

the Ophthalmologist

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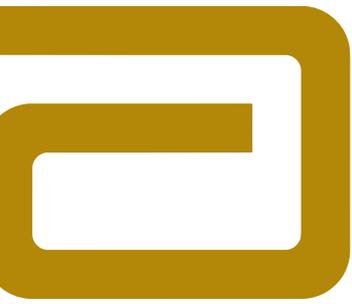
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A Brief History of MIGS

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Online this Month



Last Month's Top Tweets @OphthoMag

Preserving #photoreceptor cells following #retinalinjury:
<http://ow.ly/Q1GAf>
5:30 PM - 25 Jul 2015

Researchers pinpoint where the brain unites our eyes' double vision:
<http://ow.ly/Q1zNu>
1:15 PM - 24 Jul 2015

New eye drops dissolve the deposits that cause cloudy vision:
<http://ow.ly/PZmCd>
3:44 PM - 23 Jul 2015

Meet Ray Flynn: dry AMD patient, Argus II recipient, and the world's first person with natural and artificial vision.
6:00 PM - 22 Jul 2015



What's got you talking? www.theophthalmologist.com

Five Things We Learned This Month:
<http://bit.ly/1Ipr8iY>

Stop teaching and advocating CW laser within the macula
CW laser has been used for more than 35 years without the understanding of the harm it creates by "focal photocoagulation", a completely misunderstood application, because of the use of visual acuity to measure outcomes. Burning the retina in an attempt to control retinal or choroidal vascular leakage within 1 DD of the fovea produces unacceptable paraxial scotomata that impair vision within 3-5 degrees of fixation which expand over time and impair visual task function. Macular laser should be performed only with micropulse technology that results in no physical burns but controls leakage with equal success.
- Stephen Sinclair, USA



Stop advocating "micropulse" laser without proper comparison with CW laser!

Compare the effect of "micropulse" laser to the effect of CW laser of the same power and duration. For example, "micropulse" burst of 800 mW, 10% duty cycle and 100 ms duration should be compared to CW laser of 80 mW and 100 ms duration. As we have shown (*Retina*, 32(2): 375-386 (2012)), the average temperature and Arrhenius integral in these two cases are very similar. Until this comparison is performed clinically, the claim of the benefits of the micropulse laser is just a marketing gimmick!

What is really important is to treat the macula below the tissue damage threshold. This can be done well with properly titrated CW laser. See for example: *Retina*. 35(2):213-22 (2015).
- Daniel Palanker, USA

Ike Ahmed's MIGS Surgery Videos

In this issue, Ike Ahmed discusses the development of microinvasive glaucoma surgery (MIGS) and the part he played in the field (including coining the term MIGS). Read the full article on page 18, and go to top.txp.to/0715/MIGS to view Ike's videos of the Cypass, Hydrus, and Xen45 microstents, and how he implants three iStents into one eye.





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A nod to Peter G. Peterson's "I Like Ike" artwork, with a dash of Canada added into the mix.

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1. AcrySof® IQ PanOptix™ IOL Directions for Use. 2. PanOptix™ Diffractive Optical Design. Alcon internal technical report: TDOC-0018723. Effective date 19 Dec 2014. 3. Charness N, Dijkstra K, Jastrzembski T, et al. Monitor viewing distance for younger and older workers. Proceedings of the Human Factors and Ergonomics Society 52nd Annual Meeting, 2008. http://www.academia.edu/477435/Monitor_Viewing_Distance_for_Younger_and_Older_Workers. Accessed April 9, 2015. 4. Average of American OSHA, Canadian OSHA and American Optometric Association Recommendations for Computer Monitor Distances.

The Closest Thing to The Six Million Dollar Man

*But he still doesn't have a "bionic eye",
no matter what the newspapers tell you.*

Editorial



July 21st (my birthday) saw the world's press assemble at the Manchester Royal Infirmary to be told that, for the first time, a patient with dry AMD – Ray Flynn – had received a retinal prosthesis. Implanted by a team of surgeons led by the tremendously gifted Paulo Stanga, the world learned from both men the outcome of the procedure: success. Ray received some degree of central vision from the implant, augmenting the remains of peripheral vision. Happily, this had already led to small, but functional improvements in his vision.

I have two confessions to make. The first: the realization that Ray was the first person in the world to combine artificial and (the remains of his) natural vision sparked a bit of excitement in me – above and beyond the fact that this implant made Ray a Cyborg. My PhD was in developmental neuroscience, where I examined the plasticity of the somatosensory system, so it was fun pondering how Ray's 80-year old brain might adapt to the new input to the visual system.

The second confession: I wasn't able to make it. My colleague Michael had the pleasure of meeting not only Ray and Paulo, but also journalists from Associated Press, the BBC, and most of the UK's national newspapers. He came back with plenty of copy, photos, figures and gossip. Superb.

It was interesting to see how the non-specialist media reported on a story that concerned ophthalmology. Like all of the other major media outlets present, we had prepared copy to go live when the news embargo was lifted on July 22nd, initially via the 140 character-or-less medium of Twitter. Some of our proposed tweets used the words "bionic eye". Clearly, my birthday had made me an older and grumpier pedant than before. I immediately vetoed the use of that phrase: eyes are more than just a retina. Further, Googling around to justify my decision, I found: "Bionic implants differ from mere prostheses by mimicking the original function very closely, or even surpassing it." Groundbreaking as they are, no retinal prosthesis can offer that today – or likely ever will.

So how did the lay press do? Very well. Some reported the science. Others went for the human angle, with most combining both perspectives. The vast majority failed to mention that many patients blinded by retinitis pigmentosa have already successfully received retinal implants. Almost all of the headlines missed these subtleties. But all – literally all – used "bionic eye".

"Bionic eye implant world first" (BBC News). "British man given world's first bionic eye" (The Guardian). "Bionic eye helps man see in first transplant of its kind (even with his eyes shut)" (The Independent). I could go on. What did I learn? You can't win them all.

Mark Hillen
Editor



Ike Ahmed

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 new generation of surgical approaches and devices. Based in Ontario, Ike is chief of ophthalmology at Trillium Health Partners, Mississauga, Ontario, Canada. Ike tells of his mission to retire trabeculectomy with MIGS on page 18.



Florian Kretz

One of The Ophthalmologist’s Top 40 under 40’s cadre, Florian is a lead surgeon at the Eyeclinic Ahaus-Raefeld-Rheine, Ahaus Germany, as well as a consultant ophthalmologist and research fellow at the International Vision Correction Research Centre Network and David J. Apple International Laboratory for Ocular Pathology at the Department of Ophthalmology, University Hospital Heidelberg. When not in the clinic, lab, office, or on the autobahn, Florian enjoys spending time with his wife and young family.

On page 30, Florian and his co-authors explain that to satisfy patients receiving premium IOLs, you have to ask the right questions – and this includes ones on intermediate vision requirements...



Ray Radford

An honorary senior lecturer at the University of Manchester, UK, and a founder member of the British Oculoplastic Surgery Society, Ray is a consultant ophthalmic and oculoplastic surgeon at multiple practices in the UK. An experienced cataract and eyelid surgeon, he has also lectured and trained nationally in the field of glaucoma. His research interests include deep sclerectomy, and outside of the clinic, Ray appreciates fine art, cuisine, sailing and rugby.

On page 34, Ray poses the question – if monovision gives patients great visual outcomes, why isn’t it more important with surgeons?



Daya Sharma

Daya Sharma is a corneal, cataract and refractive surgeon, co-owner of the Eye & Laser Surgeons practice in Bondi Junction, Sydney, Australia, and founding member of the American-European Congress of Ophthalmic Surgery. An established author in both journals and magazines, Daya is also a prolific tweeter and prominent proponent of social media use. Follow him on Twitter at @DrDayaSharma.

Daya’s top tips for using social media platforms to interact, educate and promote your practice can be found on page 56.

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Eyedrops to End Cataract Surgery?

The story behind the headlines heralding eyedrops that can “dissolve cataracts”

Cataracts present a massive and worsening healthcare and societal problem. Of the 39 billion people today who are blind, half have lost their vision because of cataracts, with the burden disproportionately affecting developing countries (1). As the demographic bulge that is the baby boomer generation ages, things are only going to get worse. Over the next two decades, the demand for cataract surgery (already the world's most frequently performed surgical procedure) is set to double. It has been estimated that delaying the onset of cataract formation by a decade would halve the demand for cataract surgery (2,3) – but that's easier said than done.

Part of the problem is that, for lens fiber cells to be transparent, they have to consist almost entirely of highly ordered crystallin proteins. To achieve that, as the cells develop, they degrade their

organelles, minimize extracellular space, and change the density of their cell membranes to levels approaching that of the cell's cytoplasm – all in the name of reducing light scattering (4). This makes for fantastically transparent cells, but ones that lack the synthetic apparatus to produce new proteins. So what does this mean? Crystallin proteins, unlike others, age: they are not turned over and are some of the oldest in the body, and disruptions to the highly ordered crystallins over time leads to crystallin aggregation, opacity... and cataract.

Kang Zhang is both a physician and a genetics researcher, so when two young children with cataracts walked into his clinic, he was able to do something most physicians couldn't – sequence their genomes (5). When he did, he found mutations in the gene that encodes lanosterol synthase (LSS). Since little was known about the role of lanosterol (Figure 1) in the eye, he and his team performed tissue culture experiments in a number of cell lines that expressed “six known cataract-causing mutant crystallin proteins” – which resulted in collections of misfolded proteins called aggregates. The application of lanosterol (or the co-expression of wild-type LSS) went a long way to dissolving the protein aggregates and rescuing the

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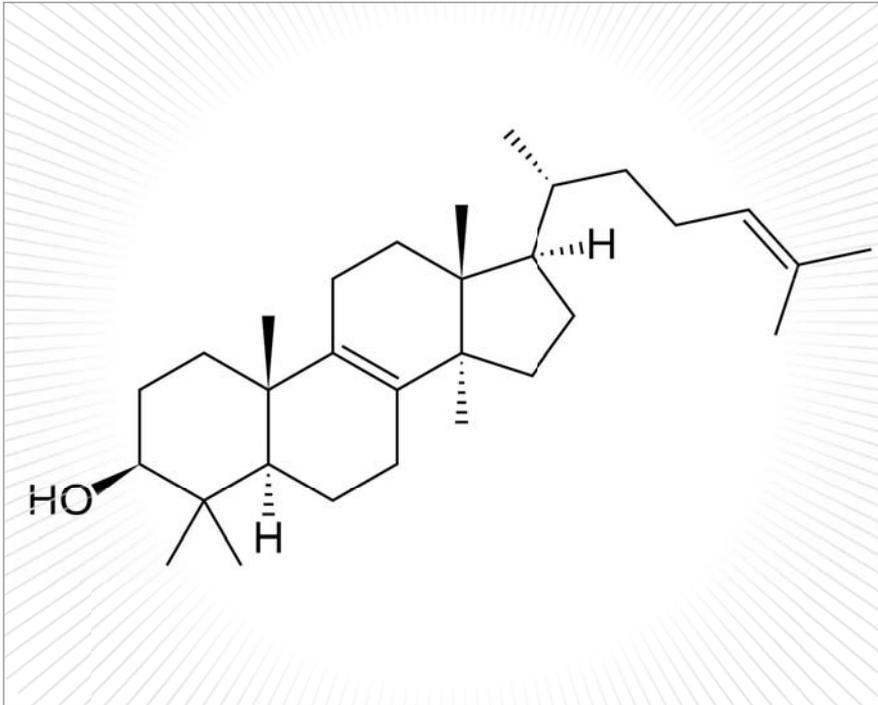


Figure 1. Lanosterol, the steroid that Zhao et al. (5) claim can dissolve the crystallin aggregates that can cloud the crystalline lens.

phenotype. Further, isolated cataractous rabbit lenses significantly increased in clarity following incubation with lanosterol over a six-day period. But cell culture and *in vitro* experiments are one thing; activity *in vivo* is another, so the team decided to see if they could use lanosterol to treat dogs with age-related cataract. An initial 100 µg dose of a nanoparticle formulation of lanosterol was injected into the vitreous cavity, followed by the administration of one 50 µl drop of lanosterol every three days over a six-week period. All seven lanosterol-treated dogs exhibited decreased cataract density relative to both baseline levels and the vehicle-only treated fellow eyes.

So how long will we have to wait until patients' cataracts are cured with eyedrops? Zhang thinks not very long, telling *Nature* that, "since lanosterol is a molecule produced by our own body, the toxicity issue of such a drug is minimal,"

and that, "I think we will go forward to commencing a clinical trial in humans within the next year" (6). *MS/MH*

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The Argus II: Thirty Patients with RP, Three Years Later

What does the data say about the safety and efficacy of the retinal prosthesis?

The Functional Low-vision Observer Rated Assessment (FLORA) ratings

- Subjective (patient) and objective (independent assessor) assessment of the real-world benefit of the Argus II implant
- Ratings:



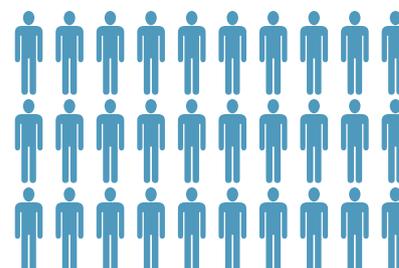
Reference

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3 years of follow-up



30 patients



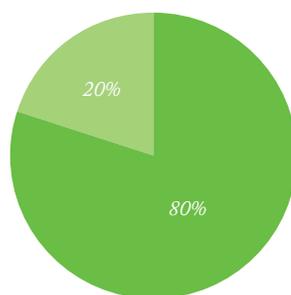
Geographical location of patients and treatment centers



Incidence of serious adverse events

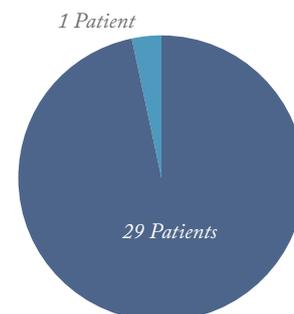


Impact on patients' daily lives after three years



- No quality of life/functional vision benefits
- Quality of life/functional vision benefits

How many patients still have the implant?



- Implant removed
- Implant in place

Minimally Invasive, Maximally Successful

An updated surgical technique restores sensation to patients with corneal anesthesia

Corneal anesthesia is a debilitating condition in which the function of the ophthalmic division of the trigeminal nerve is impaired and the brain receives little or no pain sensation from the cornea. This loss of sensation, which may be congenital or secondary to a variety of causes, means that, over time, minor corneal injuries add up to significant ulceration, scarring, and ultimately blindness. Not only that, but corneal sensation is critical for limbal stem cell function, so its absence impairs repair of the corneal epithelium. Most treatment options – artificial tears, corneal or scleral contact lenses, and in more severe cases, tarsorrhaphy and keratoplasty – can help, but all fail to address the underlying problem.

All is not completely lost, though. There is a type of surgery that can address the root cause (1): corneal neurotization with locally available donor nerves (typically the supraorbital and supratrochlear nerves). But this has historically been a rather invasive approach – initial procedures took 10 hours to perform and required an incision from ear to ear across the forehead, extensive dissection, and the denervation of the contralateral forehead and scalp. But now, a team of Toronto-based surgeons have refined the procedure into a minimally invasive approach that uses a sural nerve graft from the leg (2,3). The new operation requires only a small upper lid incision to access the supratrochlear nerve for neurotization and the creation

of a subcutaneous tunnel along the nasal bridge to connect the supratrochlear nerve to the globe. But crucially, it spares the supraorbital nerve – and with it, forehead sensation – and results in minimal scarring.

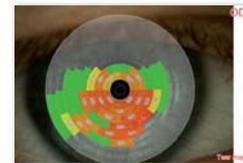
What happens to the patients after surgery? The team believe that the graft slowly innervates the cornea at around one millimeter per day, with sensation typically returning within six months. Those with damaged corneal epithelia might experience pain postoperatively, but once protective sensation is established, the discomfort subsides as the ocular surface is allowed to heal. Of note, patients initially reported that mechanical stimulation of the cornea felt like the cutaneous skin territory of the supratrochlear nerve was being stimulated. But over the few months following surgery, patients shifted to perceiving this as true corneal sensation – suggesting that some degree of central nervous system remodeling takes place (3). The first patient to receive the treatment experienced significant improvements in corneal clarity, and is now eligible for a corneal transplant. Of the four children and one adult who have undergone this procedure, all have experienced the development of a protective corneal sensation by six months postsurgery, and to date, follow-up has uncovered no ocular healing problems or loss of forehead sensation. *RM*

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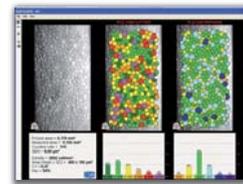
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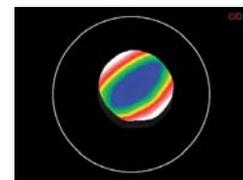
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Sight in a Single Cell

Unicellular planktonic organisms have evolved a complex eye-like structure by repurposing organelles within the cell

The human eye is a complex structure, but not a unique one – eyes are thought to have evolved independently between 40 and 65 times in different organisms (1). Unicellular organisms have thus far been limited to the simplest stage of eye evolution, the eyespot, which is no more than a light-sensitive region of photoreceptor proteins capable of distinguishing light from dark. But one single-celled plankton, the warnowiid dinoflagellate, hasn't settled for eyespots – instead, the organism has evolved itself a miniature mimic of the multicellular eye.

Called an “ocelloid,” the eye-like structure is a prime example of exaptation, the co-option of a structure intended for one purpose to fulfill another. In the case of the warnowiid ocelloid (Figure 1), a layer of mitochondria forms a makeshift cornea over the vesicular lens, while the “retina” is composed of a network of double-membraned organelles called plastids (2). Despite its unique composition, the ocelloid looks so much like a true, multicellular eye that researchers initially mistook it for the eye of a more complex organism eaten by the plankton. In a press release from the University of British Columbia, where the origins of the ocelloid were examined (Figure 2), lead author Greg Gavelis said, “It's an amazingly complex structure for a single-celled organism to have evolved. It contains a collection of subcellular organelles that look very much like the lens, cornea, iris and retina of multicellular eyes found in humans and other larger animals” (3).

The similarity between the ocelloid and

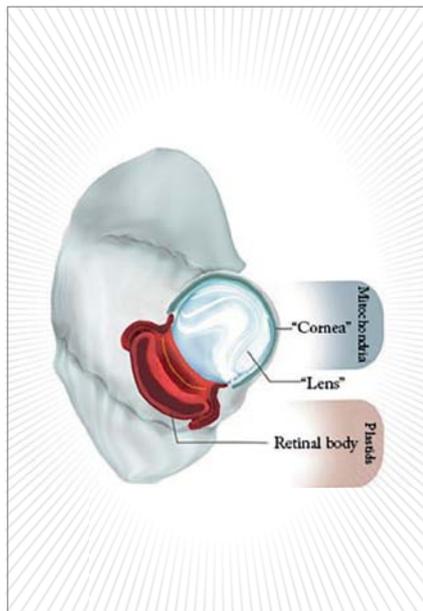


Figure 1. The structure of the ocelloid in warnowiid dinoflagellates, indicating the subcellular organelles that form each structure (1).

the complex eye highlights the similarities between the multiple evolutions of the eye – the presence of opsins, the need for an opaque “retinal” surface, and, in the case of advanced forms like the ocelloid, the presence of a focusing lens and even a “cornea.” It's a particularly striking case of convergent evolution because the ocelloid is one of the most complex structures seen in a unicellular organism. But where there is an evolutionary need for such complexity, as the repeated development of visual sensory organs at all levels of complexity has shown, life will find a way. *MS*

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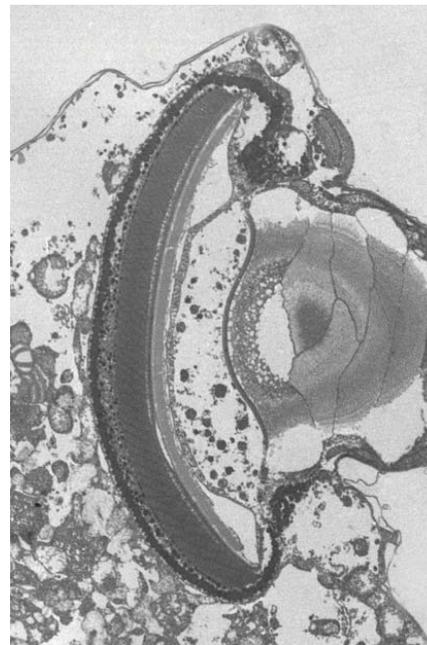


Figure 2. A transmission electron micrograph of the warnowiid ocelloid (1).

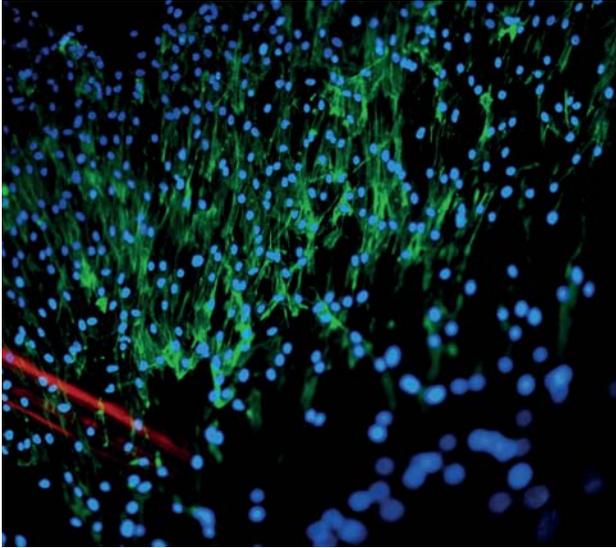
Standardizing Stem Cell Selection

Stem cell therapies may be the future of treating retinal disease, but how do you choose the best source?

Stem cell therapies hold tremendous potential for treating ophthalmic disease, but as the field is still relatively young, many questions remain unanswered. One research team, led by staff from St. Jude Children's Research Hospital, set out to discover more about the biology of stem cells by posing a question: how do you identify the best stem cell source for transplantation into the retina?

The team examined three stem cell types: embryonic stem cells (ESCs), fibroblast-derived induced pluripotent

Tired of seeing those **unhappy patients?**



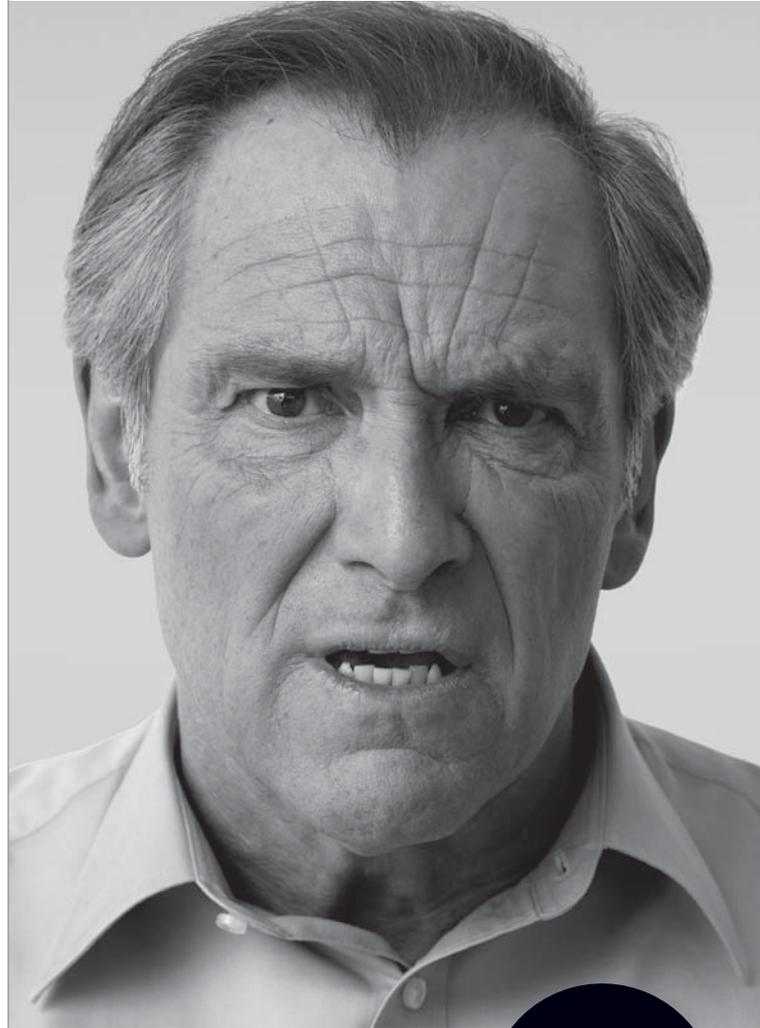
stem cells (f-iPSCs), and iPSCs derived from murine rod photoreceptors (r-iPSCs), all of which are able to produce retinal pigment epithelium (RPE) in culture. The different types of cells produced were then compared using the STEM-RET protocol, which quantifies retinogenesis using measurements of molecular, cellular and morphological criteria. The researchers found that r-iPSCs are more efficient at producing differentiated RPE, whereas f-iPSCs show reduced numbers of inner nuclear layer and ganglion cell layer cells.

“There has long been a debate in the field about how to standardize the quantification of stem cell differentiation,” says Michael Dyer, lead author of the study (1), adding, “Our STEM-RET method enables that standardization, which means that laboratories can accurately compare their results with one another and different stem cell lines can be compared. We believe the method could be adopted widely.”

But why might r-iPSCs make superior RPE cells? One factor might be epigenetic memory – the photoreceptor-derived cells retain distinct epigenetic switches after being reprogrammed, which affects how well they can produce different cell types and could explain why rod-derived stem cells are better than other types at creating differentiated retinal cells. Dyer hopes that using this information to create epigenetic “fingerprints” could allow for better selection of cells for therapeutic purposes. *RM*

Reference

1. D Hiler, et al., “Quantification of retinogenesis in 3D cultures reveals epigenetic memory and higher efficiency in iPSCs derived from rod photoreceptors”, *Cell Stem Cell*, 17, 101–115 (2015). PMID: 26140606.



**SWITCH
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Wireless Drug Dosing

“Smart” nanowires deliver drugs on demand using an applied electromagnetic field

Sometimes an occasional missed drug dose isn't a big deal; sometimes, it's deadly. But often, in ophthalmology, it ends up with patients losing vision. It's understandable that people are busy, forgetful, and in the case of intravitreal injections, can strongly dislike the procedure or find monthly clinic visits inconvenient – but it can be acutely frustrating to watch a patient lose vision because of something as simple (yet as common) as regimen noncompliance.

One method of addressing this problem is the use of implants that slowly release therapeutic drug doses over an extended period – and there are already a few of them on the market today. But these release their drug based on a combination of the formulation's intrinsic release properties and the local ocular environment in which it's placed. What if you wanted more control?

A neuroscientist, Wen Gao, and a biomedical engineer, Richard Ben Borgens, may have an answer: a “smart” nanowire that releases drugs when exposed to a strong electromagnetic field (1). The nanowires are fabricated out of the inert, biocompatible polymer polypyrrole (Figure 1), and can be loaded with a drug. Borgens explained, “When the correct electromagnetic field is applied, the nanowires release small amounts of their payload. This process can be started and stopped at will, like flipping a switch.”

To test their tiny drug delivery device, they impregnated the nanowires with dexamethasone, deposited them onto a droplet of sterilized water, placed it on a spinal cord lesion in a mouse, and then applied an electromagnetic field

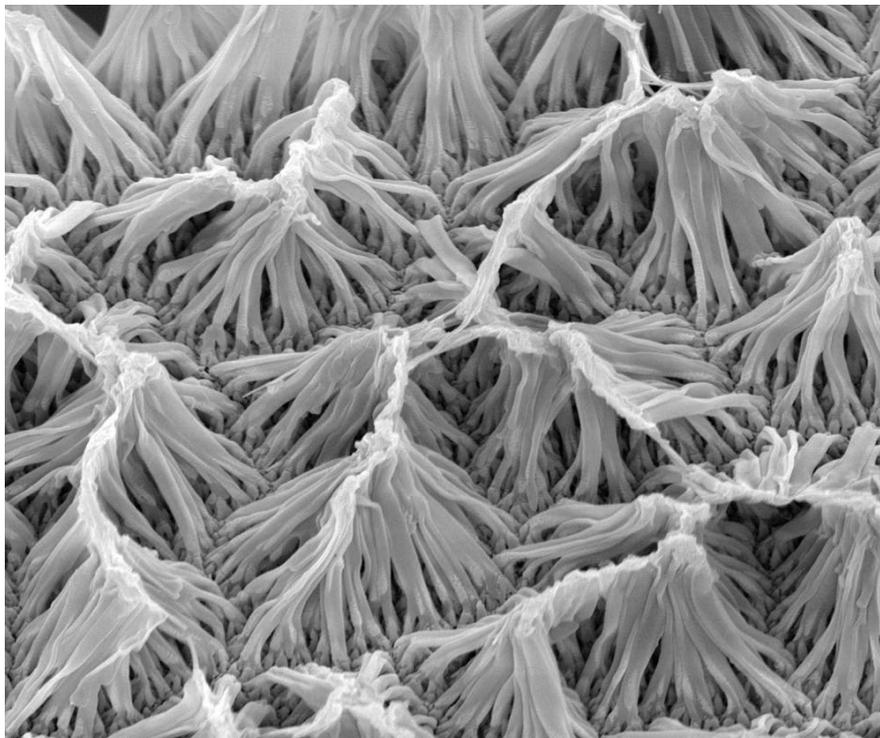


Image credit: Purdue University/ Image courtesy of Richard Borgens

Figure 1. A scanning electron micrograph of vertically arranged, gold-embedded polypyrrole nanowires.

for two hours a day for a period of one week. Compared with controls, treated mice showed significantly lower levels of glial fibrillary acidic protein, a marker of spinal inflammation, at the location of the spinal injury. Furthermore, the effect was hyperlocal – no systemic dexamethasone was detected in the mice.

The authors noted one major limitation: the maximum depth that the implanted nanowires would function was limited to just under 3 cm, although as the mean axial length of an adult human eye is ~2.4 cm, this shouldn't be a problem with ophthalmic use. They are also working on developing biodegradable nanowires.

This technology is years from making it to the market (if it ever does), but the implications for telemedicine if it does so are quite profound. If we take the example of a patient with wet AMD; rather than be assessed and injected every month or two with an anti-VEGF agent by a hospital-based ophthalmologist, the patient could

see the ophthalmologist just once to be injected with the nanowires, and then be monitored by a local optometrist or community healthcare center using automated OCT imaging devices. The resultant images can be assessed remotely (or by algorithm), and the appropriate dose can be calculated automatically and administered by timing the patient's EMF exposure. And if the EMF device is something a patient could take home and have programmed remotely, the drug administration part becomes even easier – and helps ensure that the patient receives the effective therapy they need every time they need to receive it. *RM/MH*

Reference

1. W Gao, RB Borgens, “Remote-controlled eradication of astrogliosis in spinal cord injury via electromagnetically-induced dexamethasone release from “smart” nanowires”, *J Control Release*, 13, 22–27 (2015). PMID: 25979326.

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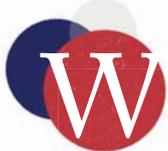
We make it visible.



A Brief History of MIGS

The long and controversial journey to microinvasive glaucoma surgery (MIGS), and the quest to retire trabeculectomy

By Ike Ahmed



When I began my career in ophthalmology, glaucoma was not necessarily a popular field of study. I was attracted to it because I saw it as a field ripe for innovation. You see, I grew up in the medication era of glaucoma, but the more we developed medications, the more we realized their shortcomings as well as their benefits. My first choice was to pursue a fellowship in glaucoma, and I was fortunate to do that in a pretty innovative place. At the Moran Eye Center in Salt Lake City, we did a lot of non-penetrating surgery like deep sclerectomy and viscocanalostomy as alternatives to trabeculectomy.

After I came back to Canada, I started doing some of the newer glaucoma surgeries, like deep sclerectomy with mitomycin-C, which was a twist on what we had previously been doing. Very few surgeons had taken this surgery up due to questions on efficacy and technical difficulty. But I gravitated to the challenge and exhilaration of dissecting into

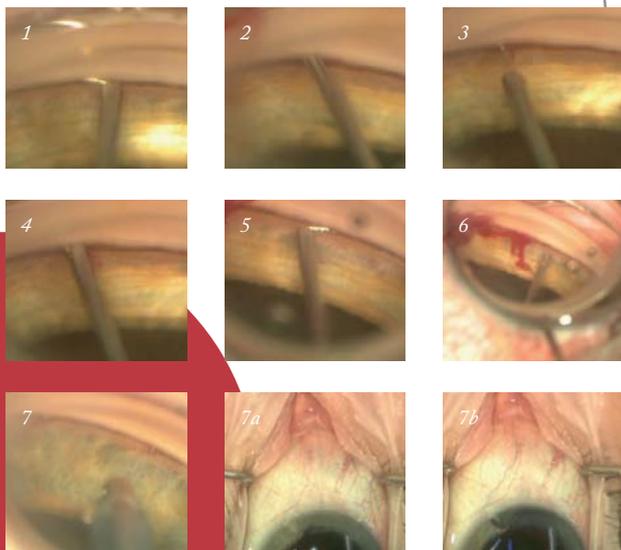
Schlemm's canal and peeling away juxtacanalicular meshwork. Although I knew non-penetrating surgery was not the final solution, I learned a lot about outflow anatomy and knew we could do better than what we were doing. I had also built up considerable experience in complex anterior segment surgery, taking on many extremely challenging cases that most surgeons didn't want to touch. For me, I was drawn to non-traditional ideas and challenges, especially when told, "That's not possible."

About three years into my career, I started to present and publish some of my work on glaucoma surgery, and it was one of the engineers at Glaukos who came to me at a meeting and said, "We want to talk to you about how we can better understand the iStent's potential." At that point, I had already worked on SOLX's Gold Shunt, as I was involved in their North American trial comparing it against New World Medical's Ahmed glaucoma valve. That was the first device

iStent

The *iStent* is implanted prior to phacoemulsification. The head has been turned, the microscope tilted, and a Swan-Jacob gonioscope positioned to visualize the nasal angle.

1. Enter the meshwork at a 30° angle in the supranasal angle. With this acute angle, the self-trephinating tip approaches with adequate entrance into the canal, avoiding entrapment within the inner wall. 2. Once one-third of the device is in the canal, lift toward the hand and straighten the hand out to allow smooth passage of the implant within the canal.
3. Release the snorkel end gently, observing its position within the inner wall. 4. Then tap the implant to push it against the canal while pushing the snorkel end against the outer wall to ensure adequate placement. At this point, it's normal to see blood reflux from the insertion and from the snorkel end. 5. A second *iStent* can be placed in a backhanded fashion, again approaching at a 30° angle. After the self-trephinating tip incises the inner wall, the main body of the device is slid into the canal by straightening the hand and pulling slightly. 6. The snorkel is gently released from the implanter, and the tip is used to push it against the outer wall. Tapping ensures the device is well-seated, as its elbow must be placed fully within the canal. Viscoelastic helps with visualization and moving blood away from the area of interest. 7. A third *iStent* can be placed in a similar fashion. It's important that the eye moves very little, to ensure that the surgeon doesn't torque it and hit the outer wall during implantation. The three implants are placed approximately two clock hours away from each other. 7a/b. Toward the end of the case, irrigation and injection of trypan blue nicely shows the distal outflow passage. The visible pattern of filling and blanching of the episcleral vessels nasally, superior and infranasally, is only present in the area nasally where the implants have been placed.



company I worked with, and I learned a lot about what it takes to run a large glaucoma surgical trial. I also was the principal investigator for a five-year randomized prospective study (the AVB study) that compared the Ahmed valve and AMO's Baerveldt glaucoma implant.

Developing the *iStent*

So 10 years ago I began to consult for Glaukos and immediately started working with the *iStent*. I quickly realized that we weren't maximizing the ability of microstenting Schlemm's canal. I felt that there were issues with proper stent placement, and I wondered about the potential value of placing multiple devices. Looking back at seminal work done on distal aqueous outflow in the 1940s, I felt that we needed to do a better job at targeting stent placement and accessing larger areas of outflow. We started building up our studies from there and just kept on improving our surgical techniques. At the time, there wasn't really much training – it was very much, “Here's the device, Dr Ahmed, go and use it.”

When you're working toward innovation, you have to take the plunge. We didn't do anything without the right thought process; we planned carefully, chose the right patients, and did everything with institutional review board and regulatory approval. But when we went for it, we just dove right in. The beauty of this procedure is that it's so safe that the worst outcome is being unable to insert it – as opposed to a procedure that actually changes the structure of the eye. I think that's what made me much more willing to jump into it rather than wait on the sidelines; I felt that there was a certain degree of safety that allowed me to push the envelope a bit.

My role with most companies has been a strategic one – developing and moving existing technologies to the next level. Glaukos had already started their pivotal FDA *iStent* study (phaco compared with phaco with a single *iStent*), so my immediate thought was to go past that and implant multiple targeted devices. And not only that, but work to perfect the surgical technique. It was a great opportunity for me; this new glaucoma surgical space was in its infancy and I was learning so much every day. It's interesting when a clinician-scientist like me interacts with the business of medicine. Sometimes we're aligned, and sometimes we butt heads. But I have to give Glaukos credit for supporting me to do the scientific work we did. It also helped to be in Canada and work with a very supportive hospital and Health Canada to push studies forward.

For my initial population, I chose patients who needed better IOP control, but were high-risk candidates for traditional filtering surgery. I was able to discuss my ideas with Health Canada and get their support to try this entirely new

technology on a compassionate basis. That's how it started; we had the perfect mix of scientific curiosity, personal interest, patients that were not being best served by current technology, industry collaboration, and being in the right place at the right time. The first place that glaucoma stent technology was fully approved was actually in Europe, where it was CE marked. However, the uptake in Europe at the time was in fact poor. I suspect that this was because the IOP reductions were less than expected – but this was because our understanding of surgical technique and strategic placement was still in its infancy at that stage.

The rise of MIGS

At the time I started working with Glaukos and the iStent, I was also consulting for three other MIGS companies – AqueSys with their development of the Xen subconjunctival gel stent, Ivantis and the development of the Schlemm's canal scaffold Hydrus microstent, and Transcend Medical with their CyPass suprachoroidal microstent. I feel very fortunate to have worked with these companies at the earliest stage of device development and to help shape the products and how they are used. It may seem odd that I have worked with each MIGS company at such a deep level; each a competitor in some way. Confidentiality was therefore critical, but I always made it clear to everyone that I worked with that my interests lay in science and patient care. I've always felt that I don't serve individual companies; I serve my patients.

My journey in developing these new devices also took me all over the world as I worked with international collaborators. Hours and hours of tireless work in the lab were at times frustrating, but the prospect of the end result kept things in perspective. I think few people understand the painstaking work that comes with early-stage device development. One has to be prepared for failure early on, and believe in the concept of critical appraisal and leaving no stone unturned. I do have to admit that at times I had my doubts, but my optimism and desire to do better for my patients gave me the perseverance to continue.

Within a few years, I felt it was important to distinguish these devices from what was already being done in the glaucoma surgery field. Clinicians, patients and industry professionals needed to understand that these were different products. I toyed with the right words – I started with “minimally invasive,” but other medical specialties had used that term, and I thought, “No, we're talking about the eye. We're talking about microns here. This is not just minimally invasive, this is a microinvasive procedure.” So then it evolved to microinvasive, and that's how I coined the term “MIGS”: microinvasive glaucoma surgery. This was truly a revolutionary

The Essence of MIGS

- 1. Ab interno microincision* Surgery through a clear corneal incision allows easy visualization of anatomic landmarks for better device placement, combines easily with cataract surgery, and prevents significant scarring of the conjunctiva. The smaller the incision, the safer the procedure, improving the surgeon's ability to maintain the anterior chamber, retain the natural ocular anatomy, and minimize changes in refractive outcome.
- 2. Minimal trauma* The device should cause minimal disruption of normal eye anatomy and function. Surgeons should take a broad view of manufacturing materials and placement, with the ultimate goal of enhancing the natural outflow pathways of the eye.
- 3. Efficacy* MIGS procedures should have at least modest efficacy. Initial assessments of device and placement efficacy are often made using case series; the final determination and quantification of a procedure's efficacy should be made by randomized clinical trial.
- 4. Favorable safety profile* MIGS procedures should avoid the serious complications that can arise with other forms of glaucoma surgery.
- 5. Rapid recovery* Speed and ease of use are both vital characteristics of MIGS. The procedure should have minimal impact on patients' quality of life.

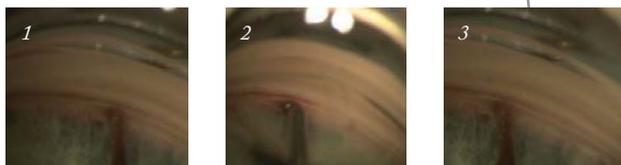
MIGS Timeline

- 1999: Glaukos Corporation produces its first micro-bypass glaucoma stent prototype
- 2001: First human implant of Glaukos' iStent
- 2004: The iStent receives a CE mark
- 2005: The FDA grants an IDE for US clinical trials of the iStent
- 2008: Transcend Medical's CyPass micro-stent receives a CE mark
- 2009: Ike Ahmed coins the term “MIGS”
- 2010: The iStent receives Health Canada approval
- 2011: The second generation of iStents (Inject and Supra) both receive CE certification
- 2011: AqueSys' XEN gel micro-stent receives a CE mark
- 2012: AqueSys' XEN stent begins FDA trials
- 2012: The iStent receives FDA approval and becomes the first MIGS device approved in the United States
- 2013: The Transcend CyPass begins FDA trials
- 2014: The iStent is available in 17 countries
- 2015: The AqueSys XEN receives a medical license in Canada
- 2015: Transcend Medical announces its plan to file a Premarket Approval Application with the FDA for CyPass
- 2015: Transcend Medical announces its plan to file a Premarket Approval Application with the FDA for CyPass

Cypass

The Cypass suprachoroidal microstent is implanted using gonioprism to visualize the angle.

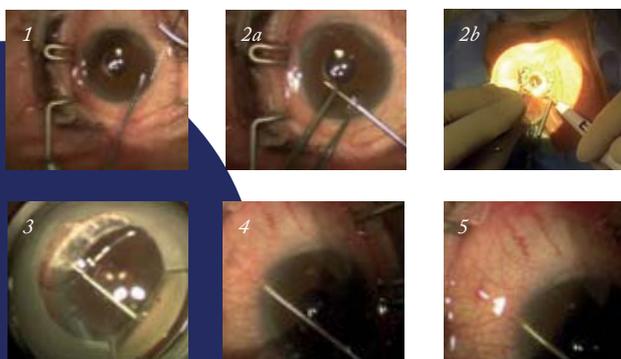
1. Identify the trabecular meshwork and the scleral spur. Aim the tip of the applicator for the scleral spur, allowing the guide wire to disinsert the iris at the point of the spur. 2. Pass the implant forward. The guide wire is curved to follow the undersurface of the sclera. Place the implant so that at least two rings of the collar can be seen in the anterior chamber, to avoid a deep implantation. If using viscoelastic, inject it around the device at this point. 3. Release the device from the cannula, ensuring that the proximal end can be seen sitting at the appropriate point in the meshwork to avoid corneal contact.



AqueSys Xen45 One-Handed

The AqueSys Xen45 suprachoroidal microstent is implanted using gonioprism to visualize the angle.

This is a new, lightweight one-handed injector for the AqueSys XEN45 implant (a 45 µm lumen implant preloaded into the injector). It places the implant in the subconjunctival, interscleral and anterior chamber space. 1. Remove the injector from its packaging and examine it under the microscope to locate the metal post within the lumen of the 27 G needle (intended to prevent the implant from moving during shipping). Remove this post. 2a. The clear corneal incision was made in the infratemporal quadrant to direct the needle toward the supranasal quadrant. 2b. Notice the overhand grip – two fingers straddling the proximal portion of the injector with the thumb on top. 3. Use the goniolens to localize the angle and structures of the eye, then place the needle into the area of the spur-meshwork junction. 4. Fill the anterior chamber with viscoelastic, then use a spatula to rotate the eye down to facilitate adequate visualization and passage of the needle. 5. Once the needle is visualized through the sclera, advance the sliders to inject the implant and then retract the needle into the cannula. The free hand can be used to fixate the globe and rotate the eye if necessary for visualization.



new way to look at glaucoma treatment, offering patients something we could never offer before.

At first, of course, it was a term nobody had heard and people were laughing at it, but now it seems everybody wants to call their device a “MIGS device.” It’s funny how things have exploded; right now, we have thousands of patients in trials around the world with MIGS devices. It’s incredible considering that, prior to the iStent, there had never been a formal, well-designed glaucoma device study of that scale – so that really spawned a whole era of glaucoma surgical clinical trials. The iStent wasn’t the first approach to draining aqueous in glaucoma patients, but it was years ahead of the other technology available at the time. So other companies started thinking, “Can we drain into this space better? Can we drain into other spaces using stents with a different technology?” And now there are three other stent companies focusing on these kinds of developments.

Improving implantation

Microstent implantation is getting better and easier, but I think it’s still a complex procedure that takes a lot of thought and dexterity to get it just right. It’s not something anyone, even an experienced surgeon, can just pick up and do. There’s definitely a learning curve, but it is well worth it. Mentorship and proctorship are key ingredients to success. I’ve been fortunate to learn from others and teach others – to me, that’s what medicine is all about. It’s thrilling to have surgeons from all around the world visit my OR to learn some of these new techniques and take their experience back to hopefully benefit their own patients. One by one, we’ve built this MIGS-surgeon international fraternity of sorts.

We’re continuing to work on technologies to identify the best patients for these procedures and help with stent implantation. Preoperative and intraoperative imaging will help us select our optimal stent approach and placement. We are working on better intraoperative visualization tools and instrumentation to enhance the surgical technique. In the meantime, we’ve developed some very good clinical and surgical techniques even without technological assistance.

The power of people

At first, I didn’t like social media; I thought it was a waste of time. But then we set up a medical professional page for me on Facebook, and I realized what a powerful medium it is for communication. Facebook and in particular YouTube have been very important for me in disseminating information. People no longer pick up a textbook or journal to read about clinical issues or surgical techniques– they go online.

My group of collaborators has multiplied hugely over time.

I love it, because I love people. The biggest draw to innovation for me is the opportunity to build relationships. Working together as a team, whether it's in the clinic, the operating room, or with engineers, scientists and businessmen, is a thrill. My personal approach is very collaborative; I don't really keep my ideas to myself. I believe in sharing and in just getting things done, even at the expense of losing some intellectual property rights. I realize that companies have to make money and continue producing new things, but I believe medicine works best in collaboration. I'm a clinician first and foremost, so my primary goal isn't to make money, it's to improve patient care – because it's all about people.

It's important to work hard at what you want to do, but it's also important to learn how to prioritize, delegate and understand where to invest your time and resources. Anticipation and timing are everything when it comes to success.

That translates to my life in general, too. I think I've gotten a little better – I've cut down my clinical load a lot – but my philosophy is to work hard and play hard. I'm very fortunate to have a great family and an awesome wife (who is also a physician) who have been supportive as I find myself often bringing work home! However, one thing my family knows is that I am a huge proponent of “family time!”

Changing the culture

Being at the forefront of innovation is a lonely journey in many ways, but it's a journey worth taking because I see what our patients can get out of it. In general, people don't like change – especially glaucoma specialists! And for good reason – our patients have a blinding chronic disease, with little room for error. We're not looking for a flash in the pan, but something that is proven to help our patients. There are a couple of things that seem very certain these days; firstly, that there is still an unacceptably high rate of glaucoma patients going blind under our watch, and secondly, that traditional filtering surgery is very much looked at as a late-stage treatment option. I also think we need to reframe glaucoma treatment to understand that it really goes beyond just IOP lowering, and that selecting treatment based on quality of life is becoming more and more important. Whether it is multiple daily drops, side effects or compliance issues, or high surgical risk – glaucoma treatment takes its toll on a patient's wellbeing. MIGS is very much at the center of changing the traditional glaucoma treatment paradigm.

My colleagues are starting to perform procedures I helped to develop. The culture of glaucoma treatment is slowly changing. Before it was very much “sit back, analyze, medicate, analyze, analyze, more medications, laser, wait, wait, and as a last resort, go to surgery.” Now it's becoming more active

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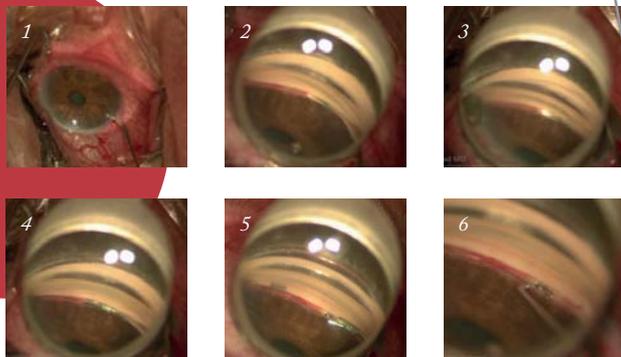
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The Hydrus Microstent is implanted into the eye using an ab interno clear corneal approach.

1. Make the incision to the right of the cornea (as you view it) to allow for the unique curvature of the cannula.
2. Use the distal tip of the cannula to incise the inner wall. Only about 100 μm of this tip will actually enter the canal. There will be some torquing of the eye and positive pressure on the canal to allow penetration.
3. Relax the hand slightly and advance the roller wheel to place a device into the canal.
4. The device is placed in an upward fashion to ensure adequate passage.
5. Relax the hand again to release tension on the outer wall and direct the implant smoothly into the canal.
6. Use the slide interlock to release the inlet from the implantation device, then the cannula is then withdrawn.
7. Evaluate the position of the device using a Sinsky hook to manipulate the eye. At this point, there may be normal blood reflux behind the three windows in the canal, which are scaffolding the inner wall and keeping the canal open. The inlet is slightly inside the anterior chamber, with a transition zone visible where the incision has been made into the inner wall.



and interventional. New innovations in drug delivery are on the horizon and they are going to change things as well. I'm excited about that, and by the way, I see synergy between MIGS and new methods of drug delivery. I see that as the next step, because I think that combination can be very powerful.

Given other options, most patients would rather not choose a trabeculectomy – so we hope to offer an alternative that can be used earlier in the treatment paradigm through a combination of MIGS and drug formulations. Back when I started my fellowship, my goal was to retire the trabeculectomy before I retired. We've still got a lot of work to do, but I'm excited to see continued innovation in this space. We're at level one, MIGS 1.0," at the moment – and we're on the cusp of "MIGS 2.0." Thus far the storyline for MIGS has been about safety – the major Achilles heel of trabeculectomy. Now that we're gaining confidence in the safety of MIGS, we're seeing efforts made to enhance the efficacy of these devices. Examples of this include multiple targeted iStents, scaffolding Schlemm's canal with stents like the Hydrus, viscoexpansion with the suprachoroidal CyPass stents, and use of mitomycin-C with the subconjunctival Xen stent.

I've described "MIGS plus" now. I use that term for new devices and technologies that encompass the qualities of MIGS, but have a bit more power – and involve a bit more risk. We've been trying things like using the Xen gel stent with mitomycin-C (well-established in the trabeculectomy world) and seeing significant IOP lowering while maintaining the

Ike Ahmed Timeline

- 1995: Graduates from the University of Toronto, Faculty of Medicine, Canada
- 2000: Completes his ophthalmology residency at the University of Toronto.
- 2001: Completes his glaucoma and anterior segment fellowship at the John Moran Eye Center, University of Utah, in Salt Lake City
- 2001: Joins the academic faculty at the University of Toronto and University of Utah, and starts his practice at Credit Valley Hospital, Mississauga, ON
- 2002: Founds and directs the Toronto Cataract Course, an annual conference that has become one of the biggest in Canada and attracts over 300 participants
- 2002: Invents the Capsular Tension Segment with Morcher GmbH for use in complex cataract surgery
- 2003: Develops the first micro-instrumentation system for

- complex anterior segment repair with MST Surgical
- 2004: Participates in the North American trial comparing SOLX's Gold Shunt with the New World Medical's Ahmed glaucoma valve
- 2005: Glaukos approaches Ahmed to work together on iStent development
- 2005: Initial work with AqueSys on an ab-interno delivered subconjunctival microstent that will be called the Xen implant
- 2006: Starts working with Ivantis on a Schlemm's canal scaffold microstent that will later be named the Hydrus
- 2006: Collaborates with Transcend Medical to develop the CyPass suprachoroidal microstent
- 2009: Coins the term "MIGS" to describe a new genre of highly safe and minimally invasive glaucoma interventions
- 2010: Selected as one of Canada's "Top 40 Under 40," a prestigious national award recognizing significant achievements at a young age
- 2010: Best Glaucoma Paper award for "The Ahmed versus

minimally invasive nature of the procedure. So we're moving toward using devices with drugs to improve their efficacy. This is another aspect of MIGS 2.0, but we're only just getting started with it.

Despite the optimism I have toward MIGS, there is much need for further large-scale and longer-term studies to show efficacy, cost-effectiveness, and enhanced quality of life. I have colleagues who are skeptical of these new technologies, often questioning the IOP-lowering potential of these devices. I tell them, "You know what? This isn't the final frontier. This is just the beginning: the first frontier." It's important to keep the environment fertile to keep building on our early results. Don't close the door on innovation just as we're starting to have some bursts of enthusiasm and success. But let's do it right – it can be difficult to separate medicine from business, but it isn't impossible for those two interests to work together to improve patient care. Most innovations in medicine would not have come about without that kind of collaboration.

Ike Ahmed is chief of ophthalmology at Trillium Health Partners, medical director at Credit Valley and Osler EyeCare, research director at the Kensington Eye Institute and co-medical director of TLC Laser Eye Center in Mississauga, Ontario, Canada. He is also a professor at the University of Utah and an assistant professor and the director of the Glaucoma and Advanced Anterior Segment Surgery fellowship at the University of Toronto, Canada.

Ike's financial disclosures are available at: top.txp.to/0715/MIGS

Baerveldt Study: Two-Year Follow-Up Results" by the Canadian Ophthalmological Society

- 2012: Starts working with the InnFocus Microhunt, a subconjunctival device made from a novel material
- 2013: Selected as Head of Ophthalmology at Trillium Health Partners, Mississauga, ON, Canada
- 2013: Selected as Research Director, Kensington Eye Institute, University of Toronto
- 2014: Receives American-European Congress of Ophthalmic Surgery Visionary Award
- 2014: Receives the prestigious Binkhorst medal from the American Society of Cataract and Refractive Surgery for outstanding contributions to the understanding and practice of cataract surgery and IOL implantation
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Who Benefits from Preservative-Free Glaucoma Therapy?

Taking the time to talk with patients about the signs and symptoms of ocular surface disease and performing some quick assessments could ensure selection of the most appropriate therapy, and help improve patient outcomes

As we've seen in previous issues of *The Ophthalmologist*, there's a significant proportion of patients with glaucoma who are, or will become, sensitive to the preservatives present in their topical glaucoma medications, and this typically manifests itself as ocular surface disease (OSD) – most commonly as dry eye disease (1,2). This is something that's best avoided as it negatively impacts patients' quality of life (2,3) and adherence to their topical glaucoma medication regimens, ultimately accelerating disease progression (4,5). In recognition of the extent of the issue, the European Glaucoma Society (EGS) advise that "particular attention should be paid to glaucoma patients with pre-existing OSD or to those developing dry eye or ocular irritation over time" (6). Further, the European Medicines Agency recommends avoiding preservative-containing topical therapies in patients who do not tolerate eye drops with preservatives, and considering the use formulations without preservatives as a valuable alternative for long-term treatment (7). Clearly, it's important to find these patients and switch their medications wherever possible, as soon as

possible. So how do you identify them?

The first thing to do – before any examination – is to take the patient's history (8), see Figure 1. Ask the patient about any factors that might impair ocular surface function, including occupational factors like computer display use, and any systemic diseases or therapies that may cause them to experience OSD, and consider the patient's age and gender – older age and female sex predispose patients to OSD (8). If you don't already have the information, ask the patient about any other ocular disorders they may have been previously diagnosed with, and what other ocular topical therapies they may be taking: if they're self-administering over-the-counter artificial tears, then that suggests the presence of some degree of OSD. Finally, ask about dry eye symptoms: do they have discomfort along the lines of a "recurrent sensation of sand or gravel in their eyes", or visual disturbances such as contrast sensitivity, decreased visual acuity and increased optical aberrations? (8).

You then follow this with a clinical assessment. The EGS' guidelines (6) state that this can be achieved with "careful assessment of redness of the eyelid margin, positive corneal and conjunctival fluorescein staining or reduced tear break-up time". Recently, Stalmans et al., (8) have also proposed three quick and easy steps are required to assess the patient.

The first step is essentially a series of quick glances. Examine the ocular surface, the eyelids (particularly the lower lid) and the periocular skin for any signs that are suggestive of meibomian gland dysfunction (MGD), and look out for abnormal positioning of the tear film meniscus, the presence and location of any apparent hyperemia, and finally, check for the presence of any debris at the canthi.

The second step is a slit lamp examination: check the lid margins for signs of MGD, meibomitis or blepharitis. Examine the bulbar and tarsal conjunctiva for surface

abnormalities that might affect tear film distribution, and remember to check for lid laxity causing possible lid malpositions, by determining the distance between the peripheral cornea and the inferior lid border.

If, at this stage, OSD is suspected, the third step is to reach for the fluorescein bottle, in order to perform conjunctival fluorescein staining (CFS), in order to assess tear film stability (with tear film break-up times [TBUT] of <10 seconds considered abnormal) and to identify any damage to the corneal epithelium (helping to assess the severity of the disease).

These simple steps: talking with the patient, taking their history, quick visual assessments (with and without the slit lamp) followed (where appropriate) by CFS/TBUT assessments, will help identify those patients who will benefit from preservative-free topical glaucoma therapy (8). Although many patients with glaucoma receive preservative-containing topical medications and don't have OSD, continual review of these patients is advised – consider taking the time to explain the issues that the preservatives in their medications can sometimes cause, and alerting them to the early signs of OSD. Dialogue between you and your patient could mean that timely switching to preservative-free therapies is performed, reducing the potential in some patients for poorer clinical outcomes.

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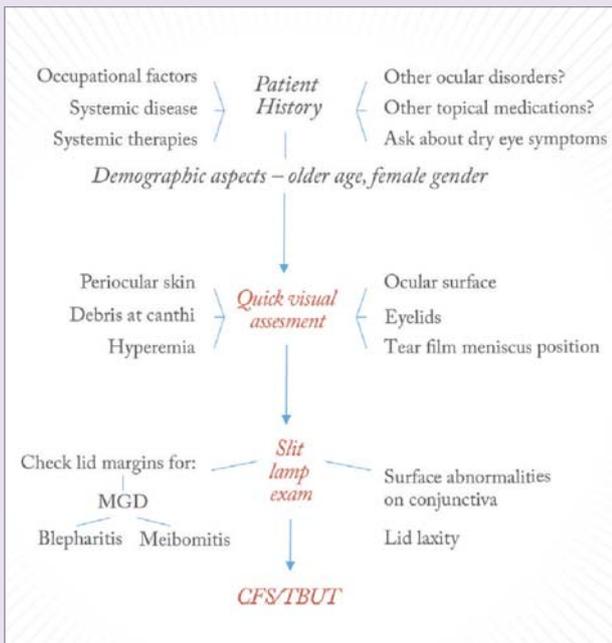


Figure 1. A short series of quick assessments can help identify patients who exhibit the signs of ocular surface disease and would benefit from preservative-free topical therapy. CFS, corneal fluorescein staining; MGD, meibomian gland dysfunction; TBUT; tear film break-up times. Adapted from (8).

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Next month

A discussion on the impact of preservative-containing topical glaucoma therapy on glaucoma surgery outcomes. Preservatives present in topical glaucoma therapies may adversely affect the outcomes of surgical procedures (9).

Job Code: STN 0717 TAP 00019 (EU).

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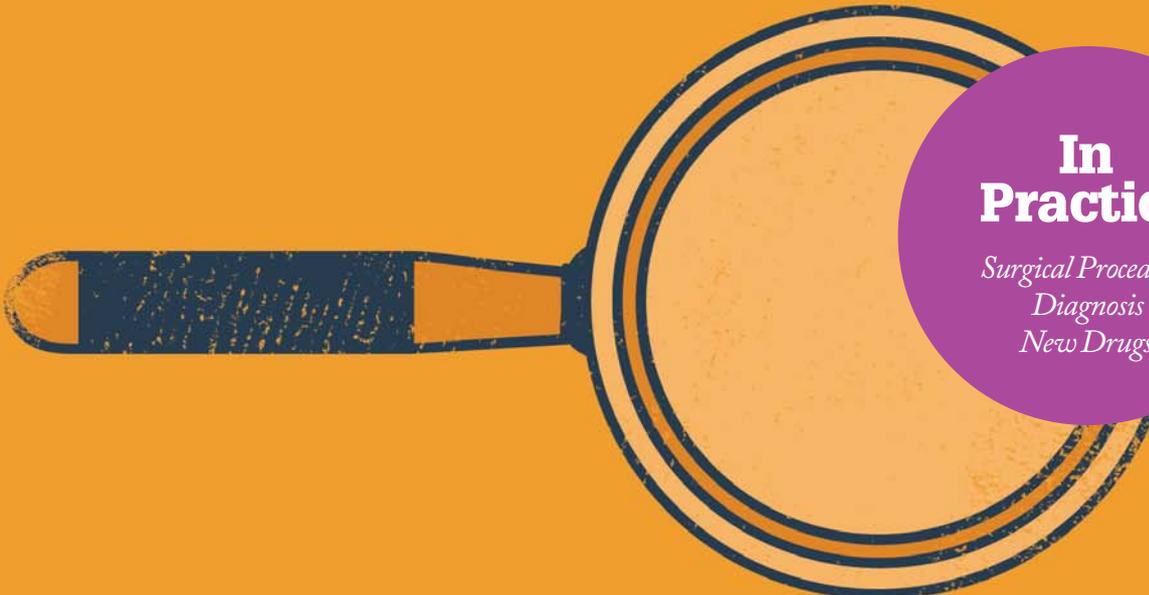
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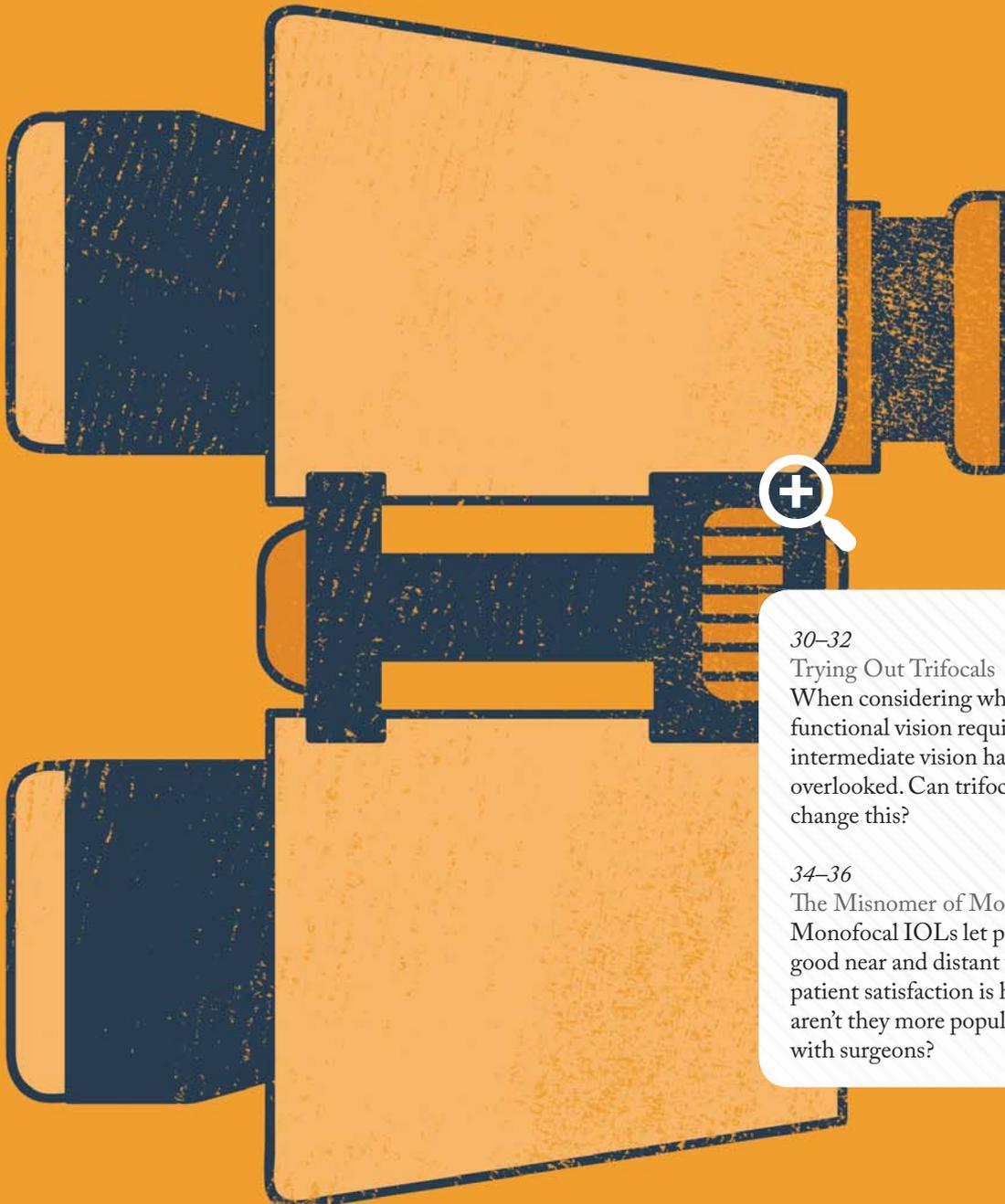
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Trying Out Trifocals

When considering what patients' functional vision requirements, intermediate vision has often been overlooked. Can trifocal mIOLs change this?

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The Misnomer of Monovision

Monofocal IOLs let patients retain good near and distant vision, and patient satisfaction is high. So why aren't they more popular with surgeons?

Trying Out Trifocals

When considering patients' functional vision needs and satisfaction levels, intermediate vision has been overlooked for too long – new trifocal mIOLs may change that

By Florian Kretz, Mariyana Dzambazova, Matthias Gerl and Gerd Auffarth

The introduction of trifocal intraocular lenses (IOLs) to the market in 2011 changed what many ophthalmologists think what “functional vision” actually means. Before, intermediate vision wasn't really given much attention; it was so low on many people's radar that many studies didn't even test it; the mindset was near

At a Glance

- The introduction of trifocal and low-add multifocal IOLs (mIOLs) means that cataract/refractive surgeons can now offer IOLs that give good intermediate vision
- One, if not the most important factor is patient satisfaction. Glare and halo are potential complications – but some patients are more bothered by them than others
- We report on a study that used the Heidelberg DATE score to assess patients' satisfaction and ability to perform daily tasks after AT LISA tri 839MP mIOL implantation: overall, patients were very satisfied
- A full understanding of patients' needs and how much they might encounter glare and halo (e.g. night driving) and how much that will bother them is key to offering them the right mIOL that will make them happy with their postoperative vision

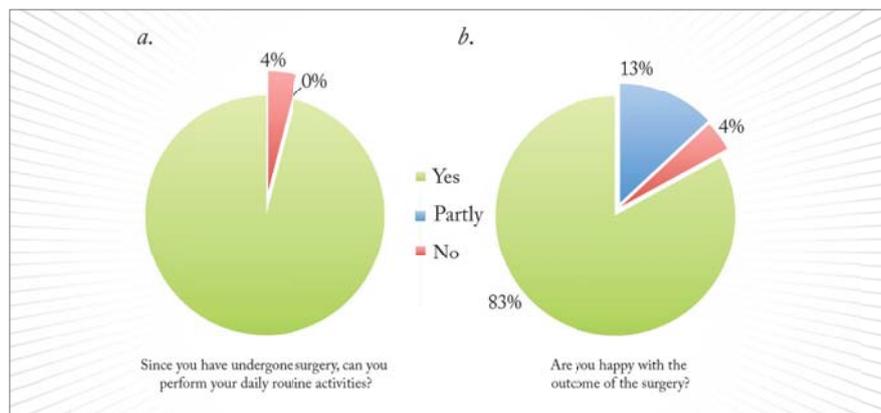


Figure 1. Patients' self-reported results for the first (a) and second (b) questions of the DATE questionnaire.

vision and far vision. But now that trifocal and low-add multifocal IOLs (mIOLs) have hit the market, things are changing. Now that we can offer a variety of trifocal IOLs to patients, we're having to think harder about finding the right IOL for them. This involves thinking about our own daily experiences and individual vision distances as reference points, and asking our patients about theirs, in order to find each person the right mIOL for their needs.

Fulfilling patients' needs is more than just giving them great distance, near and intermediate vision under a range of lighting conditions – it turns out that this isn't enough on its own. Patient satisfaction with their postoperative vision should be paramount. No one will ever explain a mIOL in a satisfied and happy patient, even if they have functional vision that's much lower than average. On the other hand, we've all had to explant mIOLs in unhappy patients, some of whom have had great functional results from the doctor's point of view, but were never satisfied with their own vision.

Asking the right questions

There are multiple questionnaires available (1,2) to help us look more closely into patient satisfaction, but they are often time-consuming and I believe that they don't ask the right questions. Ulrich

Mester and his colleagues recently published a paper discussing the impact of personality characteristics on patient mIOL satisfaction (3) in 180 patients implanted with different mIOLs – finding that four psychometric parameters had a significant effect on patient satisfaction: “compulsive checking” – that is, the need to perform repeated checks (on anything from door locks to news headlines) to calm obsessions; orderliness, competence and dutifulness. These four parameters correlated, not directly with patient contentment, but with the perception of glare or halos, which in turn translated to a likelihood of postoperative dissatisfaction.

In our study, we wanted to demonstrate the effect of personality in “compulsive checkers” on satisfaction in a smaller cohort of 52 patients, who all underwent cataract surgery or refractive lens exchange with implantation of an AT LISA tri 839MP mIOL (Carl Zeiss Meditech, Jena, Germany) for the correction of aphakia and presbyopia. We used the DATE (DAily Tasks Evaluation) score – a questionnaire developed at the International Vision Correction Research Centre (IVCRC) of the Department of Ophthalmology, University-Clinic Heidelberg, Germany – to provide a quick method for evaluating patients' satisfaction and ability to perform daily tasks. The

Question	Answers			
Since you have undergone surgery, can you perform your daily routine activities?	Yes	Partly	No	
Are you happy with the outcome of surgery?	Yes	Partly	No	
Would you select the same lens for surgery again?	Yes			No
Would recommend this surgery and lens to a relative or friend?	Yes			No
Can you do this without glasses:				
Reading newspaper?	Yes	Partly	No	Not assessable
Reading a book?				
Watch TV?				
Drive car during the day?				
Drive car during the night?				
Shopping in supermarket?				
Work at the PC?				
Work at home or in the garden?				
Do precision work (e.g. sewing)?				
Since you have undergone surgery:	0-No experience of such perception to		10-Very strong experience of such perception	
Do you experience more glare sensitivity during the day?				
Do you experience more glare sensitivity during the night?				
Pain or burning of your eye(s)?				
Do you experience halos?				
Do you experience double images?				
Do you have problems in bright light conditions?				
Do you have problems in normal light conditions?				
Do you have problems in low light conditions?				

Table 1. The Heidelberg Daily Task Evaluation (DATE) questionnaire: self-developed subjective questionnaire used in the current study to evaluate postoperative patient satisfaction with surgery and its impact on daily activities.

scoring tool consists of 28 questions; three are yes-or-no, 11 can be answered with yes, partly or no, and the remainder offer a scale from 0 to 10, where 0 indicates no problem or influence and 10 indicates a severe problem or significant influence (see Table 1).

The patients' replies
 Figures 1a shows patients' self-reported results for question 1 ("Since you have undergone surgery, can you perform your daily routine activities?") and Figure 1b shows the results of question 2 ("Are you happy with the outcome of the surgery?"). Almost all patients (96 percent) replied

positively to the first question, with none saying no; to the second, most (83 percent) said yes, with the vast majority of the remaining population replying "partly." All patients said that they would select the same mIOL model again and would recommend the AT LISA tri 839MP to a friend or relative. They're pleased with their vision for detailed work, too; 64 percent no longer needed glasses to read the newspaper, 58 percent did not require them to read books, and 38 percent did not have to rely on them for precision tasks (Figure 2) like knitting. Furthermore, there was a significant positive correlation between the binocular uncorrected near visual acuity and the near tasks results, and more than half of our patients were always able to work at the computer without glasses after the mIOL implantation procedure, with only 8 percent unable to do so even part of the time (see Figure 2).

Figure 3 gives an indication of disturbances the patients experience during daytime and nighttime driving. We found a statistically significant correlation between spectacle independence and impairment caused by halos or by increased glare sensitivity during driving. During daylight driving hours, there was no significant association between binocular uncorrected distance visual acuity and glare. For distance vision, 90.4 percent of our patients said that they no longer needed to use spectacles. Median DATE scores (standard deviation) performing tasks that require near, intermediate and distance vision were 2.3 (2.81), 2.5 (2.12) and 3.0 (2.82), respectively.

Adverse events related to mIOLs implantation were minimal. Patients generally experienced very low levels of pain and discomfort after implantation, with a median ranking of 2/10 and a mean of 3.8/10 on the DATE scale. For double image perception, patients reported a median and mean values of 1/10, and 3.8/10, respectively. When we looked at the glare component of

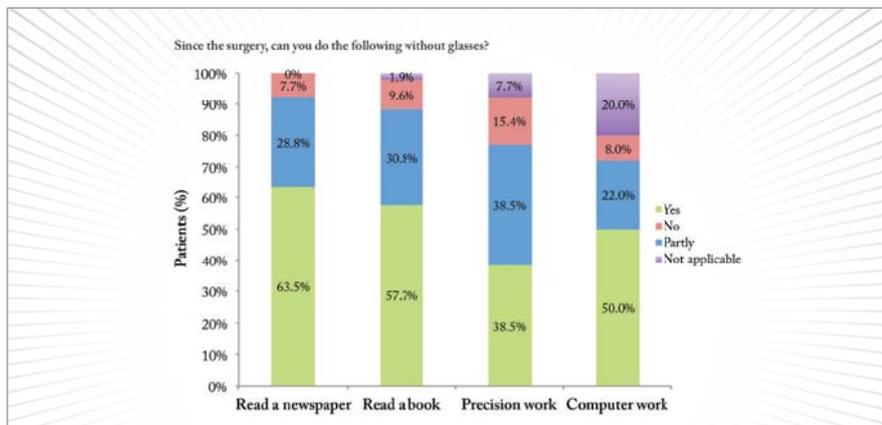


Figure 2. Level of postoperative spectacle requirement in patients (N=52) enrolled in the trial.

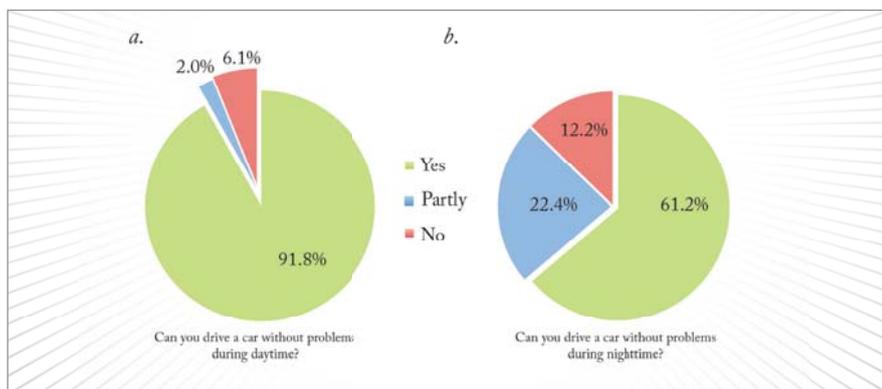


Figure 3. Postoperative disturbances experienced during night time driving.

the DATE scale, we found that the amount of glare reported in lower light was significantly higher, with values distributed equally throughout day and night. Though patients were able to perceive halos and glare, they all stated that they experienced little to no impairment of daily life – and even with these aberrations, they preferred the convenient lifestyle they had after mIOL implantation to their previous lifestyle with glasses. One patient said, “I don’t know if anyone can imagine how it feels to wake up and not see. Everything is blurry. [...] For me, those times are over. I wake up and I can see my husband beside me. It was weird not having to look for my glasses, but now it feels so much better being free and seeing what is around me.” In general, patients have

no problems with visual disturbances under normal light conditions – and even under especially bright or low light, they report very few issues.

I believe our results demonstrate that overall, our patients are very satisfied with trifocal mIOL implantation compared to their previous vision correction. The AT LISA tri 839MP lens offers a high level of spectacle independence and gives patients the option of intermediate vision as well as near and far (4) – something that has greatly improved their lives. In light of our findings, perhaps it’s time for ophthalmologists to pay more attention to intermediate vision, and to remember that it can be an important contributor to both visual function, and patient satisfaction.

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Further online content at top.txp.to/0715/interview.

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The Misnomer of Monovision

Monofocal IOLs allow patients to retain good near and distance vision, typically with high levels of satisfaction. So why isn't monovision more popular with surgeons?

By Ray Radford

Monovision is not a new concept. In fact, some people's vision is naturally set up to provide them with both distance and near vision, helping them avoid presbyopia without a doctor's help. So why is this vision solution so overlooked by cataract and refractive surgeons? At the 2013 meeting of the European Society of Cataract and Refractive Surgeons (ESCRS), there was only one main speaker to discuss monovision. During a UK talk, I asked an audience of consultant surgeons to raise their hands if they routinely discussed presbyopic correction – in particular using monovision techniques – with their UK National Health Service (NHS) patients.

At a Glance

- As cataract and refractive surgery improves, patients' demands grow – “perfect” vision, with good near and distance focus, is now what many patients want
- Monofocal intraocular lenses are one way of achieving the best possible range of vision for patients without introducing unwelcome aberrations
- Though many surgeons doubt patients' ability to adapt or be satisfied, monovision has been successful in the over 90 percent of patients
- The key to patient satisfaction with monovision is to listen to your patients, clarify their expectations, and establish reasonable and well-understood goals

Out of about a hundred surgeons, fewer than five hands went up. It's clear that monovision isn't getting people's attention. So why should we offer it to our patients?

Most patients in NHS practices are between sixty and ninety years of age. They're all presbyopic by default. In the NHS, a monofocal lens is the “standard premium” lens. Monofocal lenses have been developed over the last 50 years, so at this point they are extremely well manufactured of high quality and very reliable. The Royal College of Ophthalmologists considers it best practice to offer patients a choice of focus – we know that patients who are myopic may wish to remain myopic because that's what they've been used to all their life, whereas those who suffer from hyperopia have had the disadvantage of losing their near vision much earlier and have always been spectacle-dependent, so it's nice to offer patients the option of seeing in the way they're most comfortable seeing or giving them something new.

Demanding patients

As the accuracy and recovery of cataract surgeries continue to improve, patients now expect – and demand – better outcomes, not just in terms of the surgical success itself but in terms of refractive results. I recently had a patient worried that her vision wasn't perfect within 24 hours because her neighbor, who had undergone the same cataract surgery days before, could see perfectly well by then. Such is the rapid recovery of most elderly patients from NHS cataract surgery.

Given that our patients are more demanding as a result of our own improvements, it seems only sensible to have a discussion with them about their refractive outcome expectations. Many will tell you they want the best possible distance vision – but they're disproportionately surprised and dismayed to find they don't have equally good near vision after successful surgery as they have not really

listened to or understood the preoperative consent. People hear often only what they want to, readily listening to the positive message about how great modern cataract surgery is, assuming wrongly this is for all distances and tasks. Some consultants even run practices dedicated to implanting secondary lenses or offering other procedures to patients whose ametropia has been well treated, but who didn't fully understand before surgery that they would lose their near vision as a result. So to me, it makes sense to offer people the option of retaining some near vision in one eye before going ahead with cataract surgery and making sure they understand what is meant by near and distance vision by physically demonstrating with charts and reading font books.

Avoiding “Vaseline Vision”

Monofocal lenses have some specific advantages over multifocal intraocular lenses (mIOLs), and key among them is the much higher mIOL exchange rate. Nearly all patients will suffer from glare or dysphotopsia of some type when using mIOLs. There's also often an overall reduction in contrast and many of patients will complain of “Vaseline vision,” a common term for complaints of filmy, waxy or hazy vision after implantation (1). So widespread is the knowledge of that problem that some experts in the field recommend early surgery on the second eye, so that patients can't compare one against the other. The one thing no multifocal surgeon would recommend is the implantation of a monofocal in one eye and a multifocal in the other – that isn't considered best practice. But mIOLs are not the only way.

For some people, monovision is a natural state. Others have already tried it using contact lenses. It isn't new to the surgical scene, either; if you type the term into an Internet search, you'll find a plethora of advertisements recommending monovision created by LASIK. Clearly,

then, we're very used to offering it to patients – and patients are ready to try it. So why don't we include it in conversations about NHS cataract surgery, too?

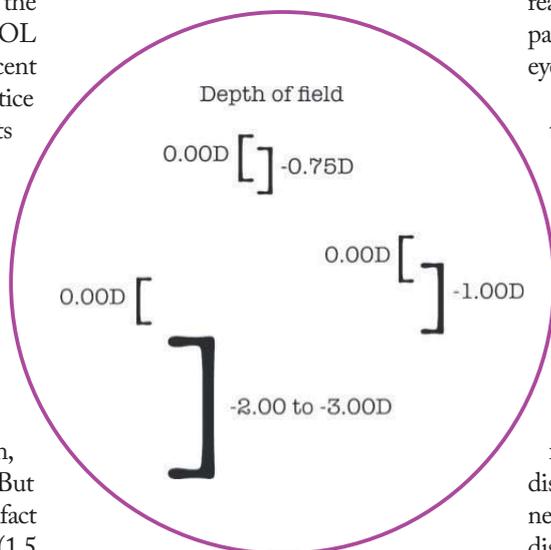
Satisfaction

For many years, the literature has papers from all over the world supporting monovision. Figures vary between publications, but satisfaction with intraocular lens monovision certainly reaches 90 percent (2,3), which agrees with my own experience. This outperforms most of the quoted figures for multifocal lenses (4–6), which isn't surprising given that a monofocal lens doesn't have all the disturbing visual symptoms of a mIOL (4). It's worth noting that some recent publications discussing multifocal practice have suggested that, to give patients the best outcome and guarantee better near vision, surgeons should consider a mIOL with preferential near correction. It strikes me that, in simpler terms, this is just monovision – but with the potential disadvantages of mIOLs.

Risking binocularity?

The major concern with monovision, of course, is the risk to binocularity. But I don't often see discussion of the fact that patients with recent, genuine (1.5 to 2.0 D anisometropia) monovision actually maintain summation. The eyes, of course, don't actually see anything; the brain interprets the images it receives. We've all had patients who, in a single eye, have attained 6/5 and N5 with a simple monofocal lens despite minor astigmatism – indicating that the visual system in certain individuals is capable of far more than we assume. We certainly don't understand it fully. But, given the brain's ability to interpret visual information so well and to maintain summation, then as long as we don't give people an extreme degree of monovision, (>3D of anisometropia) the most likely result is a very happy patient.

In those terms, monovision is actually a misnomer. Most patients will maintain binocularity, particularly if we don't exceed a refractive aim of -1.5 D in either eye. I have my own set of guidelines for different types of patients. In hyperopes, for instance, I tend to go up to 0.75 D to give them some near vision. Most patients achieve around the N8 mark, which is about the size of newspaper print. For patients with a lower degree of hyperopia or low myopia, up to 1 D in the near eye usually gives them reading vision on the order of N6 – but if they want particularly



good near vision, then an aim of 1.5 D usually achieves an N5 correction unaided. Patients who already have refractions of above 3 D, I leave with 2 D in their near eye, which usually results in N5 to N4.5 vision. I do occasionally aim for -3 D in extreme myopes, because they have already adapted to holding things close and prefer to maintain that status quo. I find it slightly annoying when people tell higher myopes holding things close, “You're not looking at it properly,” when that's perfectly acceptable given that's the way their vision works. Why change that,

when to do so would reduce their comfort and satisfaction?

Understanding the patient's needs – and delivering what you promise

There are similarities between counselling patients for monovision and for multifocals, because there's no guarantee that they won't use spectacles for some tasks. Some people are very detail-oriented and want a very specific focus at very specific points, so they still want three pairs of glasses for their daily activities. Not everyone needs that – most people get by with the depth of focus that blended vision provides. I also think it's very reasonable to check dominance and, if the patient has a clear preference, correct that eye for distance.

Consultants who offer monovision feel that it's important to make sure distance correction is as good as possible, and I fully agree. Patients' vision should be at or above driving standards – at least 6/9, and preferably 6/6, in the distance-corrected eye. To achieve this, we need good surgery and accurate biometry. To make refractive correction as accurate as possible, I suggest doing the near eye first. This allows fine-tuning of their distance eye and, having achieved some near vision, the patient is delighted to see distance once they've had the second eye done. In my experience, most people don't want to lose all their near vision, either. The hyperopes I treat are amazed to be able to read anything at all, though I take care not to push their near correction too far. But neither of these is a hard-and-fast rule; patient preference should always be taken into consideration when making any surgical plan.

Why does monovision work?

So why does monovision actually work? Despite a number of very senior surgeons in the UK who say it doesn't, it certainly works for a majority of patients. It works because we retain some depth of field –

and possibly because modern monofocal lenses are premium lenses and therefore have very few aberrations, resulting in better quality of vision. Patient preparation is key, too. It's always interesting to ask patients, before offering refractive correction, what their expectations are, what they already know, and with whom they've discussed it. Some patients come already primed to ask for monovision based on success in people they know or having tried contact lens monovision prior with success. Others come in saying they don't want it based on other information they've gathered from their opticians or from people who've tried contact lens monovision and been unhappy with it. In cases of doubt or strong preference against, I respect the patient's wishes and avoid monovision. The issue with contact lenses monovision dissatisfaction, though, is potentially that the patient's vision isn't static. People taking their contact lenses in and out means the brain has to adapt to the new image each time the refraction changes, rather than adapting to a constant stimulus and or adapting and accepting the images being processed.

I find it interesting that some multifocal practitioners tell their patients they need to wait up to six months to adapt to the new image. I've only had one patient take three months to adapt, and he had a high degree of monovision. The majority of patients seem to adapt within hours or days – a few weeks at the most. Through close liaison with occupational health doctors, I've provided monovision to many professionals for whom sight is vital, from police drivers to surgeons, and they have all found monovision to be not only convenient, but excellent. When I have asked should I use a multifocal in professionals with visually demanding occupations the answer has usually been to avoid doing so.

Who might benefit?

Of course, it isn't for everyone. Not all

patients are happy with their degree of monovision. I had a myopic patient who wanted more myopia because that's what they were used to, which is why I prefer a near aim of at least -1.5 to -2 D in myopes. There was another who had a fantastic result, 6/6 and N5 unaided, but wasn't comfortable, so they had a secondary lens implanted to make both eyes distance-focused. I've even had a patient who had 6/6 and N5 vision unaided, but was dissatisfied with their middle distance vision and couldn't improve it by using glasses – so again they sought secondary correction to have both eyes the with the same focus. But these represent only a handful of people out of many hundreds and, compared to some of the success rates in previous generations of multifocals, the overall results are very encouraging. There are, of course, cautions when giving people monovision, particularly in the presence of ophthalmic disease or at high degrees of astigmatism. Surgical incisions might help reduce corneal astigmatism, and it's possible to reduce up to two diopters simply by providing opposite clear corneal incisions – although, for more marked astigmatism, a toric lens offers the best chance of success. Toric lens monovision works, I have experienced it.

Explaining, listening and gaining mutual understanding

The most important aspect in providing monovision is to understand the patient's needs and expectations, and to communicate clearly with your patients and colleagues to ensure that everyone understands what the aims are and what's achievable. For surgeons who have not previously offered monovision on the NHS, it's probably best to start cautious and offer 0.5 to 0.75 D to interested patients. That will give them at least some degree of near vision. Meanwhile, build your confidence by looking at world literature. There are plenty of recent papers from China and the USA,

both of which have huge populations of patients receiving monovision. But the single most important concept to grasp is that communication is paramount. Explaining, listening and gaining mutual understanding is critical to achieving patient satisfaction.

In practices where patients are heard and their expectations managed and met, I truly believe that "monovision" is, as I've said, a misnomer. Satisfied patients would agree with me that better names for the procedure might be "presbyopic corrected vision," "spectacle-free vision," or even the term that I feel really sums it up best – "clear vision." Patients themselves often sum it up as simply "amazing" or "brilliant."

Ray Radford is a consultant ophthalmic and oculoplastic surgeon at multiple practices in the UK.

Online: See the summation effects and more at top.txp.to/0715/monovision.

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For Surgeons, By Surgeons
Ocular Biometry and IOL power calculation can be time-consuming, not always straightforward, and refractive surprises occur. A new ocular biometer, conceived by jobbing cataract surgeons, promises to eliminate those issues.

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Lessons from the Deep
Around one in four patients will eventually experience posterior capsule opacification. YAG lasers can deal with it, but what if there was an IOL that could eliminate it altogether?

For Surgeons, By Surgeons

A new ocular biometer automates IOL selection and offers an exciting alternative to sometimes unpredictable IOL power formulae

By Michael Mrochen, Arthur Cummings, Eugene Ng, and Ronan Byrne

In the early days of cataract surgery, before the days of A-scan ultrasound axial length biometry, ophthalmologists used a standard 18.0 D prepupillary intraocular lens (IOL) to replace the cloudy crystalline lens they had just extracted – and patients were expected to have the same degree of refractive error after surgery as they had beforehand. But in the 1970s, surgeons began calculating the power of the IOLs they inserted to achieve better vision, based on biometric measurements of the eye – principally, the axial length and keratometry. Many even required “A-constants” – theoretical values specific to the

design and placement of individual IOLs. As IOL types diversified and procedures improved, patients began expecting better results from their cataract surgeries. Today many patients demand good vision at both near and far distances, and spectacle independence is the order of the day.

Assumptions and estimations

To accomplish this, surgeons have a variety of different formulae at their disposal to estimate appropriate IOL power. A key part of this estimation is the effective lens position (ELP), which currently relies on the accurate measurement of anterior chamber depth and corneal refractive power, as measured by corneal keratometry or topography. But there are a number of factors and assumptions that can confound this process: each IOL has its own constant that needs to be plugged into the formula, and assumptions are made about the curvature of the posterior corneal surface. Furthermore, if prior refractive surgery has been performed, then IOL power calculators (like the one available online at ASCRS.org) won't produce a single power recommendation – they will present you with a wide range of options... which is less than ideal. Even without prior refractive surgery, you can make your measurements, follow the rules, use the calculator, and your patient can still experience a “refractive surprise.” Despite the fact that laser refractive surgery results in vision within 0.5 D of the intended target up to 92 percent of the time, fewer than 60 percent of IOL implantations after cataract surgery achieve this goal. Sometimes, there are additional problems like eyes that can't be measured with the current generation of ocular biometers because of dense cataract, or errors in data entry or transcription.

What it comes down to is that,

historically, IOL power formulae are good for the “average” refractive outcome, but do a poorer job of predicting individual outcome – especially in eyes with special considerations (such as those that are particularly short or long, astigmatic, or have had previous refractive surgeries, and thus require specific formulae). Understandably, after the effort of determining the best formula to use and then calculating appropriate IOL powers, many surgeons find the relative unpredictability of IOL implantation outcomes frustrating. That's what drove us to come up with a tool to help eliminate refractive surprises; what we believe to be a better ocular biometer: Mirricon.

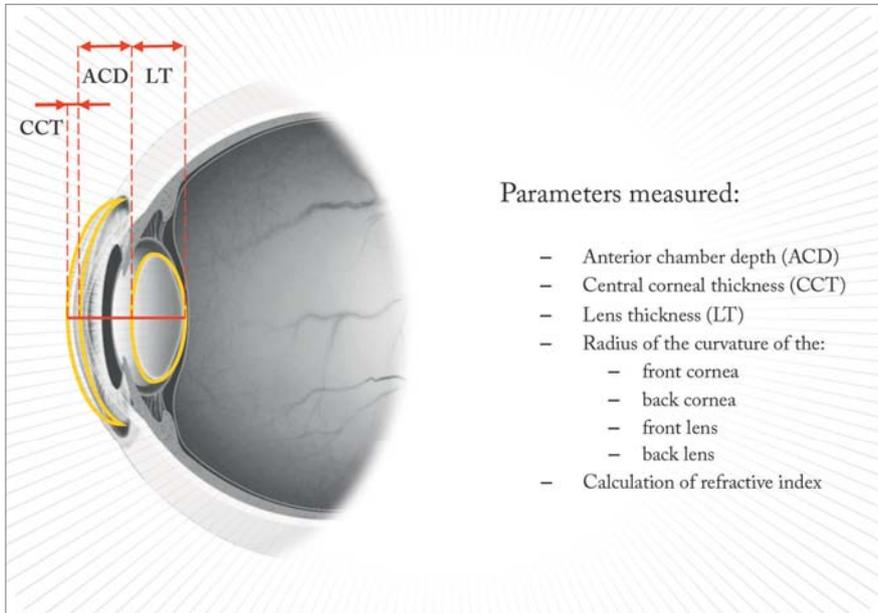
“By creating a device capable of such measurements, we wanted to enable ourselves to choose the best IOLs for our patients without having to wrestle with formulae and IOL calculators.”

A surgeon-led story

The inspiration for Mirricon came from our work on ray tracing for laser refractive surgery. It occurred to us that, if we measured all of the optical surfaces in the eye, we would be able to more

At a Glance

- Surgeons currently have a variety of IOL power formulae at their disposal, but even so, unexpected surgical results are not uncommon
- While working on ray tracing, we were inspired to develop an ocular biometer, Mirricon, that measures every refractive surface in the eye
- Mirricon can calculate lens position and IOL power required without resorting to IOL power formulae
- Our device has just completed an independent and prospective 114-eye trial that has shown it to provide equal or better performance compared with current optical biometers



Parameters measured:

- Anterior chamber depth (ACD)
- Central corneal thickness (CCT)
- Lens thickness (LT)
- Radius of the curvature of the:
 - front cornea
 - back cornea
 - front lens
 - back lens
- Calculation of refractive index

Figure 1. The ocular parameters measured by Mirricon using a combination of Purkinje imaging and optical coherence measurements.

accurately estimate the geometrical position of the IOL after implantation. Rather than guessing the lens' position based on the characteristics of the eye, we thought: why not use data gathered by measuring all of the eye's optical interfaces to model the ocular tissues? By creating a device capable of such measurements, we wanted to enable ourselves to choose the best IOLs for our patients without having to wrestle with formulae and IOL calculators.

To accomplish this, Mirricon uses a new way of combining Purkinje imaging and optical coherence measurements. This combination is not only powerful, but it's also a completely different technology to anything else currently on the market. Basically, it performs a keratometry-type measurement to assess the topography of each individual surface of the eye (curvatures of the corneal front and back surfaces and lens front and back surfaces, as well as other dimensions of the eye; Figure 1) – something that is pretty unique. When you combine that

with an optical coherence measurement system, you gain valuable technical advantages that allow us to minimize error and maximize accuracy.

The story of Mirricon's creation is unique in that its foundation lies in a surgeon-driven innovation. From the initial inspiration – the confusion of so many different IOL formulae that don't always provide desirable outcomes – to its ultimate development, the kind of people who are going to use the instrument are the same as the ones developing it: cataract/refractive surgeons.

To the test

After the idea was conceived, Ireland's National Digital Research Centre in Dublin helped with assembling a team and building the first research system. ClearSight Innovations Ltd was spun out of this collaboration, in order to commercialize the technology and create a prototype that could be brought to clinical trial. It did, and the trial commenced in July of 2014. The trial's hypothesis was that Mirricon, thanks to its full ray tracing

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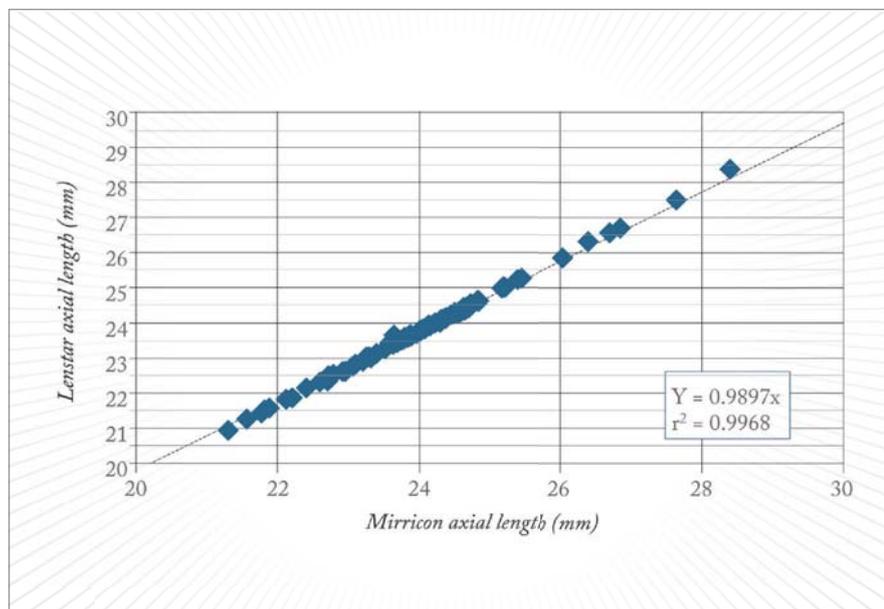


Figure 2. Correlation between ocular axial length measured by Mirricon and the Lenstar device. Both devices measured comparable axial lengths over a wide range. The Lenstar tends to measure the eyes to be longer for higher myopes.

“We still have some progress to make; the device is a prototype at the moment, but we’re working to develop a final version.”

capabilities, is at least equal to or better than current standard-of-care devices. But unlike them, Mirricon doesn’t use formulae or A-constants; instead, it predicts lens position and IOL power from the comprehensive measurements of all of the refractive surfaces of the eye.

The trial was a single-site, prospective,

observer-masked study, and compared Mirricon with Haag-Streit’s Lenstar optical biometer (Figure 2). From a population of people suitable for monofocal IOL implantation secondary to cataract, 114 eyes in 95 patients were implanted using IOL powers determined by Mirricon. The main objectives of the study were to demonstrate Mirricon’s non-inferiority in predicting postoperative refraction to within 1.0 D of actual three-month outcomes, and in obtaining preoperative measurements in patients’ eyes – both of which were achieved. In fact, the surgeon was actually able to get more eyes to within 1.0 D of target using Mirricon than using the current standard of care – all without using any formulae or IOL power calculators. We were even able to show the superiority of Mirricon to standard-of-care devices in handling patients with astigmatism.

Another important outcome of the study is that, while the Lenstar was only able to measure 95 percent of

eyes, Mirricon achieved measurements in all of them – so even in more difficult situations like dense cataracts, where surgeons might normally turn to ultrasound or other options, Mirricon can still measure. Not only did the device provide equal or better performance (while eliminating human transcription errors), it also sped overall workflow in complex patients, as the use of additional devices to perform biometry was not required.

There’s more than one way to skin a cat – and that’s true of ocular biometry, too: Mirricon’s technology is very different from its competitors’. We still have some progress to make; the device is a prototype at the moment, but we’re working to develop a final version. There are more clinical trials in the pipeline, including ones on patients receiving toric IOLs and on post-LASIK patients. Though there’s work to be done, we’re looking forward to providing ophthalmologists with a fast, easy-to-use, surgeon-inspired, ocular biometer and IOL power calculator for use in the clinic.

Michael Mrochen is the founder of IROC Science AG, Zürich, Switzerland, and is co-founder and Chief Technology Officer of ClearSight Innovations (CSI), Dublin, Ireland.

Arthur Cummings is a consultant ophthalmologist at the Wellington Eye Clinic and UPMC Beacon Hospital, Dublin, Ireland, and is CSI’s chief clinical advisor.

Eugene Ng is a consultant ophthalmologist at the Institute of Eye Surgery, Whitfield Clinic, Waterford, and at the Wellington Eye Clinic in Dublin, Ireland, and holds shares in the NDRC (from which CSI was spun out).

Ronan Byrne is co-founder and CEO of CSI.

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Lessons From the Deep

Can the combination of 360° haptics and a novel protective membrane, which emulates the pattern found on shark skin, in a single IOL prevent PCO and make YAG laser capsulotomies a thing of the past?

By Chelsea Magin

Each year, 22 million people worldwide undergo cataract surgery— and that number is set to rise to 32 million by 2020, according to the World Health Organization. Most of the time, it's a hugely successful procedure, but for approximately 25 percent of that 22 million, their vision may deteriorate afterwards. Why? Posterior capsule opacification (PCO), which results from the growth and abnormal proliferation of lens epithelial cells (LECs) that were present on the capsule at the time of cataract surgery. The LECs migrate

At a Glance

- There have been many attempts to try to minimize the development of post-cataract surgery PCO, but ~25 percent of patients still go on to develop it
- Nd-YAG laser capsulotomies help address it— but this involves additional costs and is not without risk
- An IOL that combines two PCO-combatting measures— a 360° haptic design, and a membrane that combats lens epithelial cell migration— has been developed
- Preclinical rabbit studies have shown great promise, which if delivered in a clinical setting, could spare millions from Nd-YAG laser capsulotomy over the coming decades

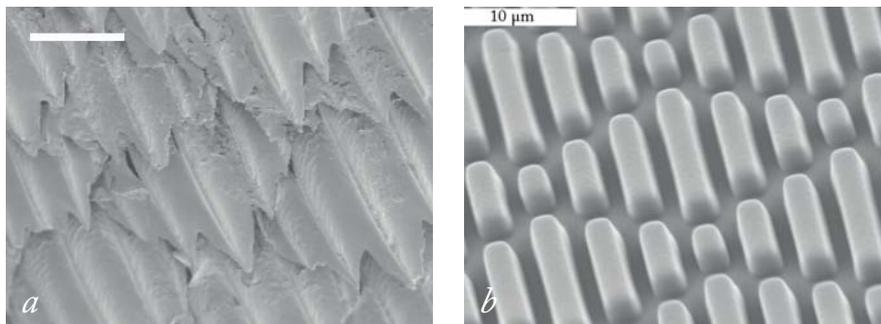


Figure 1. Shark skin (a) and the Sharklet micropattern (b) under the microscope.



Figure 2. ClearSight IOL design, displaying 360° square-edged haptics and the Sharklet pattern.

to the posterior capsule where they undergo aberrant differentiation into fiber-like cells or transdifferentiation into fibroblast-like cells, obscuring the central visual axis, causing hazy vision.

It's not the end of the world — if PCO occurs, it can be treated with a YAG laser capsulotomy, which is effective and relatively quick — but obviously, second surgical procedures are associated with additional costs and risks. The costs are handled differently depending on each country's healthcare system — in some countries, the YAG laser costs are bundled into the initial cataract surgery; in others they remain separate. In the US, where we're based, Medicare data shows that the costs of PCO are significant: around \$350 million per year, and that's set to rise to \$1 billion by 2050.

Shark stimulus

What if there were an IOL that could dramatically reduce the incidence of PCO? One way of achieving that would be to have an IOL that's resistant to LEC migration. Thanks to the landmark work of David Spalton, we've known for over a decade that square-edged intraocular lenses (IOLs) exert significantly more pressure on the posterior capsule at the optic edge than round-edged IOLs, forming a barrier against LEC migration and PCO. But as the contemporary PCO rates show: that isn't enough. What if there were a material that also made it much harder for LECs to migrate?

Sharks violate a primary rule of the ocean: things that go fast stay nice and clean; things that move slowly have things growing on them. Sharks move slowly and

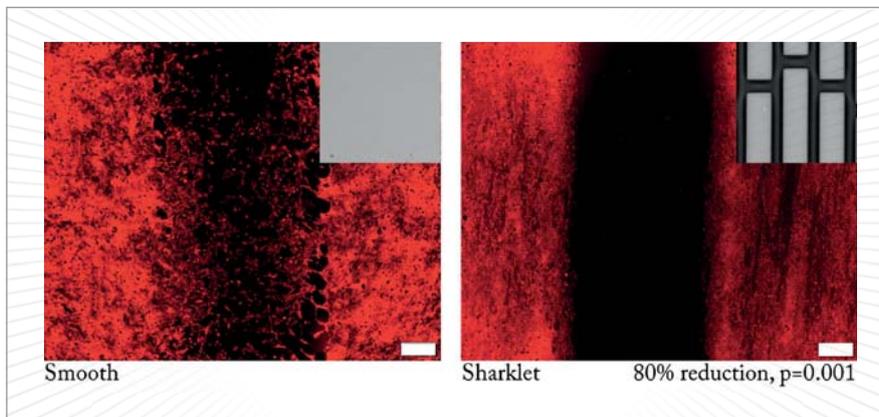


Figure 3. In vitro lens cell migration assays showed that the Sharklet (right) micropattern reduces cell migration by 80 percent compared with a smooth surface (left).

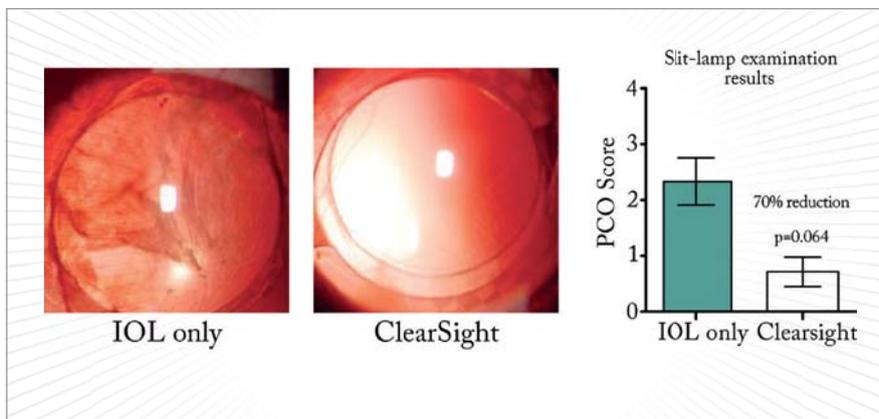


Figure 4. ClearSight IOL prototypes (right) significantly reduced PCO formation by 70 percent in a rabbit PCO model compared with standard IOLs (left).

are clean. The reason why is the physical properties of their skin: the microscopic pattern of shark skin actually inhibits colonization by everything from floating microorganisms to barnacles (Figure 1a). This texture has been replicated and refined, and the resulting pattern – Sharklet (Figure 1b) – is currently doing a great job of inhibiting bacterial migration in medical devices such as endotracheal tubes and venous and urinary catheters. This led us to question if an IOL that replicated this surface pattern could inhibit the LEC migration that causes PCO. To answer it, we developed the ClearSight posterior chamber IOL: a lens that combines a novel 360° square-edged

haptic design with a Sharklet-patterned protective membrane (Figure 2).

The power of the pattern

First, we tested a number of Sharklet micropatterns in a modified scratch wound assay for their ability to reduce or inhibit human LEC migration relative to a smooth surface control (1). The LECs freely migrated across the smooth surface control, whereas the best performing Sharklet pattern achieved an 80 percent reduction in human LEC migration (Figure 3). The unique discontinuous features that comprise the Sharklet micropattern allow for cells to be precisely guided away from the visual

axis using strictly physical stimulation. The best performing topography was selected, translated to a radial design, and applied to IOL prototypes.

Preclinical validation

Next, the ClearSight IOL prototype was compared with a standard IOL in a rabbit model of PCO formation (2). We observed considerable PCO with the standard IOL, and little to none with the ClearSight IOL – the new design reduced PCO scores by 70 percent in clinical examinations compared with the standard IOL design (Figure 4). Ophthalmologists who were blinded to the treatment group also evaluated slit-lamp exam images and confirmed that none of the ClearSight IOL prototype eyes would require YAG laser capsulotomy treatment. Clearly, the next step is for a clinical evaluation of the ClearSight IOL.

As the 360° square-edged haptics and the Sharklet pattern can be applied to monofocal, multifocal and toric lens designs, it holds the potential to reduce PCO in the vast majority of IOL use cases – and solve one of the most common surgical complications in one of the most commonly performed surgical procedures in the world.

Chelsea Magin is the Director of Product Development at Sharklet Technologies, Inc., Aurora, CO, USA.

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Look into the Intelligent Approach to Cataract Surgery

LENSAR with Streamline femtosecond laser is designed to meet the needs of cataract surgeons – simplifying their lives by enabling automation to key surgical elements such as workflow, astigmatism management and cataract removal

The evolution of femtosecond laser-assisted cataract surgery (FLACS) has been accelerating since Zoltan Nagy performed the first anterior capsulotomy in humans with a femtosecond laser as part of cataract surgery in 2008. Even the original smartphone is older – Apple launched the first iPhone in 2007, and since then, both products have improved beyond what could have been imagined back then. But it's not the smartphone that is giving people a glimpse at the future today; it's lasers like the LENSAR with Streamline Laser System.

The LENSAR with Streamline is expressly designed for refractive cataract surgery, and it brings what was tomorrow's features to today's refractive cataract surgeons. It is the first cataract laser system to enable automation of key surgical elements with the introduction of multiple new applications:

- Wireless integration with the Cassini Corneal Shape Analyzer
 - Other topographers, including the Topcon Aladdin biometer, are being evaluated
- Astigmatism Management
 - Iris registration

- Arcuate incision planning
- Steep axis corneal marks
- Automatic cataract density imaging
- Automatic fragmentation patterns

We spoke with three eminent refractive cataract surgeons about their experience with LENSAR with Streamline, and how it can help improve not only patient satisfaction, but also provide excellent clinical outcomes.

Rob Morris

Medical Director and Consultant Ophthalmic Surgeon Optegra Eye Health Care, UK

When Charlie Kelman began doing phacoemulsification in the late 1970s, he was told it would never work. I started doing it 20 years later, and a lot of surgeons still said things like, “This will never take off in my hands,” or, “In my hands, extracapsular surgery is just as good” – and look where phaco is now. New technology is always difficult to introduce, and often, the barrier to widespread uptake is cost. Technology is expensive and it takes a while to refine it and to gather enough evidence to prove its benefits. I think the adoption of FLACS is similar and the LENSAR with Streamline is going to take FLACS to the next level. One issue with standard laser capsulotomies is that it's performed slowly – microsaccades can mean that the laser can't perforate accurately. With the LENSAR laser, the capsulotomy can take less than two seconds giving tight perforations and virtually no tears. It is technology advances like these that will level the playing field on surgical skills and encourage more ophthalmologists to use FLACS.

A workflow solution that meets your practice's needs

Convenience helps, too; the LENSAR laser has a small enough platform to be

kept in the operating room, so that the patient doesn't have to be moved from one place to another. It also does not have a fixed bed, so if you have a patient under sedation, you can just swing the laser over without having to reposition them. And of course, the final major factor is cost. In the Optegra business model, the patient pays a fixed price for clear lens extraction regardless of which devices are used and what lens is implanted. So the LENSAR laser is an attractive option in that it has a faster and more convenient workflow, which should appeal to any surgeon considering a move to femto-phaco.

A solution tailored to your patient's cataract

A big advantage of the LENSAR laser is that its patient interface (Figure 1) requires minimal pressure to be applied to the cornea. It's a fluid-based system with low suction pressure, so there is little or no risk of central retinal artery occlusion and the patient can still see. But best of all, prior to treatment, the system takes up to 16 scans and reconstructs them into a detailed 3D image that can be used for extensive treatment planning including automatically optimizing the fragmentation based on the cataract density. The way OCT based lasers work is that the surgeon sets up fragmentation patterns prior to the procedure without any customization based on cataract density.

LENSAR with Streamline uses Scheimpflug imaging to visualize the cataract in enough detail to allow automatic classification of the cataract density; then, the device can set up the surgeon's pre-selected fragmentation pattern for the appropriate cataract density even allowing for the automatic isolation of fragmentation to the nucleus (Figure 2). Just like we wouldn't put unnecessary phaco energy where it wasn't needed, instead of universally applying a burst of laser energy to the entire lens

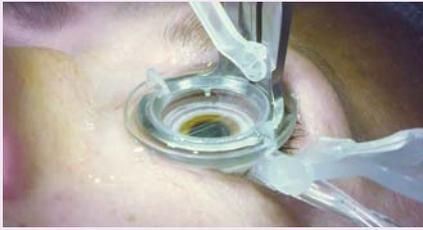


Figure 1. The LENSAR low-suction, non-applanating patient interface.

volume, the LENSAR with Streamline will customize the fragmentation appropriately to each individual cataract, saving both time and energy.

Iris registration

I think what's really going to set LENSAR with Streamline apart is the fact that it's the only femtosecond laser with iris registration technology (Figure 3). I think it's a key advantage because I have so many patients whose trickiest issue is astigmatism. The iris registration feature allows for automatic adjustment for cyclorotation that vastly improves incision accuracy versus ink marking the eye. Sometimes patients have a small amount of astigmatism – a diopter or so – and the patient or the surgeon may not want to use a toric IOL. Streamline lets me address that – I can treat the astigmatism at the time of surgery by planning arcuate incisions along with the cataract procedure.

Unparalleled accuracy

LENSAR with Streamline is great for increasing accuracy and reducing error too, because Streamline includes wireless communication with the laser to automatically populate key patient data from the Cassini. That means you minimize the risk of treating the wrong axis, and you can't make manual errors in transcription. The British cycling coach Dave Brailsford gave a very good analogy for cycling which I think is applicable for FLACS; he said that if you strip a bike down and rebuild it with

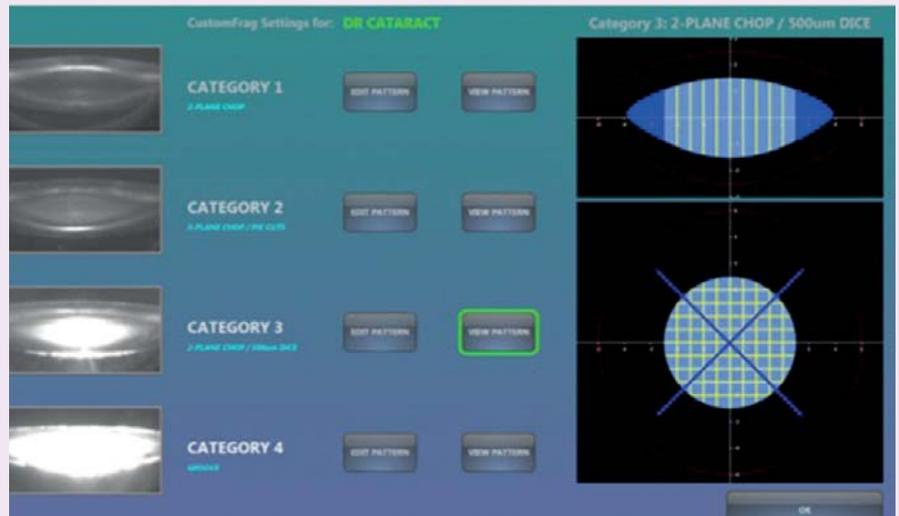


Figure 2. Streamline automatically categorizes cataract on a scale of 1 to 4 based on cataract density and determines the nuclear density and location.

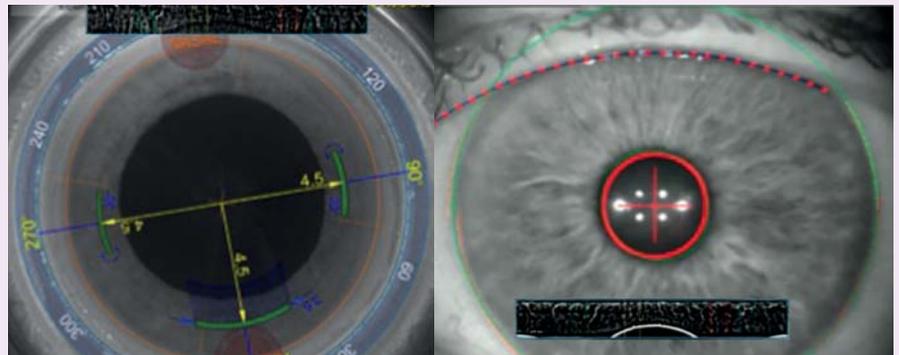


Figure 3. After docking the patient, iris registration ensures all procedures are performed at the appropriate axis – without manually marking the eye.

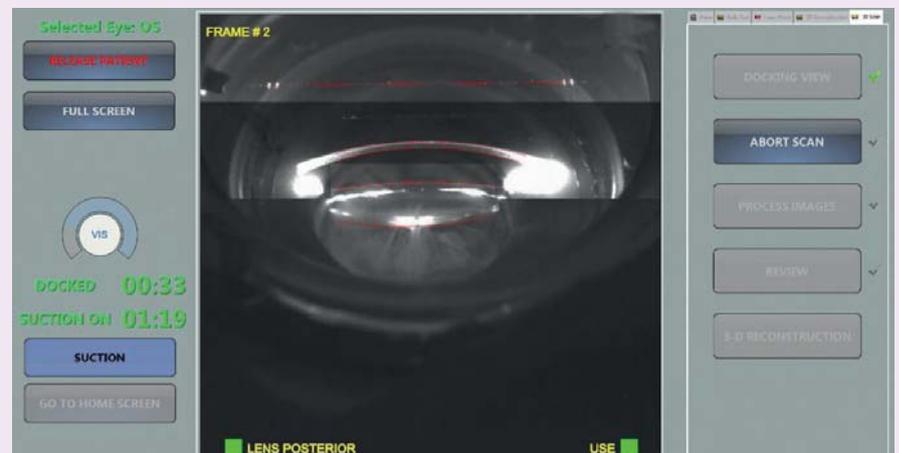


Figure 4. Real-time augmented reality imaging superimposed over Scheimpflug brings shows the surgeon the most appropriate information during the procedure.

a marginal improvement to each part, the overall improvement is significant: the philosophy of marginal gains. All of these improvements to cataract and refractive surgery are marginal gains, like

the parts of a bicycle, but I think there are a lot of those gains to be made using LENSAR with Streamline, and they add up to a very big step forward indeed.

The Evolution of Cataract Surgery

- 1949: Harold Ridley implants first intraocular lens (IOL)
- 1959: Cornelius Binkhorst coins the term “pseudophakia”
- 1967: Svyatoslav Fyodorov publishes first IOL power formula
- 1967: Charles Kelman introduces phacoemulsification to cataract surgery
- 1972: Nicholas Brown pioneers use of Scheimpflug imaging for cataracts
- 1975: Jack Hartstein patents bifocal IOLs
- 1990: John Shepherd invents in-the-bag fracturing, hydration and quartering of nucleus for phaco
- 1998: First toric IOLs to correct astigmatic vision introduced
- 2001: First use of a femtosecond laser in ophthalmic surgery (LASIK flap creation)
- 2008: Zoltan Nagy performs the first femtosecond laser-assisted anterior capsulotomy
- 2010: First femtosecond laser gains FDA approval for cataract surgery
- 2011: First femtosecond laser gains CE mark for cataract surgery
- 2015: LENSAR with Streamline launched

Robert J. Weinstock

*Ophthalmologist, The Eye Institute of West Florida, Largo, FL, USA
Assistant Clinical Professor, University of South Florida, Tampa, FL, USA*

With the recent release of Streamline, the LENSAR laser has a range of new features for surgeons – wireless integration with Cassini, iris registration, astigmatism treatment planning, steep axis corneal marks, automatic cataract density imaging, and automated lens fragmentation patterns. Most impactful among these in my view are the improvements to astigmatism management using the laser.

A speedier workflow

Until now, we’ve had to do corneal ink marking to align the laser and the primary meridians of the cornea. But with the new software, we can perform iris registration based on a preoperative image taken by the Cassini Corneal Shape Analyzer and wirelessly feed that information directly to the laser. The Cassini verifies image compatibility at the point of capture to minimize the risk of cyclorotation compensation failure once the patient is already in the operating room. Streamline corrects for cyclorotation after docking to the laser using iris architecture details from the Cassini image, this means that the surgeon does not need to visually verify that cyclorotation compensation was accurate, as is the case in some vessel-based tracking systems. The automated data transfer reduces procedure time and complexity, eliminates transcription errors, and allows surgical staff to focus on the procedure itself rather than on moving data between devices.

Efficiency and automation for excellent outcomes

After the patient is docked under the laser and iris architecture details are registered, multiple astigmatism management

techniques are available such as arcuate incisions or steep axis corneal marks that a surgeon may use to guide toric IOL placement. The benefit of using the laser to manage astigmatism is that I am confident that the treatment is at the appropriate axis – unlike manual ink marks. No matter how well astigmatism correction works, it won’t give us a good result if it’s not at the right axis.

Streamline has built-in arcuate incision planning tables where surgeons can enter a surgically induced astigmatism measurement and a nomogram of their own calculation. The software will automatically account for that and plan corresponding arcuate incision locations, depths and lengths, or corneal steep axis marks. It also corrects for cyclotorsion by comparing a preoperative iris image to the dilated iris after the eye is docked. That’s unique to Streamline – no other laser system compensates for cyclotorsion after docking the eye to the laser, thus minimizing the potential for changes caused by the docking process itself (Figure 1). Having all that surgical planning automated is also a big time saver, as well as reducing the risk of calculation errors, so it’s a major improvement in the astigmatism management component of laser cataract surgery.

Look into more precise treatment

I noticed early on that LENSAR with Streamline’s Scheimpflug imaging system (Figure 4) gave me a very different look at the anterior segment of the eye compared to the OCT imaging systems of other lasers. OCT doesn’t pick up on cataract density as well as Scheimpflug imaging – but it’s important information, because a denser cataract might call for more robust fragmentation. Streamline classifies the cataract based on its density and then recommends an appropriate laser fragmentation pattern. Those automated fragmentation patterns are based on parameters that I programmed when the Streamline was first installed on



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my laser. Once the automated patterns were set up, I didn't have to worry about changing patterns routinely during my surgical day. Additionally, the cataract density imaging feature allows me to restrict fragmentation to the nucleus to optimize where the laser energy is used to provide the best fragmentation. I've found that feature extremely useful; Streamline lets me reduce the laser energy I'm applying to the eye and avoid issues like sticky cortex that can result in increased phaco time. That makes the cataract density imaging system (Figure 2) a big advantage in terms of both laser energy and time savings.

Avoiding the excimer laser

LENSAR with Streamline can also be used on patients with issues related to astigmatism – like those who have refractions that are close to plano from a spherical equivalent standpoint but still have an astigmatism that affects their vision. Now that we have iris registration, there's definitely a role for Streamline in managing astigmatism correction on a patient – instead of say creating a flap, then using an excimer laser to ablate the cornea to correct for that astigmatism after cataract surgery. So by doing a small or large laser arcuate incisions on the cornea using LENSAR with Streamline, we're able to reduce the cylinder to the point where uncorrected visual acuity is sufficient to allow refractive cataract patients to see well at distance.

Ulrich-Christoph Welge-Lüssen

Senior Physician and Associate Professor of Glaucoma and Anterior Segment University Clinic Erlangen, Germany

I have performed more than 8,000 procedures using manual rhexes and standard phacoemulsification during my career to date. With the introduction to

the laser-assisted cataract surgery, I had to adjust my surgical approach to optimize the procedure. For instance, I used a basic setup to perform capsulotomy initially, and I often had difficulty with cortex removal, as the fibers seemed to adhere to the edge of the capsulotomy. I had to take my irrigation/aspiration system under the edge of the capsulorhexis to remove them – something that no surgeon likes to do. But we reduced the laser energy during the capsulotomy we achieved much better results. The cortex fibers did not stick anymore to the edge of the capsulotomy and fibers were free hanging in the center. So cortex removal was greatly improved, by using low energy in capsulotomy, and was as easy as in standard phacoemulsification.

Effective diagnosis with 3D Augmented Reality imaging

I've recently begun using the LENSAR and its 3D Augmented Reality feature. The cataract density imaging and automatic lens fragmentation patterns features that Streamline provides are very impressive (Figure 2). I've found that Streamline's classification system is very reliable and adapts to the individual lens characteristics by determining optimized fragmentation patterns – so I can use the lowest appropriate energy settings, which I feel is always the safest approach. I've seen a reduction of phaco energy by around 60 percent! The non-applanating patient interface should also cause less damage to the cornea than traditional applanating methods.

The “perfect capsulotomy”

That patient interface actually serves an even more important function, namely letting me create what I consider the perfect capsulotomy. When I use the LENSAR with Streamline, I can ensure that the IOL that I implant is perfectly covered by the edges of the anterior capsule. That's always beneficial, but it's especially important as about one in five of my patients receive

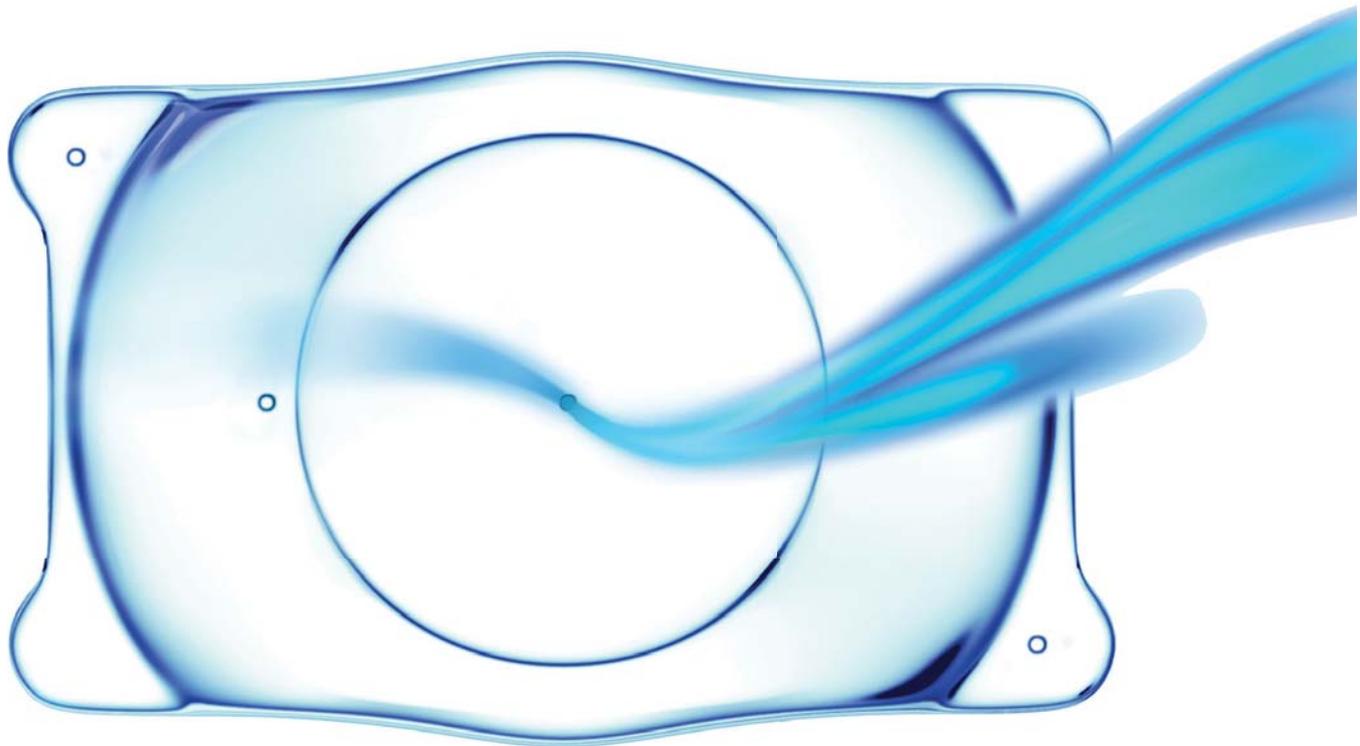
multifocal lenses. In that type of procedure, having the edges of the artificial lens covered by the edges of the capsulotomy is a real must. So far, I've performed 115 capsulotomies with the laser and I haven't had a single problem or complication. I always compare the technology to cars, which is a great analogy to use with patients – a standard phaco is a Volkswagen Golf, but a femtosecond laser like LENSAR with Streamline is a Mercedes S Class.

Automation helps beget safety

Because I focus so much on safety, I've found LENSAR with Streamline's preoperative assessment tools extremely useful. Streamline has wireless data transfer from the Cassini Corneal Shape Analyzer, which avoids transcription errors; automatic fragmentation planning, including cataract density imaging; the ability to predict and minimize the amount of laser energy that will be needed; and the ability to include arcuate incisions in the surgical plan, which may reduce the need for toric lens implantation, and if I need a toric IOL, steep axis corneal marks that I can use to guide lens placement. All of these things can be done on a single machine during a single procedure, so if something unexpected does arise, the surgeon can deal with it immediately.

Safety was the primary factor I considered when I decided to buy a femtosecond laser, but efficiency was also important – in the form of the workflow efficiency offered by automation and wireless transfer. I've been very happy with LENSAR with Streamline since I bought it; if I had to make the choice a second time, I'd definitely opt for the LENSAR with Streamline again – especially as the service from Topcon was excellent, both in setting it up and in training me to use it. In fact, if I were to have an IOL implanted myself, I'd like the doctor to treat me with LENSAR with Streamline, because I feel it's safer for the patient than other devices.

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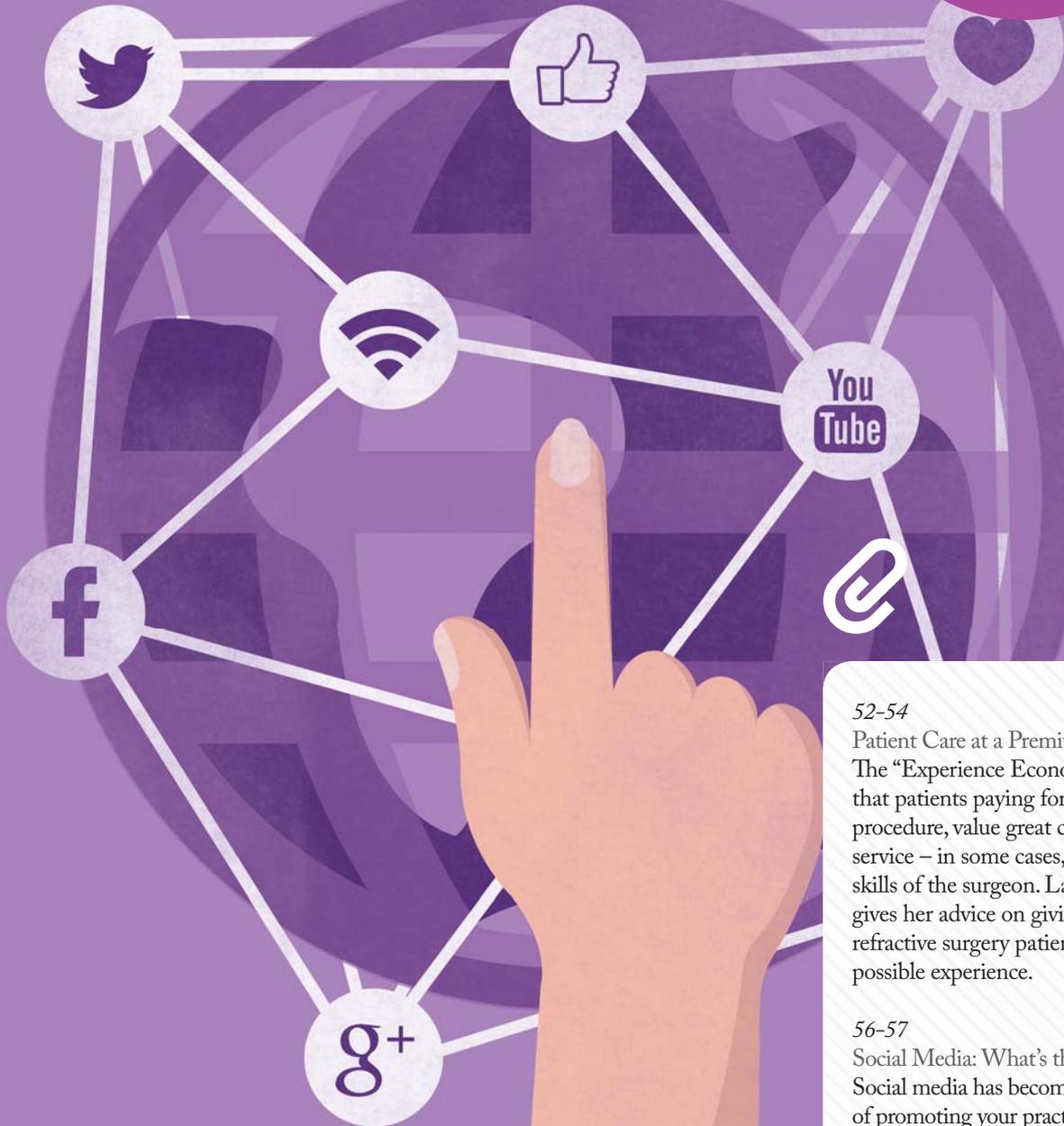
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52-54

Patient Care at a Premium

The “Experience Economy” dictates that patients paying for a premium procedure, value great customer service – in some cases, more than the skills of the surgeon. Laura Hobbs gives her advice on giving cataract/refractive surgery patients the best possible experience.

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Social Media: What’s the Point?

Social media has become a crucial part of promoting your practice and making connections. Daya Sharma explains how you can make sure you can remain visible and relevant to your prospective customer base using social media.

Patient Care at a Premium

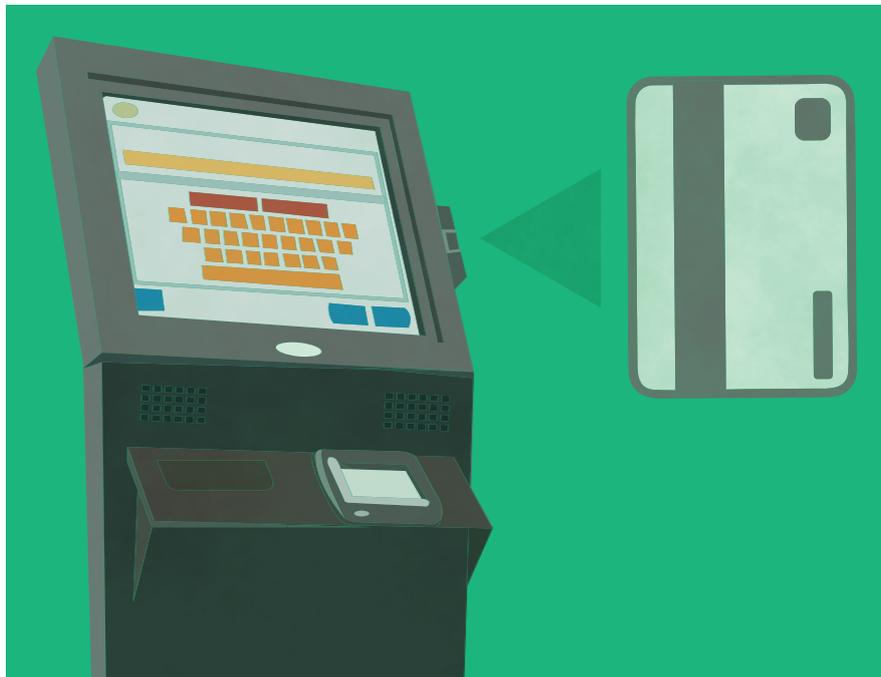
The rise of the experience economy means that ophthalmology practices must go to great lengths to ensure their patients are receiving not just the best medical care, but also the best possible customer service

By Laura Hobbs

In many commercial sectors, including medicine, the “experience economy” is now a powerful force. It’s an upgrade to the service economy, where rather than simply delivering a service, businesses must ensure that the time customers spend with them is memorable – the experience itself becomes the real product of the business. In the case of ophthalmology practices, this translates to making patients feel not just comfortable, but happy with their visits. It isn’t enough just to offer excellent eye care; ophthalmologists in

At a Glance

- *The rise of the “experience economy” means that people now expect the highest levels of customer service everywhere – including ophthalmologists’ offices*
- *Patient-facing staff must be friendly, available and educated to avoid sending potential patients away*
- *Technologies like check-in kiosks can improve the efficiency of high-volume practices and accommodate patients with additional needs*
- *Careful monitoring of patient-staff interactions can be combined with an incentive program to encourage front desk and telephone staff to perform well*



Check-in kiosks can't replace the human element, but they can speed the checking-in process, take payment, and present a new marketing opportunity too.

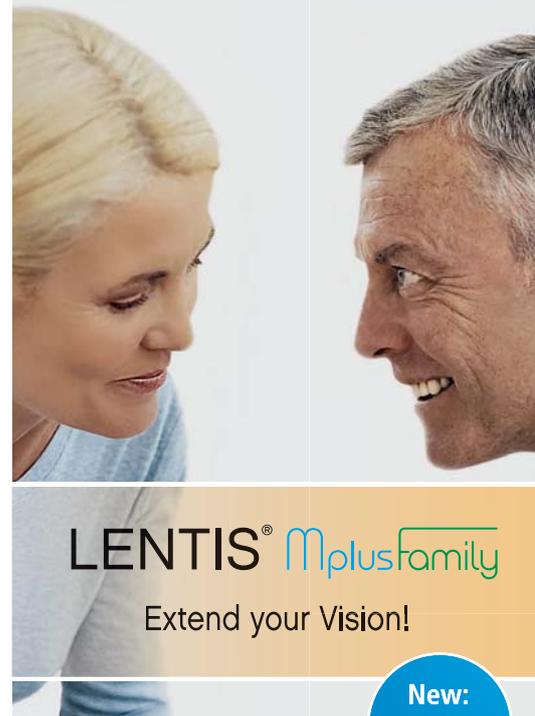
private practice must ensure that every step of a patient’s appointment, from preliminary research to aftercare, is as carefully tailored as possible.

Because of this, customers expect excellent service no matter where they go – and ophthalmologists’ offices are no exception. Because so many patients have to pay out of pocket for additional services, you need to create a more welcoming environment to not just draw them in, but reinforce their purchasing decision. There are a lot of clinics offering cataract and refractive surgery, so patients don’t need you like they did in the past; you need them more than they need you. Certainly, reimbursement reductions in the US and austerity policies in Europe mean that practices’ margins have decreased, so surgeons offer elective options like premium lenses, laser cataract surgery, or aesthetic procedures to make up the difference. Essentially, the landscape of the healthcare community is changing,

and doctors need to change with it if they want to continue earning at the same level. Here in the US, there’s a measure called the “cataracts per Cadillac ratio” (1) that reflects the change in reimbursements: in theory, it used to take six cataract surgeries to buy a Cadillac, whereas now it takes something like 20. So you need to consider what measures you can put into place to help promote the practice’s premium options, which will take that pressure off your front desk and telephone staff so that they can focus on other aspects of creating a seamless and efficient experience for your patients.

The Face of the Practice

The staff who come into direct contact with the patient, either face-to-face or by telephone, are vitally important. Doctors spend a significant amount of money on advertising, but there’s far more bang for the buck if they simply



train their patient-facing staff. There have been secret shopping studies where clinics spend a lot of money on advertising a given service, and then when patients call to inquire about it, the front desk staff aren't aware of it and suggest online research. That's the worst thing they could possibly recommend, because those patients might actually find the clinic's competitors while looking for information. So it's key to educate your front desk staff and phone team – even if you only teach the most basic of information – just so you don't risk sending your patients away.

First impressions count, and the environment your patients experience upfront – even before they come into contact with the clinical staff – has a significant effect on how they feel about your practice and whether or not they come back. You want to create a “boutique” environment with a higher level of customer service. A recent study revealed that, in many cases, it wasn't even the surgeon's experience that was the deciding factor for patients – it was the practice environment. The Zagat rating service recently expanded to include physicians, allowing patients to rate their doctors. But under this rating system, the top criterion is trust, followed by communication, availability and office environment. I find that interesting because overall, factors like the outcome of the patient's procedure or the experience of the surgeon aren't even in the top four considerations for patients.

Checking Into Patient Satisfaction

Some high-volume practices have begun using “check-in kiosks” like the ones travelers use at airports, and they're surprisingly popular. You can't sacrifice the human factor for it, but it's an excellent method for increasing efficiency. One clinic I know has a receptionist to greet patients with a

smiling face and to explain the kiosks if the patients haven't used them before, and lets the machines take care of the rest. You give the patients a card – they can swipe it and their information is pre-populated, and you can change it if necessary. The kiosks can also collect unpaid balances, verify insurance details and so on. Automating these tasks will free up staff members' time, meaning that they can have more personal interactions with the patients.

Some kiosks even take it to another level by asking a single targeted marketing question based on the patient's age or the physician that they're going to see. If they're of an age where LASIK is possible, it may say, “Have you or a loved one ever considered having laser vision correction to reduce your dependence on contacts or glasses? Yes or no?” If they say yes, the doctor immediately receives a text message that says, “John Smith, who is going to see you in five minutes, has an interest in laser vision correction.” The administrator or the nurse gets a similar message that says, “John Smith has an interest in lasers. Have a package ready for him.” And it reminds the patient, too – “I'm interested in this, but I forgot to mention it last time I was here. Now is a good time to ask!” The questions are tailored, so that you can ask different patients different things, phrasing each question the way you think is best for your practice.

I love the kiosk concept for its marketing possibilities, but it's also great from an operational standpoint. I asked an older lady who was using a kiosk how she liked it, and she said, “It's so much easier for me to push a button on the screen than it is to fill out forms by hand. It's difficult for me to hold a pen because my hands are so arthritic. I can't see very well, either, and the font on the paper forms

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“The benefits of being able to accommodate visually impaired patients with things like font size and contrast are obvious.”

is small and grey.” She really liked the kiosk and I just thought, “This is genius.” The benefits of being able to accommodate visually impaired patients with things like font size and contrast are obvious – but I hadn’t even thought of patients with accessibility considerations like arthritic hands, who can also benefit.

A Direct Line to Assistance

It’s a good idea to ensure that all of your patient-facing staff start their conversations with exactly the same ingredients. Everyone who answers the phone answers the exact same way—acknowledging the caller’s needs and assuring them that the practice can definitely help. You say “I can certainly help you with that” no matter what they’re asking, because nine times out of 10 someone in the practice is in fact able to assist them. Because of the fact that there’s a consistent greeting – the acknowledgement and reinforcement – it gives them reassurance that they’ve called the right place. It helps them to feel like they’ve made a good decision by choosing your practice.

Then, if you ask for more details about their chief complaint, you can schedule their appointments accordingly. For instance, if you have a caller who wants a LASIK evaluation and you learn by asking standard questions that they are 70 years old, you know they are more

likely to be a cataract patient. So if you do block scheduling – say, LASIK on Tuesdays and cataracts on Thursdays – you can place that patient in the appropriate slot for their condition. I’m a firm believer in block scheduling, because that way you know exactly what you’re going to be doing all day long, which makes things easier for both doctors and patients.

You’ve also got to make sure that your patients don’t end up in “voicemail jail,” where instead of having the chance to explain their chief complaint to a real person, they have to leave a message without knowing when their call will be returned. Or worse, they have to go from one voicemail inbox to another trying to reach a human being. So it’s important to have enough people on staff that they can actually speak to patients. It helps patients feel like they can cross one obstacle off the list – they’ve talked to someone and scheduled an appointment, or gained reassurance that they’ve administered their medications correctly, or whatever the reason for their call. Patients should never feel like they’ve been left in limbo, and your front desk and telephone staff are the people who can resolve most of their issues and leave them happy.

Maximizing Motivation

In my clinic, our telephone interactions used to be recorded on a regular basis and we were graded on our performance. All of the staff members got a link to see the grades – “Suzie’s got an A, Jen’s got a B, Laura’s got a C...” Because we could all see the grades, it was embarrassing if you didn’t keep up with everyone else – so there was an element of competition there, and you didn’t want to be the weakest link in the office. That experience taught me to constantly reinforce good patient interaction techniques, because it’s easy to become complacent and fall

back on bad habits. If you have a weekly staff meeting and you take the time to review telephone recordings, you can turn them into learning experiences. It’s money well spent.

Many clinics reward staff who perform well. Some do it financially with group incentives – if their clinic’s business plan states a target number of premium procedures, then there’s a bonus for the staff when they meet that target. Other practices will “secret shop” their own staff, and when they’re overheard saying or doing the right things, they’re rewarded with things like cinema tickets or special lunches. There are a lot of different ideas as to how you can recognize and reward good performance, but most of all, it’s important to have a good relationship with your staff so that you understand what they need in order to be happy. Not everyone likes the same things – some people prefer private or group recognition, while others might prefer a financial or otherwise tangible reward, so it’s good to get to know your staff. No matter how you choose to accomplish it, having a happy staff will result in better service for your patients.

Most ophthalmologists understand that the skills and successes they bring to the table are vital to growing and maintaining their patient populations. But fewer are aware of the impact that their front desk staff and office environments can have. With a few simple tactics – educating your patient-facing staff, maximizing your use of technology, and rewarding good performance – you can turn your practice into a place where your patients feel safe and confident.

Laura Hobbs is a practice development specialist who has worked at high-volume refractive clinics in the United States and Europe.

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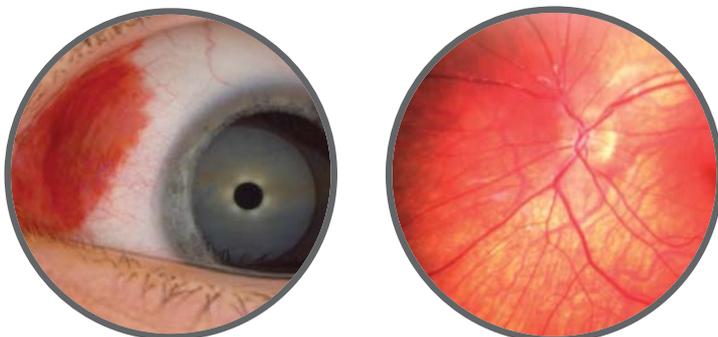
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Social Media: What's the Point?

Using social media platforms to interact, educate and promote your practice

By *Daya Sharma*

Very soon after establishing our private practice, a new (and young) patient said something that shocked me. He had searched for me online and had discovered that our website wasn't active yet – and almost didn't come in for the appointment. The clear implication was that in the eyes of Gen Y, if you don't have a website, you risk being either nonexistent or not worth seeing, even if the patient has been referred by someone they trust.

But it's more than that. The mass adoption of social media, combined with the ubiquity of permanently Internet-connected smartphones and tablets that can perform multiple functions,

At a Glance

- *It's vital nowadays to have an online presence for your practice – and even more so, on social media platforms*
- *Facebook and LinkedIn are good resources for interacting with patients and colleagues, respectively, but they shouldn't be used interchangeably*
- *Twitter is a great way to reach patients and medical professionals who are pressed for time – especially when paired with other online tools like CAPTIV8, which provides informative animations*
- *Regardless of which social media platforms you use, it's important to embrace it and make sure your online presence is keeping up with the times*

has changed how people behave online. People today are spending ever-increasing amounts of time interacting with these devices, principally with social media apps, so when it comes to attracting patients or maintaining online visibility in front of colleagues and referrers, merely having a website that provides static information is not going to be enough. You need to present yourself and your practice well on social media too.

Professional Facebooking

Most of us are familiar with Facebook, which is primarily designed for interaction with friends and family, but it can also be fun to connect with international colleagues who have become friends. Nevertheless, the usual advice is not to “friend” patients on Facebook, so that professional boundaries are maintained. That's not to say there's no place for it as a medium to connect with patients. A business can set up a professional Facebook page that patients can interact with. If a patient “likes” your professional page, they can receive updates about your practice and the services you offer, and they can share that information with their Facebook friends. It's particularly important to understand what your obligations are with regard to patient testimonials. In Australia, for example, our regulatory body prohibits publication of patient testimonials on your own website or any social media under your control. The initial instruction was that doctors should even ask third party websites to remove testimonials, which would have been unwieldy, if not impossible, to perform. In this rapidly evolving area, it's important to keep abreast of what your obligations are.

A wider reach than you think

What people used to talk about face-to-face has now moved to online discussion. For example, on Facebook, I've seen

discussions amongst my group of school friends about which doctors they should see in various specialties. I no longer live or work in that area, and yet I know what people are saying about the doctors who work there. The obvious implications of this are that the discussion's reach is far wider than a face-to-face conversation amongst friends, and that the discussion is probably going to be permanently recorded. It should be a given that once something is posted on the Internet, it's there forever. As a general rule, it's said that a dissatisfied customer will tell 9–15 people about their experience (significantly fewer than a satisfied customer) – so social media has the potential to magnify the impact of a single patient's experience. It's a sobering thought, and one social media users should keep in mind.

The LinkedIn impact

Although professional Facebook pages are good for interaction with patients, LinkedIn is far more useful for maintaining contact with colleagues and business contacts. Because people update their own contact information online, it's often far easier to look up a professional contact on LinkedIn than to search through your own records. LinkedIn even allows endorsements from colleagues, which tells others – including patients who look you up – where your particular skills lie. It's also very useful for updating professional contacts on your recent activities, such as presentations or publications. It's very important to avoid using LinkedIn like Facebook though – it's a professional, not a personal, network.

Google Plus' utility

Google Plus is perceived as being less useful than other social media because of a lower number of active users. However, it's useful to note that posting a YouTube video on Google Plus may help it get a ranking in search engines, especially Google. There is a

wealth of information in surgical videos on YouTube, and putting more of my own out there is on my to-do list.

Twitter – not just celebrities making inane comments

I read an aphorism recently (probably via Twitter): “Twitter makes you love people you don’t know, whereas Facebook makes you hate the people that you do know.” One of Facebook’s most frustrating issues is that it can become clogged with the “oversharing” of personal information – especially negative updates. On the other hand, Twitter is public and allows users to find content by searching hashtags (e.g., #keratoconus). That makes it relatively easy to find interesting content, without requiring any prior connection to the user posting it, and then to follow users who share similar interests.

Twitter is best appreciated as a medium for brief, rapid communication. If other users find your content interesting, they’ll retweet it to their followers – spreading your message further. Although tweets are short, they’re often used to share a photo or a link to a longer article or blog. Increasingly, Internet users – especially surgeons – are time-poor, so it can be much easier to read hundreds of tweets quickly than to engage with more extensive content. Ophthalmic journals and news sources often tweet links to articles, and there are even Twitter Journal clubs nowadays that facilitate excellent learning opportunities with international colleagues. Surgeons are tweeting more from conferences, which is great if, like me, you live in Australia and an international conference often means two days of travel!

Recently, a judge asked me if I read – but when I responded that I read Twitter, he laughed. Some people perceive Twitter as full of celebrities making inane comments. This preconception may have prevented professionals from using it in the past, but these perceptions are changing. Just as previously uninterested

grandparents have now embraced Facebook, their grandkids may be leaving it for newer social media platforms. What makes Twitter most appealing to me is that it offers an opportunity to follow and interact with people from all walks of life, including international ophthalmologists, medical practitioners, scientists, optometrists, journalists, politicians and more. I’m also always curious to see who is following me – it is often pleasantly surprising and makes it more fun to interact. One of my former surgical bosses, Henry Woo, has a great presentation (1) further arguing the point that every surgeon should use Twitter – I highly recommend it.

One of the newer apps that I predict will improve surgical teaching is Vine. The app produces six-second video loops (called “Vines”) that can be posted to Twitter. What’s the point of a video that’s only six seconds long? Although surgical videos on YouTube are great, they can be quite time-consuming to watch. Other specialties (such as urology) have demonstrated that it’s possible to demonstrate key surgical steps in a six-second video. Sometimes, it’s useful to see an important step repeatedly. This is great for a surgeon in a rush, who can get lots of tips quickly without needing any tools beyond a smartphone.

Patient education and interaction

These tools are useful for patient education too. Personally, I use an animation program called CAPTIV8 in the office and online. In our waiting room, we have a series of animations playing that demonstrate various procedures and conditions and can be adjusted depending on the clinic. This helps with our internal marketing, allowing us to raise awareness of conditions we treat. In the consulting room, I will often show one patient a relevant animation while I make notes or see other patients. For instance, I can have the patient view a series of cataract and IOL-related animations before they

book a cataract surgery appointment. Procedures like that are much easier for a patient to understand if they have an explanation with animations, and it saves me time and effort in repeatedly clarifying the same concepts. I can then focus on any specific residual questions that the patient has. The software allows me to pause the animation and even draw on it to demonstrate concepts. Outside the office, our website works well with CAPTIV8 to provide educational material to potential patients. I can also give existing patients links to our various animations. For example, if I make a new diagnosis of primary open angle glaucoma, I will often provide that patient with the link to our online animation, which they can then pass on to friends and family.

There is also a Social module that scans Twitter for keywords and allows your practice to offer users further information. Let’s say I wanted to find potential patients commenting on “laser eye surgery” within a 100 km radius of my practice. The Social module can display a stream of people talking about this subject, and my staff can respond to them by simply clicking on an animation (such as LASIK) and posting it. The end result is a link to the chosen animation that plays on a webpage branded with my clinic’s details. Inbound marketing like this is more targeted than straightforward promotion, and it encourages patient education and dialog.

No matter what your chosen platform, I recommend that all surgeons embrace social media and build an online presence. Engage with your colleagues to enhance your learning opportunities. Don’t be left behind as patients adjust to the rapidly changing online world.

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In Folkman's Footsteps

Sitting Down With... Joan Miller,
Chief and Chair of the Department
of Ophthalmology, Massachusetts
Eye and Ear, Mass General Hospital
and Harvard Medical School

Joan Miller
Ophthalmologist

How has ophthalmology changed since your early days?

Ophthalmology initially intrigued me because it was a specialty that combined medicine and surgery in a single organ. When I started, vitreoretinal ophthalmology was all about surgery. Meetings featured talks on new surgical techniques or different ways of peeling tissues. But now that's changed. Now we have many more drug- and even cell-based therapies, and most of the talks at meetings are focused on medical, rather than surgical, treatments for retinal diseases. Not all of my colleagues are happy with that – retinal surgeons like to do surgery – but we are happy to have new solutions for patients with issues like macular degeneration and retinal vein occlusion, whom we couldn't treat surgically.

How did you come to work on anti-VEGF therapies?

I was lucky enough to be able to combine clinical care and research. It was fascinating to look after patients clinically and then think scientifically about the problems we couldn't solve. The one that interested me most was macular degeneration, because it was so frustrating for both patients and doctors. I worked with Judah Folkman, who pioneered anti-angiogenesis research in cancer and inspired several others to pursue lines of inquiry that dovetailed beautifully: Anthony Adamis, Lloyd Paul Aiello, Patricia D'Amore, Evangelos Gragoudas, and George King, among others. It seemed to us that the same biology involved in cancer angiogenesis might play a role in vision loss, so we started research on animal models of retinal disease. First, we sought to understand what was driving the blood vessel growth, and then we tried to either block the growth or address it – which led to two major projects that resulted in treatments.

One of those was photodynamic therapy, which combines a photosensitizing agent with laser light to injure abnormal blood vessels. We figured out the parameters that would work on abnormal retinal blood vessels and ended up with Visudyne, the first pharmacologic therapy for macular degeneration. At the same time, we were trying to understand the causes of retinal angiogenesis, which led us to VEGF – discovering that it was an important mediator for abnormal blood vessel growth in diabetic retinopathy, retinal vein occlusion and macular degeneration, and then developing drugs that would block it. It was very exciting for all of us to build this body of research and take those findings from the laboratory to patients.

“Young ophthalmologists should remember that we have a great opportunity to change the way people live their lives.”

We had no idea VEGF would have such an impact. When we started to explore it, nobody believed it could be such an important factor in macular degeneration. We actually had trouble publishing our results at the beginning! The first time we gave an ARVO presentation on VEGF, it was in a tiny room on the last day, and only the authors and their friends attended. But within two years, VEGF had taken off so much that the presentations were in the main room.

What's the next step for retinal disease? We need to work earlier in the disease, and halt progression to the advanced forms. One of my mentors, Ephraim Friedman, chastised me for working at the end-stage disease, but there was a reason for that – it was where the severe vision loss was occurring. I'm working on targeting early macular degeneration by looking at ways to affect the lipid deposition and inflammation that occurs. I'm also very interested in neuroprotection; we've just gotten some interesting data suggesting that there may be ways to target retinal – and especially photoreceptor – cell death. There's an ongoing loss of photoreceptors in macular degeneration, and if we can block that process, we can preserve vision for longer. But I don't think that benefit is limited to macular degeneration – it can be applied to a number of retinal diseases.

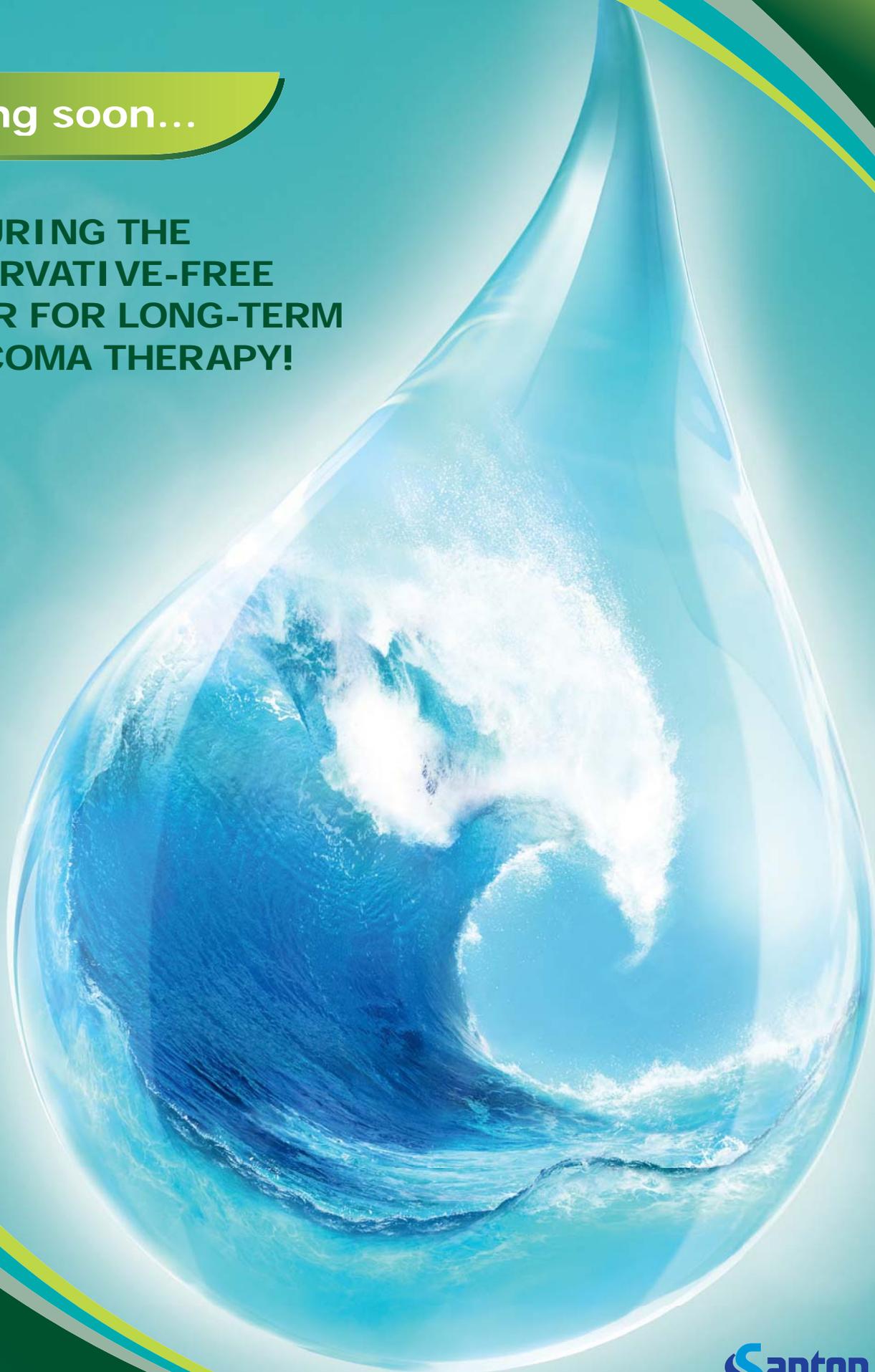
What advice do you have for younger ophthalmologists?

A lot of my work has been a team effort; having the right people working together on a problem at the same time is serendipity of a wonderful sort and leads to great things. But my academic team aren't the only people helping me to succeed. I also have a family, and they're a huge part of my life. You have to be a little bit crazy to be in academia and have a family, because it isn't easy, but nobody should ever think it can't be done.

Young ophthalmologists should remember that we have a great opportunity to change the way people live their lives. I hope they find problems that excite them and try to solve them, because you have to be passionate – and a little bit stubborn – to succeed. But we live in a very visual world, so anything that can preserve or restore vision is a great thing to work on.

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