philadelphia, Pennsylvania

George Spaeth discovered the disease homocystinuria as a resident at Wills Eye Hospital, and published much of the early work on the condition, including the use of pyridoxine as a successful treatment. He developed methods of describing the anterior chamber angle, the optic nerve head (The Disc Damage Likelihood Score), and detecting visual loss (SPARCS), that are clinically more useful than other systems.

With over 420 published articles, over 100 book chapters, 200 editorials and 18 books, his surgical texts are used in many countries around the world. A founding member and first president of the American Glaucoma Society, he was also a founder of the Glaucoma Service Foundation to Prevent Blindness, and served as chair of the Ethics Committee of the American Academy of Ophthalmology.

Spaeth has presented over 30 named lectureships, which he uses as an opportunity to present his views on the importance of individualizing patient-driven care and helping patients celebrate their lives. A busy practitioner, teacher and investigator, he has been recognized by awards from Greece, Poland, France, and the UK, including the Weisenfeld Medal from ARVO, and the Albert Schweitzer Leadership Award (something that he has in common with Ronald Reagan, George H.W. Bush, Madeline Albright, Hillary Clinton and Mikhail Gorbachev, to name but a few).

Outside of his work, Spaeth is an emeritus member of the Board of Directors of the Pennsylvania Ballet and the Philadelphia Bach Festival, and enjoys being with his family and loved ones, being creative (playing the piano or organ, gardening, writing, composing music, flower arranging, cooking) and celebrating the gift of life.

A nominator said...

"An inventor, entrepreneur, and great mentor in the field of glaucoma."

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*Post hoc analysis of postoperative UCVA compared to preoperative BSCVA of 230 eyes contained in the FDA T-CAT pivotal trial at 12 months. The primary end point evaluated changes in BSCVA.
1. Results from FDA T-CAT-001 clinical study for Topography-Guided vision correction (with the 400 Hz ALLEGRETTO WAVE® Eye-Q Excimer Laser).

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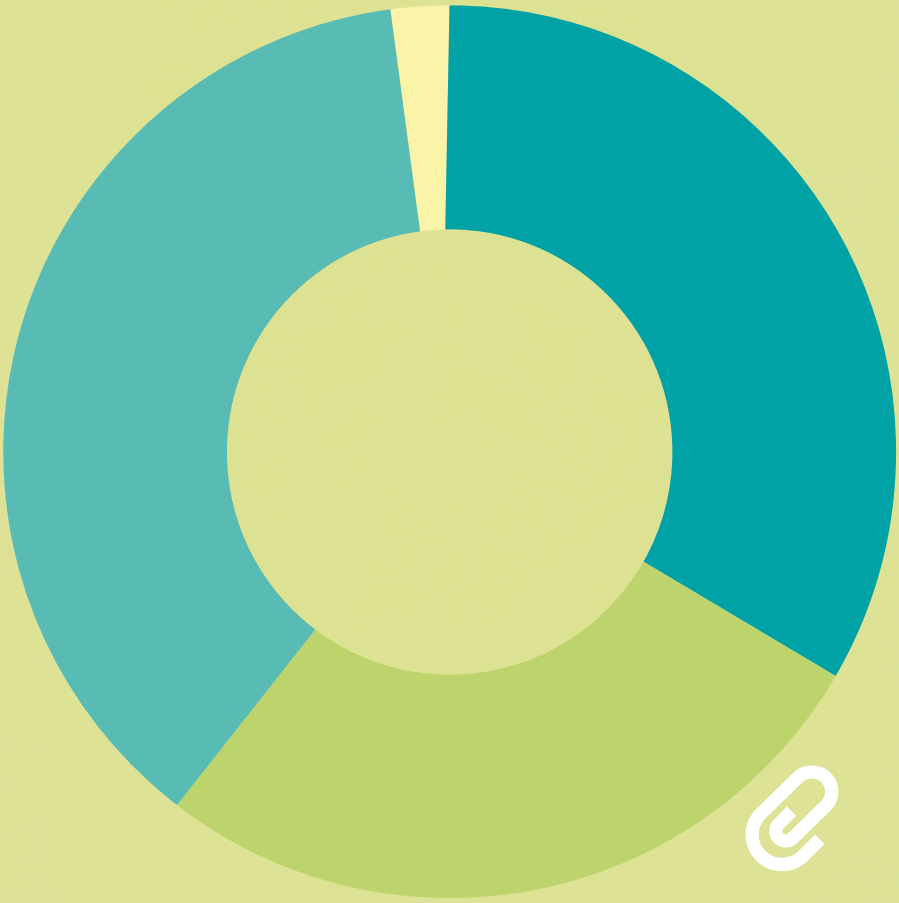


Benchmarking Your Practice

How does your practice compare with others around the EU?

By David Harmon, Tony Ingenito

In July 2015, The Ophthalmologist partnered with Market Scope to provide ophthalmologists in Europe with an opportunity to benchmark their practices against their peers, asking questions like: Which drugs do you prefer to use, how do you run your practice, what techniques do you plan to adopt, and what IOLs do you offer?

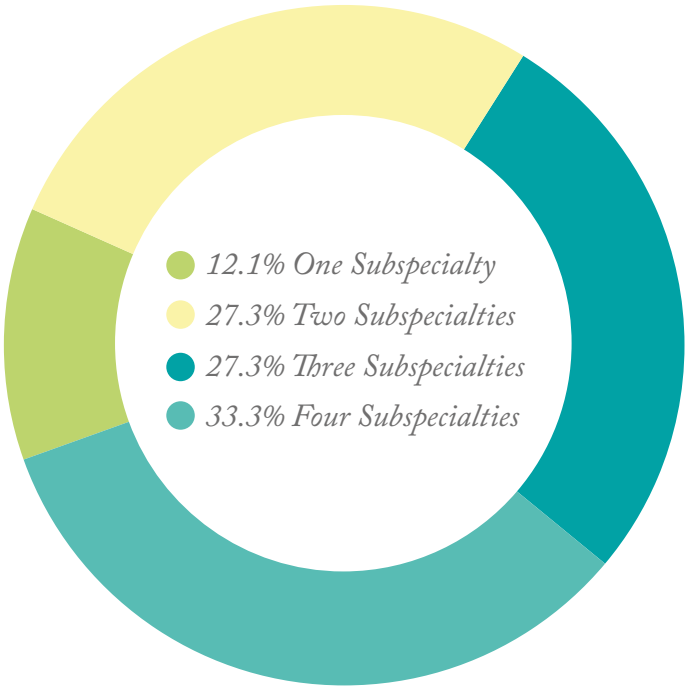
The first quarterly European Ophthalmologist Survey went live on September 1, 2015, and ran to December 31, 2015. Invitations were extended to all subscribers to The Ophthalmologist, and European members of Practice-Scope, Market Scope's online data portal. The survey questions focused on surgical volumes, techniques, new technology adoption and the latest trends with drug therapies.

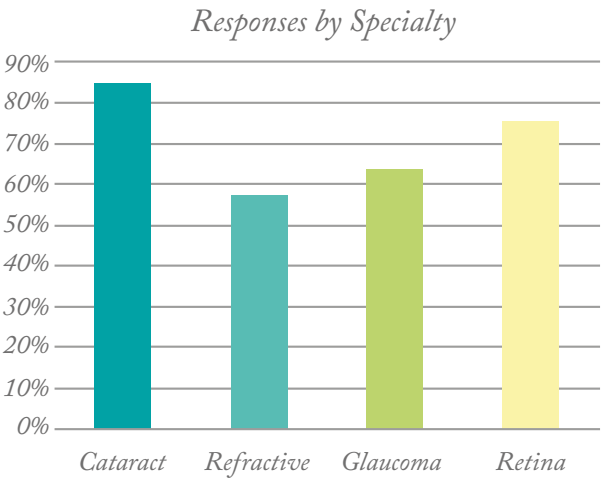
Ophthalmologists from over 20 countries got involved, and their practices are represented in this analysis. All participants are from confirmed ophthalmic practices, and all individuals' responses were de-identified.

The data below provides some interesting insight into the variation in ophthalmic practices across the EU, and the full report is available free to subscribers to The Ophthalmologist, and ophthalmologists who take part in the survey. The full analysis is available online at: top.txp.to/0416/benchmark-practice, where you are also able to participate in the next survey.

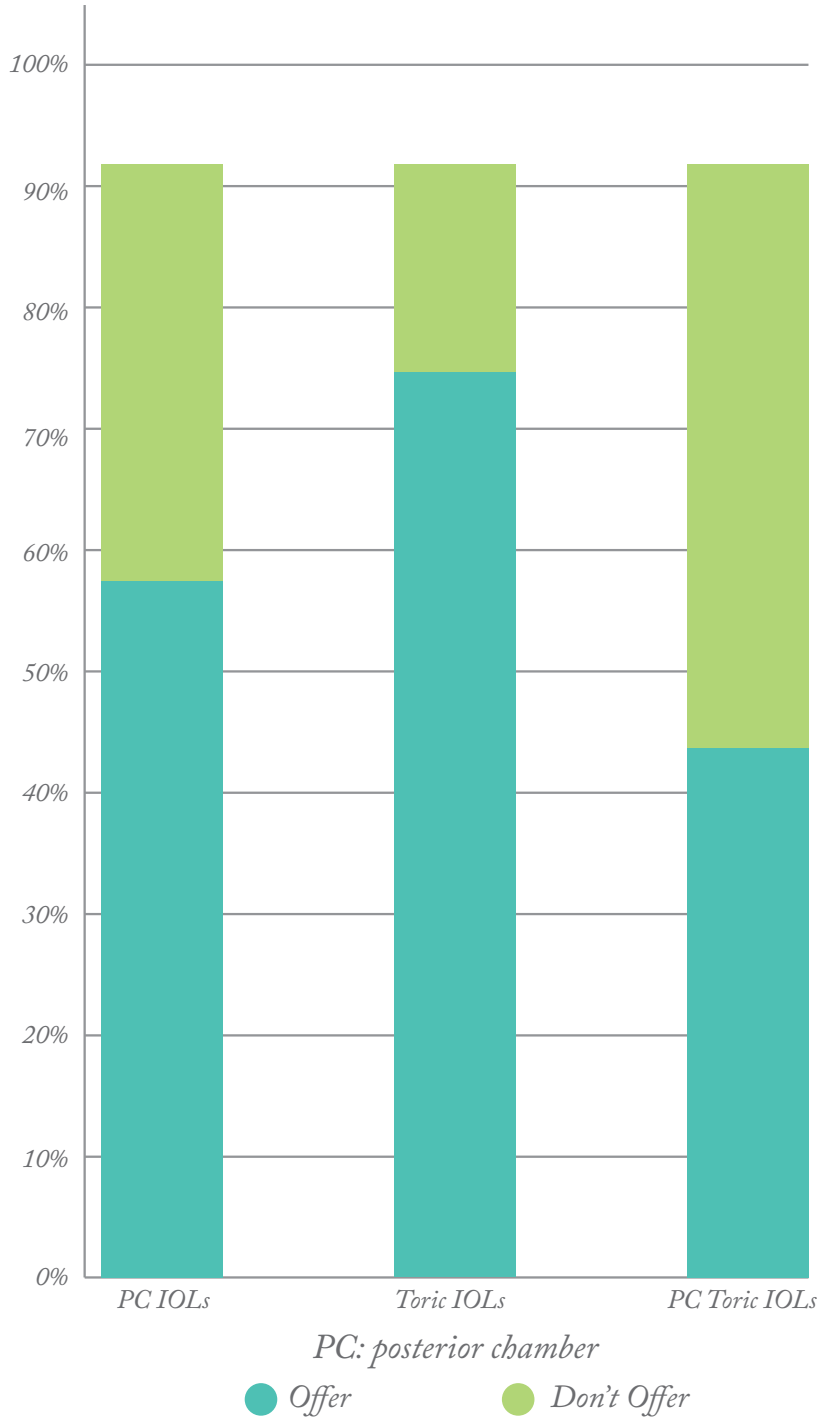
David Harmon is the Principal of Market Scope. He has more than 25 years of experience in the ophthalmic industry, and has written and published newsletters and market insight reports on the refractive surgery industry since 1996. Tony Ingenito is the Manager of Professional Services at Market Scope, and has worked in the field of eye heath since 2002.

Specialties of respondents





Premium IOLs offered



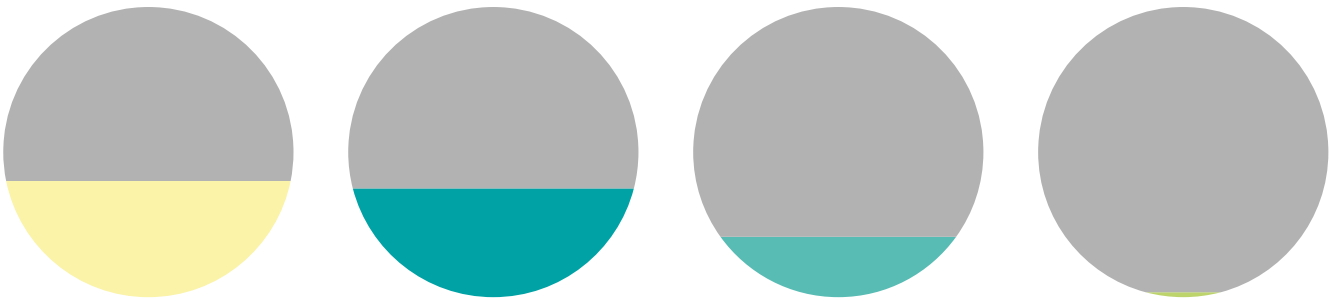
Respondents with plans to offer small incision lenticule extraction (SMILE) refractive surgery

- 46% *Waiting for more information*
- 27% *Offer today*
- 20% *No plans to offer*
- 7% *Plan to offer in the next 12 months*

Respondents' anti-VEGF use

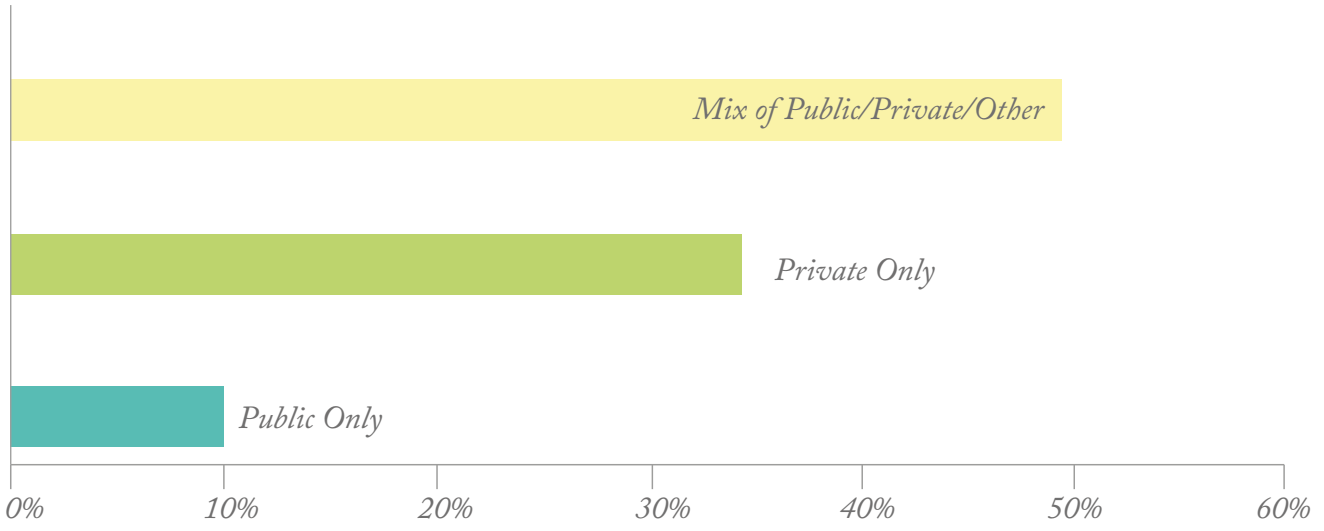
- 38% *Bevacizumab*
- 33% *Ranibizumab*
- 27% *Aflibercept*
- 2% *Other*

Posterior chamber IOLs offered (by optical properties)

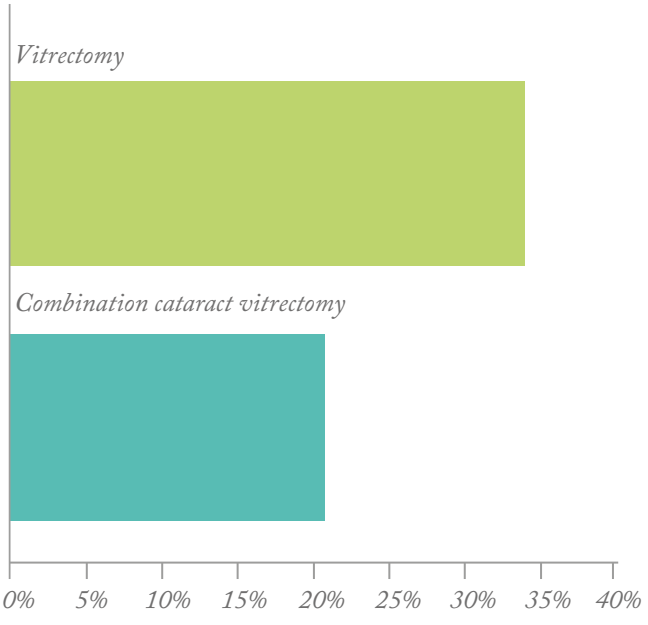


- 40.2% *Multifocal*
- 37.4% *Trifocal*
- 20.8% *Bifocal*
- 1.7% *Accommodating*

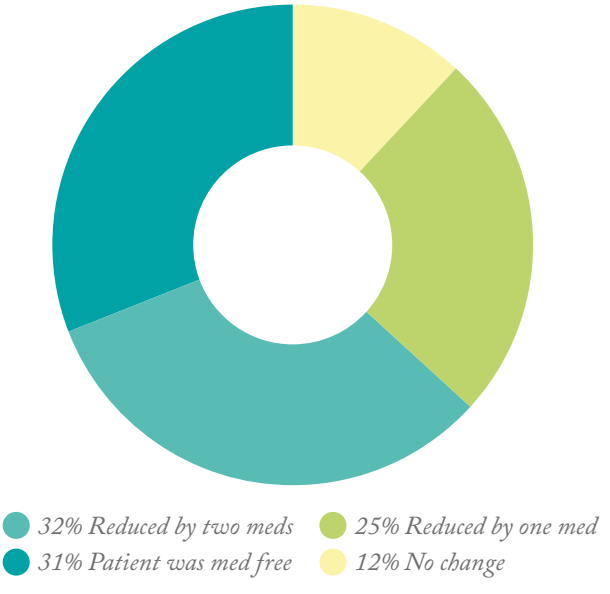
Respondents' practice type



Proportion of respondents offering retina surgical procedures



Effect of microinvasive glaucoma surgery (MIGS) on medication reduction



A League of His Own

Sitting Down With... Amar Agarwal, Chairman and Managing Director, Dr Agarwal's Eye Hospital and Eye Research Centre, Chennai, India.

Ophthalmology runs in your family…

Dr. Agarwal's Eye Hospital was founded by my parents in 1957. They started out with just two dollars, and performed their first surgery inside a patient's house. My father had a dream of building his hospital in the shape of an eye, and that's what happened – it's even been featured on Ripley's Believe it or Not. The upper lid is the porch, you enter through the pupil, and the ramp is the optic nerve.

In 2006, I told my parents I wanted to start expanding the hospital. At the time, we were seeing 100 to 200 patients a day. Since then, we've built 60 hospitals, with 14 in Africa and one in Cambodia. We see around 10,000 patients in a single day. By 2020 our goal is to have around 200 hospitals – we have a lot of plans to expand.

You're a surgeon with a heavy case load – how do you find time for hospital expansion?

I spend my days at the operating table. My four sons are all ophthalmologists, and two of them also have MBAs. So two of them look after the business and expansion plans, and two are with me in the hospital. And that's not to mention the rest of our group – we have over 3,000 people working with us now.

What achievements are you most proud of?

I'm happy to have been able to contribute to surgical techniques in my field, especially my work on pre-Descemet's endothelial keratoplasty (PDEK). In 2013 I met with Harminder Dua (who is a genius), and heard his lecture on his discovery of the pre-Descemet layer. We began a collaboration to work on keratoplasty that includes the Descemet membrane and the pre-Descemet's layer, which makes harvesting and handling easier.

There are three main types of endothelial keratoplasty surgeries. First we have DSAEK, and here you're taking a 100 or 200 µm graft. But when I remove the endothelium in the eye I'm operating on, that's only removing 15 µm – I'm making the cornea thick. With DMEK, I'm taking out 15 µm and putting back 15 µm, which is better. But in DMEK, Descemet's membrane sticks to the stroma until the age of 40 or 50 years. This means if you want to perform DMEK, you want a donor around the age of 50. With PDEK, we can use donors as young as 9 months old. I've also been using glued IOLs in combination with PDEK in extreme cases (such as eyes with trauma, or weak zonules).

What's the benefit of glued IOLs?

People often ask why I don't do a sutured or anterior chamber IOL when endocapsular placement isn't possible. My response? Break a camera lens, then suture the lens back on – you cannot take a photograph. When a patient has a sutured lens, even when it is two point fixation, or four point fixation, it's like a hammock, it has to move. A glued lens doesn't.

We've all got smartphones these days, and there's a free app called SloMo, which can slow videos you take down to 25 frames per second. Take a sutured IOL, put it on the slit lamp, and take a video with SloMo. You will see the lens move. But with a glued IOL, it won't.

What else are you working on?

Right now I'm still working on PDEK – but with this technique I've observed badly scarred, white corneas become clear. To my mind, the explanation for this could be stem cells from the young donor corneas – but I have to prove it!

Your Ophthalmic Premier League has been a big hit – what was the inspiration?

Over here in India, we have the Indian Premier League – IPL cricket. I always hold a conference in July in Chennai, the annual conference of the Indian Intraocular Implant Society. One day I thought, "Why don't we hold an Ophthalmic Premier League?" I thought about the format, and decided on four teams with four players each. I held it once at the ESCRS summer congress, and the World Ophthalmology Congress, and it was a success, so I approached the American Academy to ask if I could hold it there – we've run it at AAO's annual congress for the past two years, and will do it again in Chicago this year. David Chang will also be holding the similar-in-concept Cataract Olympics this year at the ASCRS meeting, which is great, as it introduces more people to the format.

"Take a sutured IOL, put it on the slit lamp, and take a video with SloMo. You will see the lens move. But with a glued IOL, it won't."

Why do you think it's been so well received?

I'm really happy everyone enjoys it. You have 16 of the top surgeons in the world, showcasing their craziest cases and how they handled them, with four minutes per person. It's a great learning opportunity. Then you add some entertainment value – we go to each team and say "We want you to attack the other teams!" which makes it funny, too, as you get to watch them compete.

I think what makes it so great is this mix of fun and education – it makes people laugh and it's really different to the normal lectures, but it contains a lot of educational scientific content too.