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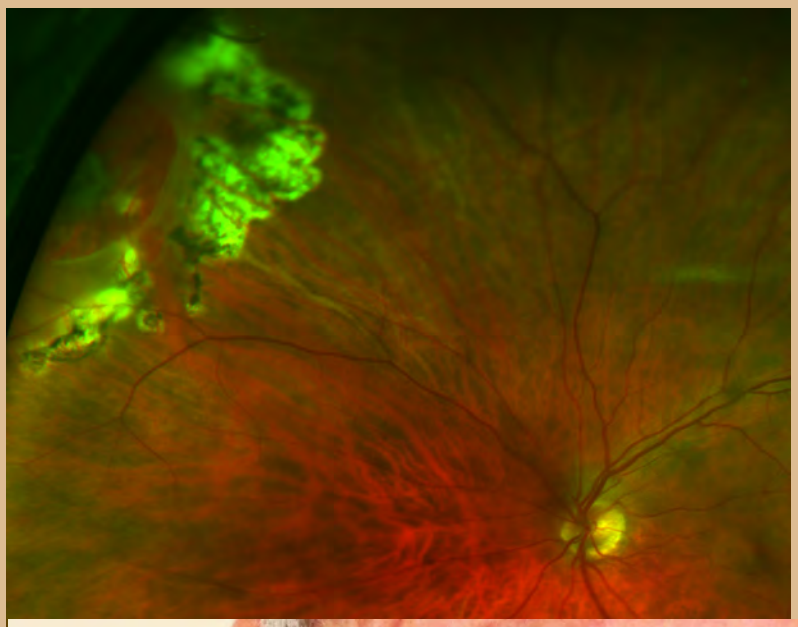

miblog

FROM RETINOPEXY TO IOL SURGERY

A Roller Coaster Ride

A series of 24 blogs written by Professor Nathan Efron AC from March 2013 to November 2015, and published in mivision.

Ink in the Sky

In the first of a series of exclusive blogs for *mivision* Prof. Nathan Efron takes you on his personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

It was a warm Tuesday afternoon in October 2009 on the Gold Coast. I had just taken delivery of my new car (a Ford G6 series). I pulled up adjacent to my home, and waited at 90 degrees to my driveway while my radio-controlled garage roller-door opened. Ahead of me was a clear blue sky, and I suddenly noticed a bizarre phenomenon that was about to have a dramatic personal impact, and in many ways change my life forever: ink in the sky.

Have you ever placed a drop of black ink in a glass of water? Perhaps not … but maybe you have seen a still image or movie clip of this phenomenon in another context. The ink drop starts to slowly spread out with a slight twist or twirl. Well, that's exactly what I noticed while looking out through the windscreen of my car. My initial reaction was that of slight bewilderment, but after a few moments, when I changed my direction of gaze slightly, the 'ink' continued to slowly swirl downwards in the same region of my field of view.

I closed each eye consecutively, and immediately realised that this event was occurring in my left eye. Apart from ink in the sky, I noticed nothing else. No pain or discomfort, no sparks or flashes, no shadow or spider-web appearance, no apparent commensurate loss of vision, no general discomfort or headache. I had not suffered any recent bumps or head trauma. Nothing. Just ink in the sky. The accompanying picture is a pretty good simulation of what I saw.

Anyway, a few seconds after first noticing this phenomenon, it occurred to me that the most likely explanation of the ink in the sky was that there was bleeding inside my eye. A sinking, sickly feeling developed in the pit of my stomach, as the real meaning of this began to dawn on me. This was most likely a retinal tear or detachment. The problem is… I know too much! I could feel my heart begin to pound, and I immediately began to consider what I ought to do next.

As a qualified and registered academic optometrist, the implications of this event were immediately apparent, and I took instant action, as I will explain later. But one wonders what a regular member of the public, without any ophthalmic or medical training, would have made of this observation. Some may realise that this appearance is abnormal, and might seek an opinion sooner or later. Retinal tears can of course lead to detachments, so such matters always require urgent investigation. I would presume, however, that the general public are perhaps not always aware of this, and a seemingly sensible option could be to wait until the next scheduled routine eye examination, and mention it then, or just wait to see if things get worse.

> **"it occurred to me that the most likely explanation of the ink in the sky was that there was bleeding inside my eye"**

GOOD FORTUNE

At this point in time, there were two other elements of good fortune (that is, in addition to my own ophthalmic knowledge): first, my wife, Suzanne, was with me at the time of my 'ink in the sky' moment, and second, Suzanne is a practising clinical optometrist. She had driven home in her own car in tandem with me, having taken me to the showroom to collect my new car. We went straight inside and Suzanne fetched her direct ophthalmoscope. Without the benefit of dilating drops or a fully darkened room, all she could still see was a mass of swirly floaters largely obscuring the fundus.

We then decided to head off somewhere so that my eye could be examined properly. We hopped into Suzanne's car and drove to a nearby optometry practice where Suzanne had previously worked, about a 10 minute drive away.

By the time we arrived, the ink in the sky had dissipated, and vision in my left eye was somewhat cloudy. After a brief exchange of pleasantries, our optometry colleague, Pete (not his real name), took me straight into his consulting room, checked my vision, instilled a mydriatic, and after a few minutes, sat me behind the slit lamp. He whipped out his Volk lens and started looking around. The silence was deafening. As anxious as I was to know what was happening in my eye, I knew I had to hold my tongue to give Pete a chance to have a look, digest what he saw, and relate that to me.

After about a minute, we both sat back, and I noticed that he seemed a little pale, which wasn't especially comforting to me. Pete said that everything looked cloudy, and that clearly something untoward was happening in my eye, but he couldn't be sure. Whatever it was, we all agreed that it was important that I get this checked out by an ophthalmologist as soon as possible.

As it turns out, there are a number of ophthalmologists on the Gold Coast specialising in retina, all with excellent reputations. Over the past few years, Suzanne had referred numerous patients to various ophthalmologists, but was especially impressed with the surgical outcomes and generally high levels of eye care of Bill (not his real name). We did not have time to contemplate and research the performance and reputation of Gold Coast ophthalmologists, and in any case it might not have made any difference who I chose, so we decided to call Bill's rooms.

By this time, it was about 6pm, and Bill's surgery was closed for the day. However, his reception staff were still there, and recognising the urgency of the situation, booked me in for the first appointment at 8am the following morning. I just knew that this was going to be the longest 14 hours of my life.

A simulation of my 'ink in the sky' moment

SOME BACKGROUND

At this point, to paint a complete picture, I need to relate to you my previous ocular and medical history. I was born on 3 September, 1954. I developed amblyopia (eye unknown) aged about five, and was treated with atropine. This was apparently successful, as I have enjoyed R&L 6/4.5 acuity, with normal binocular vision, up until now.

I have type 2, well-controlled, non-insulin-dependent diabetes (diagnosed at age 32), and for about the past 10 years, minor background diabetic retinopathy (two or three tiny microaneurysms) has been observed in both eyes.

At age 15, I attended a rock concert at the Sydney Myer Music Bowl in Melbourne with a friend, who happened to be mildly myopic. I mentioned that I couldn't really see the stage clearly, and in jest he suggested I try his glasses. I must have had a similar amount of myopia to that of my friend, because everything suddenly became brilliantly clear through his glasses, which we fought over for the rest of the concert! The next week my mum obtained a referral from our family doctor to see an ophthalmologist. My myopia was confirmed, and I started wearing glasses, switching to contact lenses when I was about 28.

My myopia kept progressing until about 35 years of age, when my refraction more or less stabilised.

My current prescription is:

R: -6.50/-1.25 x 175

L: -5.75/-1.25 x 180

Add: +2.25

The only relevant family ocular history (and it is indeed significant) is that my mother is slightly myopic in one eye (about -1.25DS) and my maternal grandfather was highly myopic. I never found out his refraction, but I remember his very thick 'coke-bottle-bottom' glasses. He suffered a trauma-induced retinal detachment in his 50's and he was in hospital for two weeks receiving treatment. My grandfather was essentially blind in the eye with the detachment, and had low vision in his other eye.

So, I have ended up a moderately high myope, and I have a family history of myopia and retinal detachment. I can just picture the ophthalmic readers of this blog nodding already… mi

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Assessing the Damage

Professor Nathan Efron's personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

It was the morning after my scary 'ink in the eye' experience. I awoke feeling a little drowsy. I hadn't slept well during the night, thinking about what had happened to my eye. It was time to get dressed, have a quick brekkie, and make my way to Bill's clinic. I usually wear contact lenses, but left them out because I knew my pupils would be dilated.

I announced myself to the intercom at the entrance to the underground car park, made my way past the impressive line of Porches, BMWs, Mercedes etc., and found a spot. Convenient and complimentary basement parking was a useful benefit that I was going to avail myself of many more times subsequently.

"At this point, I started to wonder what sort of professional was examining me..."

On making my way in the lift up to the third floor, I noticed a sign listing about six ophthalmologists who work in this group practice. It was going to be interesting to see how a large, private ophthalmology clinic operates in the modern age. All of my previous eye examinations over the past 20 years have been conducted by my optometrist wife, Suzanne, in optometry clinics, so I was unfamiliar with this form of ophthalmic clinical environment.

I presented to reception and was handed the customary medical history form on a clipboard. I sat down in a packed but comfortable waiting room of about 30 patients, all seemingly at least 60-something, and proceeded to fill out the form. No, I'm not pregnant. Yes, I have type 2 diabetes. No, I don't have HIV or hepatitis, and so on. You know the drill.

Suddenly a young lady announced in a loud, clear voice "Professor Nathan Efron". At once, everyone in the waiting room awoke from their slumber and looked around to see who among them was 'the professor'. So, up I stood and followed this young lady to a small consulting room. She performed an auto-refraction, and then took me to a slightly larger room, and commenced a routine procedure that I was soon to become very familiar with.

First, the young lady took my ocular history relating to events over the past 24 hours. "And I believe you are a Professor of Optometry?," she asked. I answered in the affirmative. She took my glasses away briefly to measure the prescription, before measuring my vision without, and then with, them. Whereas vision was a little hazy in my left eye yesterday following my 'ink in the sky' episode, visual acuity was good today: R6/4-3, L6/6-3, near R N5, L N6.

At this point, I started to wonder what sort of professional was examining me, so I politely asked, "What exactly do you do here?" She replied that she was a 'tech', which I took to mean technical assistant. On further questioning, I found out there were a number of techs assisting in this practice. They were typically orthoptists or had a biomedical science degree and were trained in-house to undertake basic eye screening examinations.

ROUGH AND READY

The tech then proceeded to perform a refraction using a trial frame. Now, every eye care professional knows that no one can do a better refraction than themself, and I am no exception. The tech seemed to do a rather 'rough and ready' refraction, using a minimum of bracketing. I was not particularly impressed. When she finished refracting my right eye, I wasn't convinced that she had determined the 'maximum plus power' refraction end point, so I couldn't hold back, and blurted out "Can you please put up an extra plus 050 just to be sure?" She obliged with a wry smile (who was she to argue with 'the professor'), and it fogged me. So she was right. I'll shut up in future.

The tech checked my pupil reactions then instilled topical anaesthetic, fluorescein and

a mydriatic. Then (I assumed forgetting who she was examining), she explained to me these drops will make my pupils larger and that she needed to check the pressures inside my eye. I reminded her she didn't really need to tell me that. After measuring IOP with a Goldmann tonometer, I was led to another waiting room.

"Bill explained that these tears were so far out in the periphery that he would not be able to deal with them adequately using a slit-lamp mounted laser; he would need to do this in a surgical theatre"

Of course, the key logistical problem with ophthalmic examinations is that it takes a good 45 minutes for pupils to dilate, so I had to duly wait the mandatory 45 minutes before being called into another examination room, where I was greeted by Mike, one of three or four optometrists working for this group. My reputation had preceded me, and Mike told me that he was a QUT graduate and was aware of my background. He then quickly talked through and confirmed the tech's findings, pulled across the slit lamp, did a brief scan of my anterior eye, and began a detailed examination of my ocular fundi eye with a Volk lens.

Mike wasted no time in getting around to the crux of the situation: he could see a large horseshoe-shaped retinal tear supero-temporally in my left eye. But there was a big surprise in store – he found an even larger horseshoe-shaped retinal tear supero-nasally in my asymptomatic right eye (see diagram). Mike asked the obvious question – if I had noted anything strange in that eye in recent times – but I could not recall anything untoward.

Just as we finished this discussion, Bill entered the room. A short, handsome chap with a pleasant smile, he welcomed me and in the process of exchanging pleasantries it became clear that he had been briefed about my ophthalmic background. He was also well aware that Suzanne had referred many patients to him. Bill then began to examine my eye with the Volk, and as he was doing this, Mike began reciting his own findings. Now this seemed like a really smart approach to me, and essentially resulted in Bill (and me) getting an immediate second opinion.

Bill confirmed Mike's findings, and added that the retinal tear in my left eye was due to an acute vitreous detachment. 'Schaeffer's sign' was observed (I had to Google this later; it apparently refers to the liberation of retinal pigment epithelial cells into the vitreous which often can be seen just behind the lens with slit lamp biomicroscopy). Bill also noted an 'old posterior vitreous detachment' in the right eye, and background diabetic retinopathy, in the form of a small number of microaneurysms, in both eyes. The latter was no surprise, and is related to my type 2 diabetes of about 25 years standing.

Bill cut to the chase. This was a very serious situation. He explained he had seen tears like this before, which can start small and in no time at all propagate to create a full detachment. Both eyes needed to be attended to immediately, one at a time, starting with my symptomatic left eye. Bill explained that these tears were so far out in the periphery that he would not be able to deal with them adequately using a slit-lamp mounted laser; he would need to do this in a surgical theatre, so that he could indent the sclera to perform retinopexy using a head-mounted laser on the proximal aspect of the tear, and cryopexy on the distal aspect.

It was Wednesday, and Bill's next surgery list was not until Friday. But it couldn't wait until then. Bill telephoned the operating theatre, which happened to be in the same building on the floor below, to see if a theatre was available that afternoon (it was being used by other doctors). Luckily, it was… mi

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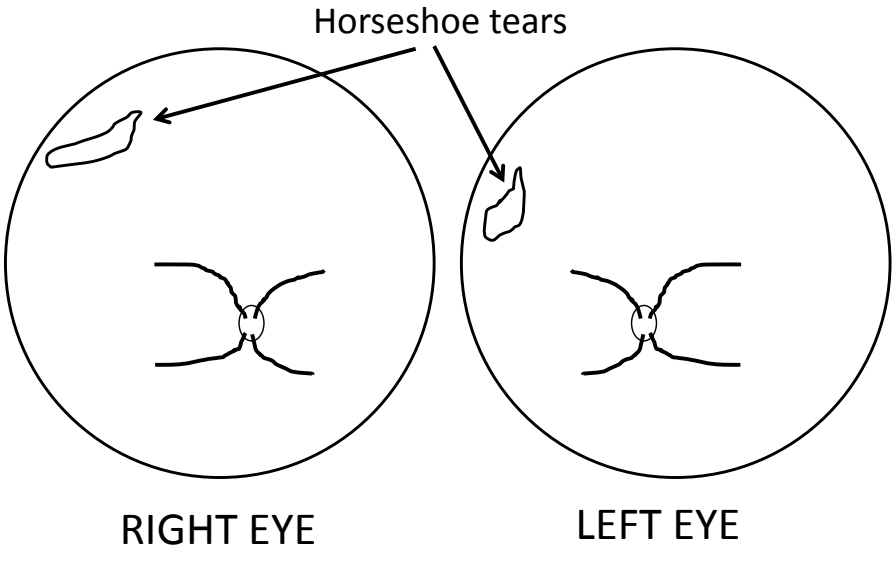

Location of retinal tears in my symptomatic left eye and asymptomatic right eye.

Laser Wars

Professor Nathan Efron's personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

I suppose being told you are going to have your eyes operated on that same afternoon is a good thing. No real time to dwell on the gravity of the situation, the likely surgical procedure, or the recovery phase.

As I left Bill's clinic in the morning, I was handed a smart folder with all of the information I required about the whole sequence of events. I was not to have anything to eat between now and the surgery, scheduled for later that afternoon. I was to arrive wearing comfortable, loose clothes and to have someone accompanying me. A unit dose of mydriatic was included in my information folder, with the instruction that this be instilled into my left eye one hour before the operation.

THE FUN BEGINS

So, later that afternoon, with dilated left pupil, I turned up at the day surgery, in the same building as Bill's rooms, two floors below. More forms to fill out. These were about informed consent – agreeing to the surgery, and allowing de-identified information about my surgery to be used for analytical or educational purposes.

After about a 20-minute wait, I was called through to the admittance room, and politely bombarded with a series of questions by the admissions nurse: What is your name? What eye are we operating on? What procedure are you having? I imagine the last question could be tricky for some people to answer.

Here there was an entertaining little twist to this story. You will remember I was 'squeezed in' to this surgical list, because Bill does not normally operate on Wednesdays. Interestingly, I noticed this admission room was filled with rather attractive young women. I later found out the reason for this; this day surgery was shared by a variety of doctors from different medical fields, not just ophthalmologists. This was cosmetic surgery day, and virtually all procedures being done this afternoon were breast augmentations. Enough said.

The young ladies surrounding me were all wearing dark blue gowns, light blue hairnets and shoe covers. I was asked to put on one of these dark blue gowns, which is tied on with a waist strap around the front, and to put on a shoe cover. However, unlike others in the room, I was given a red hair net. The reason for this is that I had declared earlier on the medical history form that I was allergic to penicillin. Actually, I am probably not allergic to penicillin. My mother told me when I was five-years-old, I had a penicillin shot for some reason, and my arms and legs broke out in a transient skin rash. It was more likely a reaction to the drug vehicle or preservative, but to be safe, I have always declared my 'penicillin allergy' in such situations.

> **"Despite the anaesthetic, this procedure was slightly uncomfortable, and at one stage I let out a slight yelp"**

The admissions nurse then placed a large arrow with black ink on my forehead above my left eye. Smart move, I thought, recalling horror medical negligence stories such as the wrong eye being enucleated. She then measured my blood pressure, which I figured was probably futile as all patients about to be operated on would surely have very high anxiety-induced blood pressure. More mydriatic and topical anaesthetic was instilled into my left eye.

I was asked to remove my glasses and place them in a drawer in a mobile cabinet that would accompany me around the surgery. Being a moderately high myope, I found this somewhat disconcerting. I was then walked about 10 metres through a very blurry corridor to a very blurry pre-surgical area, invited to hop onto a blurry mobile surgical bed, and covered in a blurry pre-heated blanket.

Bill then appeared, and after exchanging a few pleasantries, got straight down to business. A very large needle appeared and before I realised what was happening the needle was well in and I could feel a cold sensation around my eye. I assume this was a retrobulbar block. A heavy bean bag was then placed over my eye and cheek; I was told this would help disperse the anaesthetic throughout the orbital region.

About 10-minutes later I was wheeled into the operating theatre and transferred onto the operating theatre surgical bed. After inserting eyelid retractors, Bill donned his head-mounted indirect ophthalmoscope with laser delivery system and started by having a good look around my fundus. He declared that as well as the large superior tear, he could also see a small circumscribed region of inferior lattice degeneration, which he would also circumscribe with laser shots.

A RUDE INTRUSION

Then the retinopexy light show began. The laser bursts were accompanied by bright flashes of light and audible popping sounds, conjuring up an aura of a futuristic laser war zone. Soon after the lasering began, I noticed one of the assisting nurses who was standing next to me was leaning against, and occasionally bumping, the operating table as she was undertaking various tasks. I couldn't believe it! I wanted to say something, but dared not move while Bill was in the middle of lasering my eye. A few seconds later when there was an apparent pause in the procedure I blurted out a rather terse plea for the nurse to cease bumping the table, which fortunately had the desired effect.

It was a little difficult to know exactly what was happening, but I did sense pressure on my eye from time to time, presumably corresponding to Bill indenting my sclera so he could effectively laser my superior tear which was way out in the far periphery.

In fact, my superior tear was so far out in the periphery that it was not possible to fully encircle the tear with spot laser burns. Therefore, Bill had to employ cryopexy, which is a freezing probe applied to the outside of the globe, distal to the tear. Despite the anaesthetic, this procedure was slightly uncomfortable, and at one stage I let out a slight yelp when it really began to hurt. It seems Bill heard this, and modified his procedure to ease the discomfort.

THE AFTERMATH

Following the retinopexy and cryopexy, Bill had a good look around and declared the mission a success. My eye was patched, and I was transferred to a wheelchair and taken through to a very blurry post-surgical recovery room – again full of attractive young women who I presume were now suitably enhanced. My glasses were returned, and I was offered a cup of coffee and sandwiches, which were welcomed because I had had nothing to eat for about seven hours. One of Bill's assistant ophthalmologists introduced himself and proceeded to carefully remove the patch and inspect my eye with an indirect ophthalmoscope. He told me he had previously qualified as an optometrist at QUT (and was aware of my connection there) and was now an ophthalmology resident. The verdict: all seemed fine, and I was free to go.

I was sent off with a package of pre-prepared medications – paracetamol/codeine tablets and prednisolone forte eye drops – and a bill from the local pharmacist who prepared and supplied these drugs.

Especially useful were analgesics, as my eye became quite sore mid-evening after the anaesthetic had worn off. By the next morning I was much better. There was still lingering discomfort, and my eye was horribly red and ugly. But the most annoying bit was the eye drops I was now going to have to instil four times a day for the next six weeks. I will be writing more about the drudgery of eye drops in a later blog. mi

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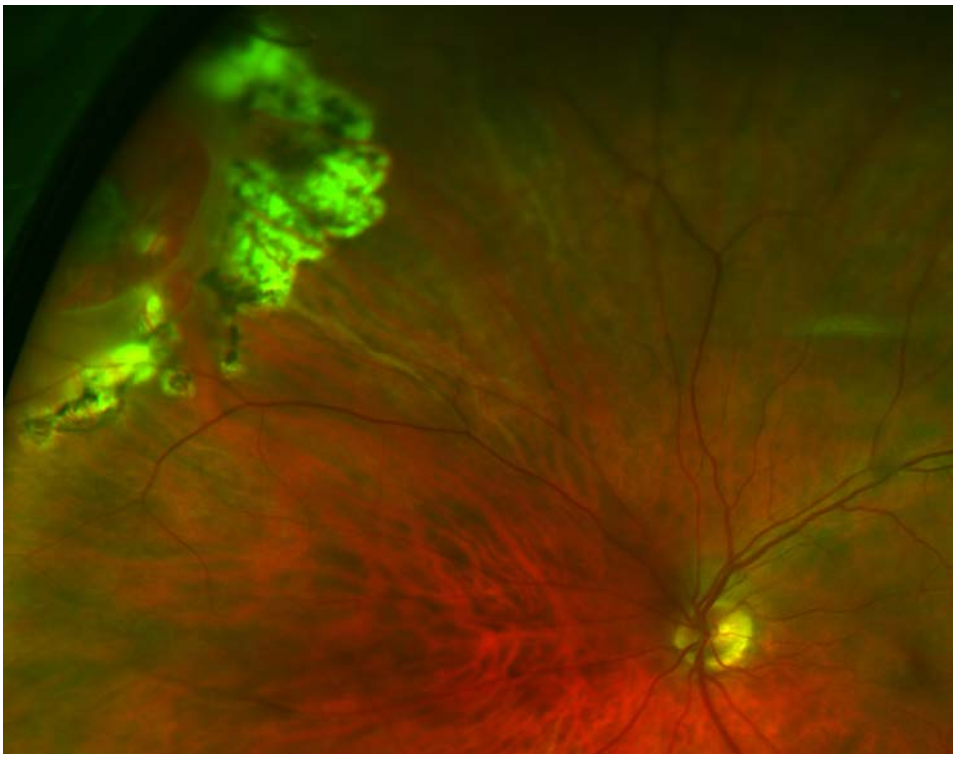


Image of the treated superior nasal tear in my left eye, captured about six months after the procedure using an Optos ultra-widefield retinal camera. The proximal edge of the tear is clearly visible, surrounded by extensive scar formation.

Second Dose

Professor Nathan Efron's personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

An unexpected "ink in the sky" moment led to urgent surgery on a symptomatic left eye, with the asymptomatic right eye to follow…

Two days after having my left eye lasered, it was time to do the right eye. After having endured the full surgical routine so recently, I wasn't really in the mood for a second dose. But I had no choice – there was a large tear in my superior retina that could propagate at any time, and it had to be sealed up without delay.

One hour before arriving at the surgery, I duly instilled a drop of mydriatic into my right eye from the unit dose dispenser I was given when discharged two days previously, following my left eye lasering. I was asked to fill out the same form that I had completed two days earlier, about my past medical history. This seemed a waste of effort, as nothing had changed, or could reasonably be expected to have changed, in the preceding 48 hours. But I guess systems are systems, and I'll just do what is requested.

RISKY PROTEST

There was an interesting question on the form that assumed increased relevance this time around. It went something like this: "Do you have any concerns about the procedure you are about to have that you would like to tell us about?", with an open field into which comments could be entered. You may recall that during the first operation, I was disturbed that one of the assisting nurses who was standing next to me was leaning against, and occasionally bumping, the operating table during my operation. So here was a chance to make a definitive statement about this concern. Should I mention this now? Or would it offend my surgeon Bill (not his real name), or his staff? I decided to make a statement, something to the effect of "please instruct assisting theatre staff to avoid bumping the operating table during surgery". I wondered how the admissions nurse would respond to this when she retrieved my form, but she said nothing.

Unlike two days before, when the admission room was full of women, most of whom were about to undergo breast augmentation, on the day of my second laser treatment, I was surrounded by generally older patients about to be subjected to various forms of eye surgery. After all, this was an 'official' ophthalmic procedures list. So again, on went the dark blue gown, light blue shoe covers and red hair net. Not especially fashionable, but fashion was of no interest here. The attending nurse again took my blood pressure, instilled more mydriatic and marked my forehead – this time above my right eye – and commented how red and angry my left eye looked. I told her that this was due to the operation performed on that eye two days ago.

"Bill said he could see a small region of 'mottling' (I think that was the term he used) inferiorly, and that he intended lasering that too, for good measure"

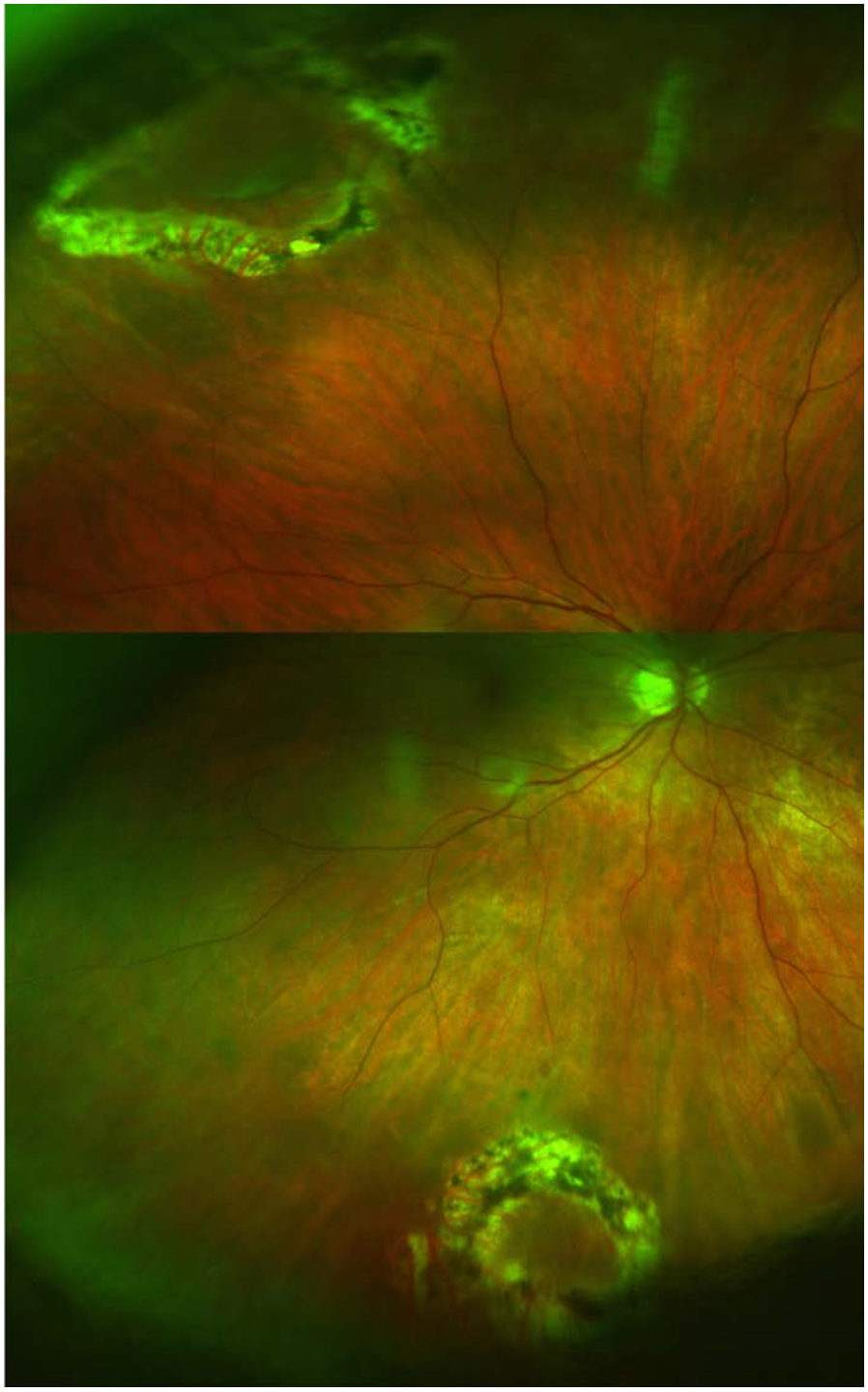
So, off came my glasses, and I was led through the same blurry corridor to the blurry pre-surgical room where Bill again injected the anaesthetic. Same cold feeling around my eye. Same beanbag placed over my eye and face to spread the anaesthetic. Then I was wheeled into the operating theatre for another round of retinopexy and cryopexy. Just before the procedures began, one of the nurses drew Bill's attention to my comment about bumping the operating the table. Bill's immediate response was "Yes, I saw that", and he then proceeded to briefly relate this concern to the assembled theatre accordingly. So, I was pleased that my concern was taken seriously.

MORE SURPRISES IN STORE

Having had this procedure performed on my left eye two days ago, I knew what to expect in terms of the retinopexy and cryopexy. But there was a surprise in store. Following an initial general inspection of my eye with his head-mounted indirect ophthalmoscope, Bill said he could see a small region of 'mottling' (I think that was the term he used) inferiorly, and that he intended lasering that too, for good measure.

Here we go again. Same sensations. Same light show. Same discomfort when cryopexy was performed. And no bumping of the operating table, thank goodness! Bill declared this procedure a success, and I was despatched to the recovery room, where I enjoyed another round of coffee and sandwiches. The same assisting ophthalmologist who saw me post-surgically two days prior was again on hand. He removed my eye patch, had a quick look around, and declared all was well and that I was free to leave.

Off I trotted with a new package of the same pre-prepared medications I received



Montaged image of the fundus of Nathan Efron's right eye showing superior and inferior treated lesions, each of which is about 10 disc diameters from his optic disc. The component images of this montage, which together span approximately 250° vertically, were captured about six months after the procedure, using an Optos ultra-widefield retinal camera.

last time – paracetamol/codeine tablets and prednisolone forte eye drops – and another bill from the local pharmacist who prepared and supplied these drugs. I didn't really need more analgesics, as I had plenty of these left over from two days ago, but it was just easiest to grab them and go. I was now faced with the prospect of instilling the pred forte drops in both eyes every four hours for six weeks or so!

Inserting eye drops four times a day is quite an intrusion into one's lifestyle! But the intrusion did not stop there. As a bit of a health fanatic, I try and keep fit by eating well and doing a workout every day – in the gym for one hour before work, or a one hour walk along the Surfers Paradise beachfront with my wife Suzanne on Saturdays and Sundays. However, I figured that while beach walks would be OK, strenuous gym training would not be such a good idea following eye surgery, and Bill confirmed this, advising I should 'take it easy' for at least the next two weeks. When I did return to the gym two weeks later, I restricted myself to cardiovascular training and avoided the heavy weights for a further fortnight, before gradually getting back into heavy lifting.

BROAD PERSPECTIVE

A few months after this double-dose of eye surgery, I was visiting an ophthalmic trade fair and on display was one of those Optos ultra-widefield retinal imaging machines. There was quite a buzz of activity around this particular display, so I waited on the side for a quiet moment, then introduced myself, explained my recent ophthalmic history, and asked if they could capture images of my eyes. They obliged, and managed to capture two great images in particular – one superiorly and one inferiorly. Fortunately I had my trusty USB thumb drive with me, and we transferred the images onto this. These images are astonishing, with the lasered regions clearly visible. Because the Optos instrument is capable of capturing images across a 200° field, it was possible to image the far lasered regions in the far periphery and my optic disc in a single frame. This is impressive, given that both the superior and inferior lasering were performed about 10 disc diameters away from my optic disc. Such imaging was not possible a decade ago, when fundus cameras were only capable of capturing images across a field of about 30°.

The accompanying figure was constructed by montaging the superior and inferior fundus images into a single picture, using the optic disc as the reference point. This has resulted in an image of the fundus of my right eye that probably spans some 250°. Now I need to declare here that I have no financial interests, shares or consulting arrangements with Optos… but let's give credit where credit's due! This amazing technology has allowed me to observe the ambiguity of, on one hand, the beauty and precision of Bill's lasering technique, and on the other hand, the tragic consequence of being a high myope with retinal tears! mi

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Still More Tears

Professor Nathan Efron's personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery. Having endured months of lasering, further complications emerged.

Am I referring to 'tears' in the title of this blog, as in 'emotional lacrimation' or as 'ripping something'? Well, grammatically speaking, I am using the word 'tears' as a deliberately ambiguous heteronym, so as to produce a double entendre.

'What is a heteronym?', I hear you ask. Heteronyms are a particular form of homonym, which are groups of words that share the same spelling but have different pronunciations and meanings. Now I bet you're totally confused… it took me an hour searching through Wikipedia to sort this out… read on, and you will soon see what I mean...

When I presented to Bill, my ophthalmologist, for a routine check six months after my bilateral retinopexy and cryopexy, I brought along print-outs of fundus photographs that were recently taken of my eyes at an ophthalmic trade exhibition in the United Kingdom. These images were captured with an Optos ultra-widefield retinal imaging camera. I had also prepared a blow-up of the superior tears surrounded by the multiple laser photocoagulation marks. The laser marks looked like they nicely surrounded the tears, but just to be provocative, I half-jokingly suggested to Bill that in trying to circumscribe the tears with the laser, he missed a few spots.

I don't think Bill quite got the joke. He responded with a considered "hmmm..." while he studied the images. Then he eased me down into the supine position, donned his binocular indirect ophthalmoscope, and proceeded to examine my eyes. He reported that my retina was nicely attached in both eyes. However, he declared he was not entirely satisfied that he had achieved full demarcation of the large superior tears in both eyes, and decided to seal these tears even more with additional 'green laser' treatment. I was left wondering whether by showing him these images of the lasered tears, I had impacted his decision to resort to the green laser.

Six months later, Bill noticed further small tears in the peripheral retina of both eyes, which were particularly evident upon scleral indentation. The verdict? More retinopexy was required in both right and left eyes.

These additional laser procedures were performed in Bill's consulting rooms rather than in hospital. That's because there was no further need to perform cryopexy as well, which is generally more involved and requires extensive anaesthesia. Some of these procedures were performed with me in a supine position with Bill using a head-mounted laser delivery system. At other times I found myself sitting at what appeared to be a specially designed slit lamp biomicroscope that had laser delivery capabilities built in. I am not sure what dictates which system is used for the particular region being lasered, and I didn't bother quizzing Bill about this.

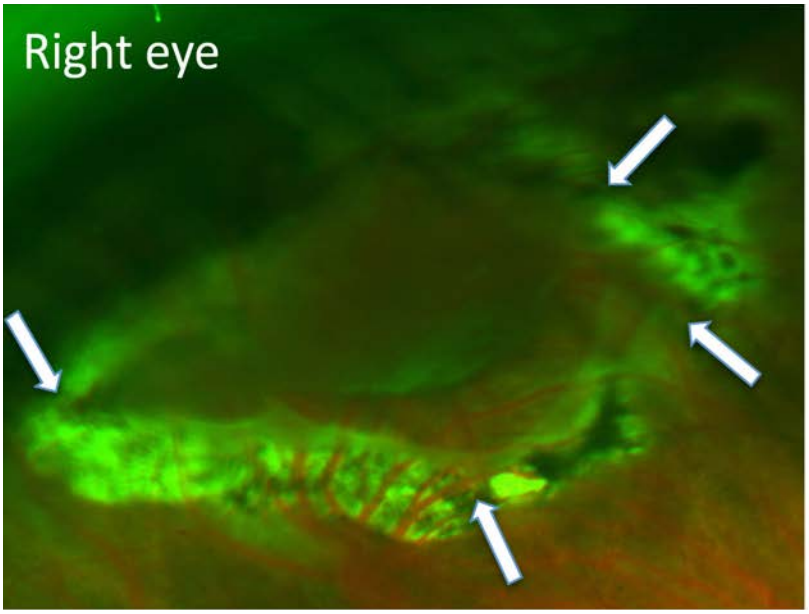
> "Bill landed a huge bombshell… there was another potential problem looming, aside from the floaters… (but) the final sting in the tail was still to come"

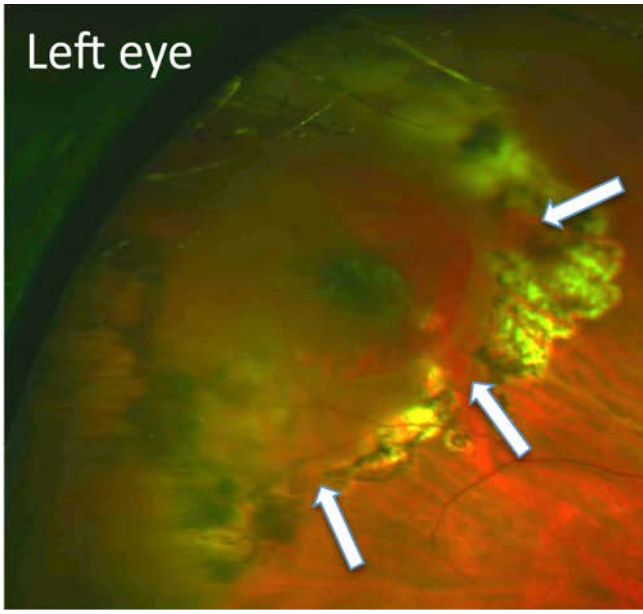
These in-office lasering procedures were not without discomfort! At various times during lasering episodes, which were performed through a dilated pupil and with topical anaesthesia, the bright flashes were followed quickly by considerable discomfort, bordering on pain. My slight yelps served as a signal to Bill that he was perhaps becoming a little over-enthusiastic in his lasering, but I knew this was all for the greater good (my ocular well-being), so I stiffened my resolve and put up with the discomfort as much as possible. After all, I was keen for Bill to do a thorough job.

DESPONDENCY SETS IN

As you might imagine, all this additional lasering, 12 to 18 months after my initial round of treatment, was somewhat disheartening. Inwardly, I was shedding tears about my tears (get it now?).

I wondered whether this was going to be a recurring theme – that every time I presented for a routine examination, more tears would be discovered and another round of lasering required. I suspect Bill sensed my despondency, so he gave me his take on the situation. Bill said, in his experience, when patients present with large tears such as mine, it is usually a single catastrophic event. It is as if the retina in a myopic eye is stretched to its limit and gives way by tearing. Bill suggested that, once the initial event is dealt





Enlarged image of the circumscribed laser photocoagulation scars surrounding tears in the far super-temporal and supero-nasal periphery of the fundus of my right and left eyes, respectively, showing apparent small gaps (arrows).

> "I wondered whether this was going to be a recurring theme – that every time I presented for a routine examination, more tears would be discovered and another round of lasering required"

with, it is the exception rather than the rule that patients suffer further tears.

So, I guess that means I am the exception… Anyway, Bill said this was unusual and he did not expect me to present with any more retinal tears in the future.

He was right. When I presented for a follow-up examination six months after all this additional lasering was over, Bill carefully examined my eyes and declared that my retinas were firmly attached and there was no evidence of any further tears. He observed a few scattered microaneurysms, consistent with my diabetes of 25 years standing. He also reported that there was no sign of cystoid macula oedema in either eye.

I mentioned to Bill that I was noticing lots of floaters, and that they were becoming troublesome, especially when reading (I will have a lot more to tell you about floaters in my next blog). Bill declared he was not surprised that I was being troubled by floaters, because he could see a somewhat murky vitreous when he looked into my eyes.

So, what was causing the floaters? Probably a combination of two factors. First, blood and other extravascular factors had entered my vitreous, and remained embedded there, following my catastrophic retinal tears. Second, vitreous syneresis is now setting in – my 59-year old vitreous gel is shrinking and slowly becoming liquefied, freeing up collagen fibrils that are also floating about.

ANOTHER BOMBSHELL

It was at this point that Bill landed a huge bombshell. He said while my retinas were secure and my eyes overall were stable and affording good vision (R&L 6/5), there was another potential problem looming, aside from the floaters. That problem was the formation of an epiretinal membrane in each eye. He said these membranes were only very slight at present and not immediately problematic in terms of eye health, but they were likely to develop further and may have to be dealt with surgically in due course, via an epiretinal membrane peel.

He was basically saying we could kill two birds with the one stone, by performing an epiretinal membrane peel and vitrectomy in a single operation.

The final sting in the tail was still to come. Bill told me that if a vitrectomy is performed and the removed cloudy vitreous replaced with silicone oil, a further operation would be required four to six weeks later to remove the silicone oil. All of this would almost certainly result in the formation of posterior subcapsular cataract, requiring cataract surgery. So, if these procedures were going to be performed in both eyes, I was looking at six possible operations over the next 18 months or so.

Bill reiterated that there was no need to act now – he just wanted to alert me as to what might lie ahead. He said I should just see how things go, and he would review me in another three to four months.

All of this came as a bit of a shock because I hadn't really thought about such issues since graduating from optometry school.

My whole career has been involved with researching the anterior eye and contact lens wear. That's a good 23mm or so away from the retina! So now I had some thinking – and reading – to do… mi

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Bloody Floaters

Professor Nathan Efron's personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery. Uncomfortable – and occasionally socially awkward – vision problems persist, despite successful laser surgery.

So here is another double entendre for you. Do I mean 'floaters containing blood' or 'damned annoying floaters'? Actually, I mean both. A few months had passed since my last round of laser surgery, and my retinas seemed firmly attached with no more 'ink in the sky' events or other visual disturbances … with the exception of bloody floaters!

So exactly what are floaters composed of? I guess this can vary considerably from person to person. In older people who have otherwise healthy eyes, floaters are generally pieces of collagen, pigment cells or other intracellular debris that become more mobile as the vitreous softens and degenerates. Just about everyone has noticed floaters at some point in their lives, but these are typically innocuous.

The floaters I experienced formed as a result of my retinal tears and subsequent bleeding into the eye (i.e. ink in the sky). Although much of that blood would have been reabsorbed, it seems that some blood remnants and other components of the extravascular fluid that entered my eye became trapped in a disorganised and degenerating, partly attached vitreous, leading to a form of floaters that were actually quite profound and annoying. In discussing my floaters over the next few months with fellow eye care practitioners, it seemed that despite my complaints of visual degradation, most were ready to dismiss my floaters as a temporary nuisance that I should adapt to and that would, in any case, dissipate over time.

In fact, neither was the case. For a number of reasons, I would consider the visual impact of my floaters to extend far beyond just being 'annoying'. They really were visually debilitating. In view of the pivotal role that these floaters were about to play in decisions I would soon be forced to make in relation to my ocular welfare, I will spend some time explaining the true impact of the floaters I was experiencing and why I considered these to be significantly impairing my vision.

Types of Visual Compromise

There were basically two forms of visual interference I experienced with floaters. First, there was the 'classical' floater, which I really only noticed when looking at a blank or featureless field, such as the sky when taking a walk along the beach or the ceiling of my bedroom just after waking in the morning. Sometimes I would see discrete small black dots or lines that would move slowly on a random direction, but quickly change or reverse direction if I executed a quick eye saccade. I would also see what seemed like small pieces of a very fine white veil. Although sometimes annoying, these floaters were merely of curiosity value and did not significantly compromise my vision per se.

> "… despite my complaints of visual degradation, most were ready to dismiss my floaters as a temporary nuisance that… would, in any case, dissipate over time"

Second, and more insidious, was the very frequent occurrence of a general degradation of vision, presumably caused by large, diffuse floaters that got between my macula and pupil. Here is a classic example of what would happen: I would be attending a lecture in a large auditorium, looking alternately at the lecturer and projected information on a large screen. I would all of a sudden realise that things were not clear, execute a quick sideways saccade, then voilà – all would be clear again. The same would happen when working on my computer. I would cross a threshold in time when I would suddenly realise that it was too difficult to see the text, and again, a quick saccade solved the problem.

The difficulty with the occasional saccade strategy is that a saccade would literally need to be performed at intervals ranging from about 10 to 60 seconds, depending on the visual task, and vision would be degraded for much of the inter-saccade interval. As you might image, this makes for an uncomfortable visual experience.

I have tried to simulate the nature of this visual debilitation in the attached pair of identical images. On the left is a clear scene of the view I have on one of my much-enjoyed beach walks. On the

right is a simulation of the beach scene as it would appear being obscured by floaters. It is sort of like a defocus effect, or maybe a diffuse degradation akin to looking through a finely ground glass panel. General forms can be easily seen, but contrast is diminished and details are obscured. Very frustrating.

FLOATERS AND MONOVISION

But, you ask, we have two eyes, so if a large floater obscures the macula in one eye, wouldn't this be compensated by clear vision in the other eye, such that you would not notice anything averse with both eyes open? Well, this is largely true, especially if you only have floaters in one eye. With floaters in both eyes, visual degradation would only occur if both maculas were obscured at the same time. So the extent of visual compromise depends very much on the severity of the floaters and whether the floaters are in one eye or both.

But my situation was different. I have been a contact lens wearer for over three decades, and have dealt with presbyopia using a monovision correction, whereby one eye is corrected for distance and the other for near. The intrinsic visual compromise inherent in such an optical approach, floaters aside, has never been a problem for me (although I am aware it is a problem for some). However, monovision compounds the potential for visual compromise for those with floaters, because floater-impaired vision in one eye can not be offset by good vision in the other eye. For example, when I am watching a lecture with my distance-vision-corrected left eye – if a large floater gets in the way in that eye – vision is degraded and is not compensated by my near-vision-corrected right eye, which is already blurred for distance. The same problem occurs for near vision. So, monovision exacerbates the visual degradation caused by floaters.

"So dispense with monovision and revert to alternative forms of ophthalmic correction" I hear you shout. Well, that's easy to say, but I love my monovision correction! Anything else for me would represent considerable compromises of other sorts. None of the other options, such as putting on reading glasses over distance vision contact lenses, wearing bifocal contact lenses, or ceasing contact lens wear in favour of varifocals or separate distance and reading spectacles, are especially appealing to me. I found this all rather depressing, really.

A SOCIAL INCONVENIENCE

Another seldom mentioned drawback of floaters is debilitating veiling glare, caused by intraocular backscatter of light. I found this to be a particular problem at social gatherings. I often found it extremely difficult to identify any facial features of a person standing against a bright background, and would suffer the embarrassment of being castigated for apparently failing to acknowledge or recognise a friend or colleague who was so obscured. Even engaging in conversation would be difficult, as I could not see lips move or facial expressions. After a while, I found myself deliberately manoeuvring around and positioning myself with bright fields behind me wherever possible to try to avoid this problem. It might sound trivial, but I noticed this time and time again. Very frustrating.

THE BIG DECISION

Every time I encountered these difficulties, I harkened back to Bill's suggestion that these floaters could be dealt with via a bilateral vitrectomy. This would certainly be a radical approach. There are many benefits and drawbacks of proceeding in this way, and I will deal with these in my next blog. However, as summer approached and I started more beach walks in bright sunny weather, these floaters began to really annoy me… and I had just been to a conference where I found myself sitting in the front row so that I could read the text on the screen.

Basically, I'd had enough. At a routine examination with Bill in December, I told him I wanted to proceed with the 'V option'. After a detailed discussion (the essence of which I will again relate in some detail in my next blog) we booked a surgical slot for the following March, in part because I was about to go to France for a lecturing engagement in February, and wanted that out of the way before proceeding. That visit to France was to have a profound effect on what would happen next. mi

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A clear beach scene (left) and a simulation of the same scene obscured by floaters (right)]

Cold Feet in Bordeaux

Professor Nathan Efron's personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery. A meeting of minds in France turned a planned vitrectomy on its head.

It was unseasonally cold in Bordeaux, where I arrived to visit my dear friend and international colleague of many years standing, the renowned French ophthalmologist and contact lens specialist, Dr. Florence Malet. I actually had the opportunity to visit Bordeaux because I was invited to Paris by Alcon to present a guest lecture at the European launch of their new water gradient daily disposable contact lens – Dailies Total1. Well, as they say in the classics, 'someone has to do the dirty work'!

I arrived in Bordeaux late afternoon and caught a cab from the undercover taxi rank. When the cab dropped me off opposite my hotel, I was in for a rude shock. Although I had lived in Manchester, United Kingdom, for 16 years and was well aware of how cold it can get during a European winter, I was ill-prepared for the prevailing conditions – about 5 cm of snow! It was bitterly cold, and my footwear was inadequate to keep out the cold. My feet were freezing! But there was to be another angle to my getting cold feet here in Bordeaux, which related more to my eyes than my feet…

Florence had arranged to pick me up and take me to her house for dinner, where we would join her ophthalmologist husband, Professor Joseph Colin. Now my mother always taught me never to turn up as a guest to someone's house empty-handed, so I had to spring into action to sort out a gift. Fortunately, there was a wine merchant immediately next to my hotel that was still open. I managed to find a nice bottle of Australian Chardonnay, which came in a lovely wooden presentation box. So I purchased this, but the irony of buying a French-derived wine with an Australian label in the heart of the wine region of France did not escape me.

FRENCH HOME DINING

Florence duly presented to my hotel at the arranged time and drove me through the surprisingly quiet streets of Bordeaux to her beautiful four-storey town house, which bordered a large area of parkland. Joseph, who I certainly knew by reputation but had never met, greeted me warmly and gratefully accepted my gift of Australian wine, which he immediately opened… and the wine kept flowing, with more authentic local produce, throughout the evening. I was entertained with a lovely meal, and before I knew it, it was time to head back to the hotel. We had a big day ahead.

But the problem was – Florence's car was frozen in! So, we had to run a shuttle, from the kitchen to the car, of saucepans full of hot water to free up the wheels and de-ice the windscreen. Joseph, myself and a friendly neighbour, who came outside to witness the commotion (and probably wished he hadn't) had to get behind the car to push it free. This succeeded, so I quickly jumped in and eventually was returned safely to my hotel.

> "The simple message was that in Europe, vitrectomies are a last-resort, drastic and highly risky procedure, rarely performed to solve problems of floaters"

I was very grateful to have the opportunity to dine with Florence and Joseph in their own house. I have been fortunate in my academic life to have travelled all around the world. I have been wined and dined countless times in restaurants and hotels, but there is always something very special about being invited into someone's home in a foreign country. To me, that is the ultimate expression of hospitality that surpasses all other pleasurable benefits of international travel. But there was to be another very sad reason why I shall have an especially fond memory of that evening, which I shall come to later.

The following morning, Florence collected me from my hotel and drove me to the Department of Ophthalmology at the University Hospital Pellegrin, where she and Joseph worked. Joseph was chairman of the Department of Ophthalmology, and revered in Europe for his pioneering research in refractive surgery and professional leadership. Following a tour of the department, Joseph, Florence and I ended up in the cafe for refreshments. In casual conversation, I mentioned that I was scheduled to have bilateral vitrectomies over the comings months… but I was not at all ready for their response!

A RUDE AWAKENING

Basically, Joseph and Florence were aghast that I would even contemplate having a

Meeting with colleagues in Bordeaux. Left to right: Prof. Joseph Colin, Prof. Nathan Efron, Dr. Florence Malet, (person unknown) and Dr. David Touboul.

vitrectomy performed for a non-urgent problem. Joseph started chatting on his mobile phone while Florence and I went to collect our coffees. It soon became clear what Joseph was chatting about – he had urgently summonsed his head of vitreoretinal surgery, and two other vitreoretinal surgeons, to join us for coffee. I was literally surrounded. The simple message was that in Europe, vitrectomies are a last-resort, drastic and highly risky procedure, rarely performed to solve problems of floaters unless vision is very severely compromised.

Now, these doctors were all very kind and polite, and they made it clear that it was difficult to comment on my specific case because they had not examined my eyes. They were speaking from general principles, but the message was abundantly clear: "You are a moderately high myope; you have had previous retinal tears and thus you have a fragile retina. The risks of complications of vitrectomy surgery outweigh the potential benefits. Perhaps you should rethink your decision."

As you will see in later blogs, these words were quite prophetic… but let me continue with my Bordeaux story.

That afternoon I had the opportunity to sit in and observe various eye operations being performed in four operating theatres. One of the surgeons, Dr. David Touboul, invited me to observe him perform cataract operations. The last time I observed cataract surgery was 25 years ago, when I sat in with Dr. Nag Rao at the LV Prasad Eye Institute in Hyderabad, India. A lot has changed since then. The whole procedure – from initial small limbal incision to final wound closure – took only about 15 minutes. Watching the phaco machine do its work, and the folded up hydrogel IOL unfurl after insertion into the sac, was just amazing.

That evening I was taken to a lovely restaurant, and the accompanying photograph was taken just before settling down to dinner. Back at the hotel, I didn't sleep that night, tossing and turning, wondering whether I should go ahead with my vitrectomies. Maybe I should just put up with my floaters and be resigned to substandard vision for the rest of my life. I mulled this over further on my long flight back to Queensland, and came to the decision that vitrectomy surgery was a step too far. I guess you could say I got cold feet in Bordeaux.

AN AMUSING ASIDE

The day after I returned home, I rang the ophthalmology clinic and cancelled my vitrectomy surgery scheduled for the following week. Prior to travelling to Bordeaux, I had contacted Mark Cushway, editor of *mivision*, offering to write this blog. But in view of my change of mind, I emailed Mark again to advise him that I wouldn't be writing the blogs after all because I had decided not to go ahead with surgery. He emailed back saying that he was disappointed. The irony of this is that I thought Mark's email kind of read as if he was disappointed that I was not going to go ahead with a series of gruelling eye operations… But of course, he was saying that he was disappointed that I would not be writing the blogs.

A SAD EPILOGUE

Fifteen months after visiting Bordeaux, I was at the annual meeting of the Association for Research in Vision and Ophthalmology (ARVO) in Seattle. I was busy reading the poster of a French vision scientist, who was standing next to his work, and we started up a brief conversation. I mentioned my trip to Bordeaux and the colleagues I had met. He informed me that Joseph Colin had died, age 63, from metastatic renal cancer in February, which was exactly 12 months after we had met. I was truly shocked. There were no signs of anything amiss when I met him, and nothing was said of any problems. I suppose my memories of getting cold feet in Bordeaux will be forever tinged with sadness when I reflect on Joseph's hospitality and his stern personal ophthalmic advice. mi

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To 'V' or Not To 'V'

Professor Nathan Efron's personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery is at a crossroad. Should he be resigned to putting up with floaters or remain focussed, positive and committed to the ophthalmic surgical journey?

After getting cold feet in Bordeaux, I returned home resigned to the idea of just putting up with my floaters and getting on with my life. After all, I had a lot to be thankful for. My eyes had been lasered in good time so as to avoid a catastrophic retinal tear, and my retinas were now securely attached with a low risk of further tears. I just had to put this whole episode behind me and get on with my life…

But as time went on, I became more and more despondent. I tried to imagine the floaters weren't there, or to ignore them, but they were still as annoying as ever. The magnificent vista that I used to enjoy so much on my beloved beach walks was constantly being spoiled by the ever-present swirling mass of cloudy vitreous in my eyes. I still found myself sitting up the front of lecture rooms. I still had to employ my eye saccade trick to clear up the text I was reading. I still had to press command-+ on my keyboard to enlarge the material I was reading on my computer screen.

When I saw Bill for a routine follow-up visit a few months after returning from Bordeaux, I mentioned that I still wasn't happy with my vision. Bill reminded me that surgery was always an option, and then related the tale of a professional golfer who had been in the news; he was considerably behind the pace after the first day of the four-day tournament, but went out fully committed on day two and focussed and progressed up the ladder to eventually win the tournament. The allegorical message was simply this: think carefully about your situation, but once you make the decision to go ahead with your ophthalmic surgical journey, remain focussed, positive and committed to see it through.

FALLING DOMINOES

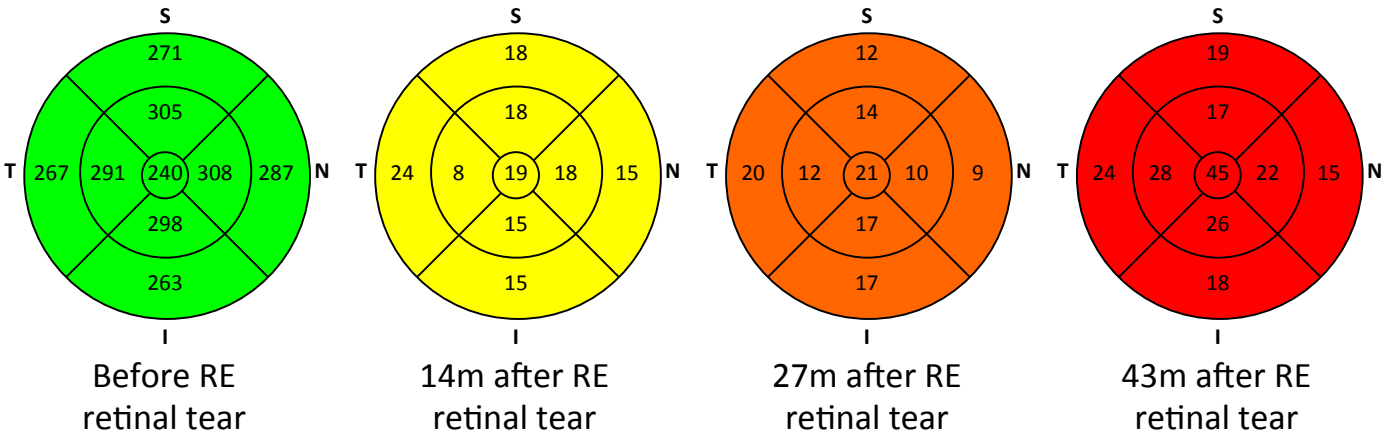
Although Bill was seeing me in the middle of a busy clinic, he could sense that I was still undecided over what to do. So he generously spent quite some time with me going through the full scenario, outlining the benefits and risks – such as post-surgical bleeding, glaucoma and macular oedema – and explaining technical aspects of the various procedures ahead. Basically, it goes something like this…

This first point is that my ophthalmic journey will be analogous to falling dominoes: once you tip the first domino, the rest will keep falling. Say we start with a vitrectomy in the right eye. Following this procedure, the vitreous chamber essentially becomes filled with aqueous, which has a different composition to the vitreous that would otherwise be there. This sooner or later results in a posterior subcapsular cataract, which inevitably requires phaco cataract extraction and replacement with an intraocular lens.

> "I tried to imagine the floaters weren't there, or to ignore them, but they were still as annoying as ever"

You might remember that I am a moderately high myope (R: -6.50/-1.25 x 175 L: -5.75/-1.25 x 180). So, for example, if my right eye ended up emmetropic after the vitrectomy and IOL replacement, I would be left with an intolerable 6D anisometropia. Therefore, even if we did not go ahead with a vitrectomy in my left eye, we would still need to perform a phaco cataract extraction and IOL replacement in that eye to balance up the refraction. Of course, a major advantage of embarking on this surgical journey is that, if all goes well, I would end up with a 'designer refraction'

Figure1: Left: Thickness of different macula regions before my retinal tear ('baseline'). From second left to right: difference in thickness from baseline at 14, 27 and 43 months after the tear. (S, superior; I, inferior; T, temporal; N, nasal)]



– either emmetropic in both eyes or perhaps leaving myself with permanent monovision (more on that later).

EPIRETINAL MEMBRANES

Another sinister pathological process taking place in the background is that an epiretinal membrane (ERM) – previously known as 'cellophane maculopathy' due to its ophthalmoscopic appearance – has been forming on the inner surface of my retina, and it is constantly getting thicker. ERMs are apparently a build-up of inflammatory cells, exudates, fibrin and other inflammatory debris, caused by the remnants of my vitreous tugging away at, and constantly irritating, the retina via a network of connecting strands.

Now here it is handy to have a wife who is an optometrist and knows her way around an optical coherence tomography (OCT) machine. Suzanne has one at her practice, and I have periodically presented for OCT scans, starting, fortunately, prior to my catastrophic initial 'ink in the sky' retinal tear event. Figure 1 shows a series of topographical plots, starting far left with a 'baseline' plot of the full retinal thickness of the macula region of my right eye prior to my retinal tear in that eye (in microns), followed by (going from left to right) plots of the change in retinal thickness from baseline at 14, 27 and 43 months after the tear. The numbers in the parafoveal retina are a little variable, but overall there is a clear trend of increasing retinal thickness, which is largely attributed to thickening of the ERM. Consider the fovea (the central round circle in each plot): 43 months after my retinal tear, my fovea was 19 per cent thicker.

The relevance of this progressive ERM formation is that it will remain an ongoing problem. It might start contracting, just like scar tissue, pulling the retina inwards and creating 'macular pucker', visual distortions and possible further retinal tears or detachments. Bill's solution: peel it off during the vitrectomy. That sounds risky to me. A lot more on that later, too!

> "...my ophthalmic journey will be analogous to falling dominoes: once you tip the first domino, the rest will keep falling"

OIL OR BUBBLE?

Bill spent some time discussing what happens after the vitreous is removed. Essentially, the vitreous that is removed needs to be replaced, and this can be with either an air bubble or silicone oil. The advantage of using an air bubble is that it naturally resolves away after 10–12 days without the need for any further surgical intervention. The disadvantage is that vision is terrible for most of the 10–12 day resolution period, and you cannot travel to high altitudes or fly in aeroplanes while the bubble is present, as it could expand and damage the eye.

The advantages of using silicone oil are that (a) it is possibly a better tamponade (i.e. physically holding the retina in place more firmly), (b) being a high myope, I might end up with reasonable vision because silicone oil has a relatively high refractive index, and (c) there are no altitude-related problems. The disadvantages of silicone oil are that (a) a second operation is required to remove it, (b) it is not always possible to remove all the silicone, leaving little silicone balls that roll around in your eye and can be distracting, and (c) the oil can clog up the trabecular meshwork and increase the risk of glaucoma.

A LITTLE HELP FROM SHAKESPEARE

You might have noticed that the title of this blog has syntactic assonance with "To be or not to be..." – the famous opening phrase of a soliloquy in the 'Nunnery Scene' of William Shakespeare's play *Hamlet*, i.e. "To 'V' (have a vitrectomy) or not to 'V'". This little phrase had been constantly buzzing around in my head during the 14 months since my Bordeaux trip. After at least three discussions with Bill over that period, and almost every night with Suzanne, I decided it was time to proceed. I simply figured that the benefits were going to outweigh the risks.

I rang Bill's clinic and made an appointment for a vitrectomy the following month; Bill had said that he would start with my right eye because it had the more pronounced ERM. The decision created the feeling of a huge weight being lifted off my shoulders. I was going to see it through, just like the golfer in Bill's story. mi

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Time for a Vitrectomy

Having finally agreed to a vitrectomy, Professor Nathan Efron's seeks to calm his anxiety by gathering information on the next step of his personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

Being an academic optometrist skilled in techniques for accessing the scientific literature, I was able to fully inform myself about the vitreoretinal surgery to which I was now committed. In particular, I was a little anxious about two aspects of the surgery – the planned epiretinal membrane (ERM) peel, and the decision as to whether my eye would be filled with oil or air at the end of the procedure – and sought to find more information relating to these issues.

GATHERING INFORMATION

The literature wasn't much help in getting a feel for the likely outcome following an ERM peel, because most of the reported cases involved patients who already had substantially reduced vision prior to surgery. Nevertheless, it was comforting to learn that in the vast majority of those cases, there was a substantial improvement in vision with reduced visual distortions. The literature was silent in respect of my situation, which was removing the ERM from an eye with good visual acuity. Figure 1 shows an OCT scan of my right eye prior to my retinal tear, and 43 months after the tear. The formation of an ERM after the tear is evident, albeit subtle, my wife Suzanne tells me, compared to the pucker and resultant macula oedema she has seen in some of her own optometry patients.

The literature addressing the question of whether to replace my vitreous with oil or air as a tamponade was somewhat equivocal. There appeared to be no clear evidence for superior outcomes with one technique or the other, except that silicone oil is regarded as a more secure tamponade and it can be left in the eye for a few weeks. It is typically used where there is judged to be a greater risk of retinal detachment after surgery. A post-operative increase in intra-ocular pressure was the main risk of oil. Air only has a full tamponade impact for a few days, because it starts resolving immediately, and is fully resolved after about 10 days.

As well as reading the academic literature, I decided to spend some time looking at patient forums on the internet. These turned out to be very revealing, and seemed to be very biased against silicone oil. A number of people complained that following their vitrectomy, some silicone oil remained behind and formed into small silicone balls which would roll around inside their eye, resulting in annoying and distracting entoptic phenomena (not a term they used). The other big disadvantage of using oil is that eventually it has to be surgically removed.

DISCUSSING THE SURGICAL APPROACH

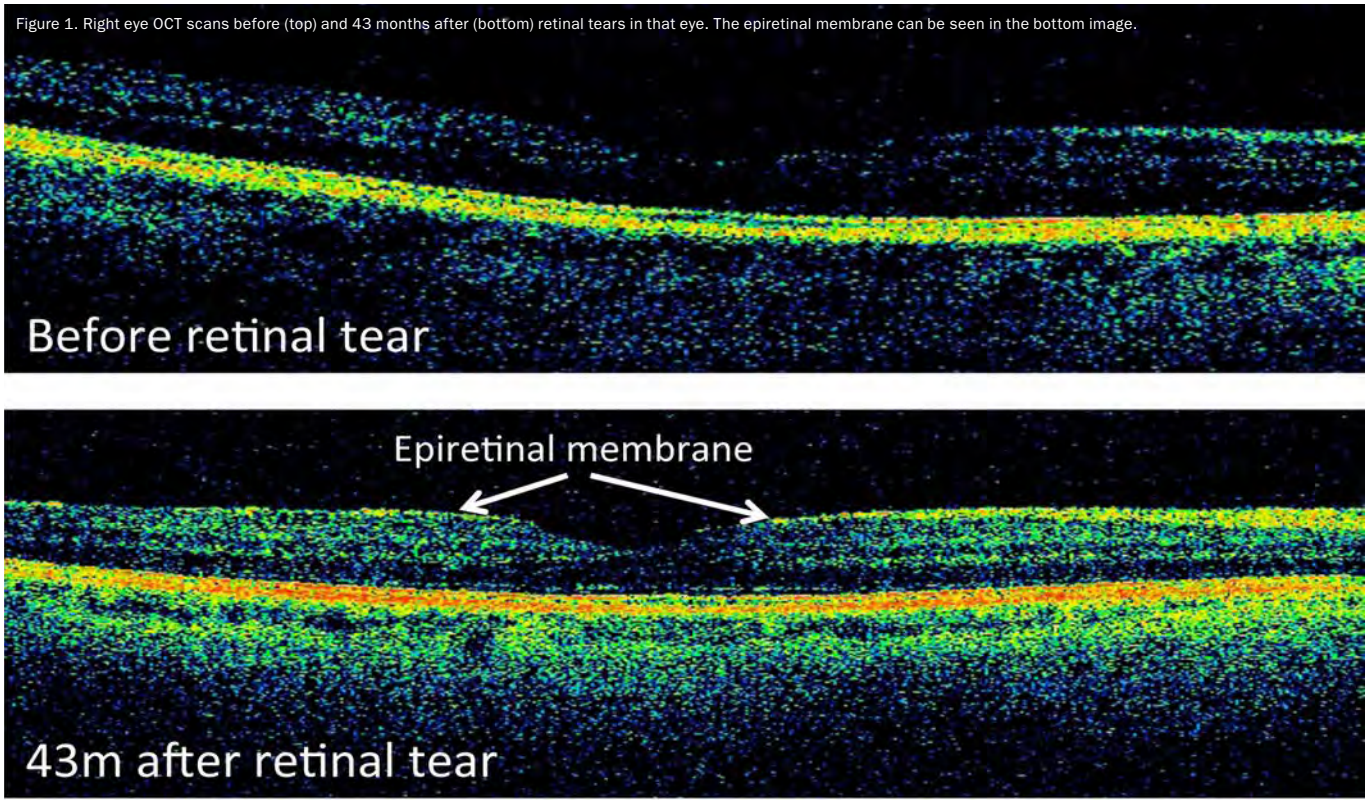
I had a pre-surgical review visit with Bill one week before the scheduled vitrectomy. I told him that I was a little nervous about the ERM peel, but was happy to accept his preference to proceed with this. On the question of oil versus air, Bill advised that because my retinas were well attached he would probably use air, but would make his final decision on this during surgery. He asked if I had any further questions. I said "no", to which he replied with a smile, "See you next Friday then".

Before I left Bill's office I was handed the usual glossy folder with all the paper work, including informed consent, hospital admission and medical history forms. I was also asked to obtain a letter from my general medical practitioners verifying that I was fit for surgery. A bit of an overkill, I thought, but I went ahead anyway and got my doctor to complete and sign the form.

> "This instruction was emphasised so strongly and repeatedly that I started to wonder if this was really a euphemism for not having sex!"

I was also bombarded with other instructions. I was to instil Systane eye drops three times per day, and Polyvisc eye ointment before bed, for three days prior to the vitrectomy. I suppose Bill likes being presented with a well-lubricated eye at surgery. I was not to have anything to eat or drink for four hours prior to surgery. I was not to get any water near my eyes for two weeks following surgery. I was reminded that I would need to engage in 'posturing' (position my head to face the floor) for extended periods for three days following the operation. I was advised that I would receive a phone call around 4.00pm the day before the operation to tell me of the admission time. I registered my preference for an early start. I was given a minim of mydriatic (1 per cent cyclopentolate hydrochloride) to instil in my right eye one hour before my admission time.

Figure 1. Right eye OCT scans before (top) and 43 months after (bottom) retinal tears in that eye. The epiretinal membrane can be seen in the bottom image.



One instruction that was stressed verbally and in writing was that for two weeks following surgery I must not engage in anything particularly energetic or lift heavy objects. This instruction was emphasised so strongly and repeatedly that I started to wonder if this was really a euphemism for not having sex!

HERE WE GO

Admission time was 6.30am, which suited me perfectly. As one of the first procedures of the day, Bill would be fresh, and I wouldn't have time to get hungry…

I duly presented at the allotted time with a nicely dilated right pupil. All of the pre-surgical formalities were as before: red hair net (allergic to penicillin), dark blue gown, light blue show covers, marker pen cross on my forehead above the eye to be operated (right), more mydriatic and anaesthetic drops and blood pressure taken. I was also given two Panadol tablets.

I had not forgotten the unfortunate incident of a surgical assistant bumping the operating table during my retinopexy procedure three-and-a-half years ago, so I again jotted down the following 'concerns' in the open field box on the pre-surgical admission form that invited such comments: "please instruct assisting theatre staff to avoid bumping the operating table during surgery". The admissions nurse said she would pass on this concern.

I was led through to another pre-surgical room, a pre-heated blanket was placed on my lap, and the anaesthetist appeared and proceeded to insert a cannula in my left arm. After studying my case notes, he looked up and said (with a slight smile), "Professor of Optometry, eh? So you know what's going on here then"… to which I replied (with a big smile), "Yes, I know exactly what's going on here". To which he replied (with an even bigger smile), "Hmmmmm… I'll give you a nice, deep sedation, then".

I was led through to the operating theatre, where I was made comfortable on the operating table, which was actually like a large armchair that laid back flat. The anaesthetist connected a syringe to the cannula in my arm… and that's just about all I remember about the operation. I recall seeing bright lights and shadows, presumably as instruments were inserted and manipulated in my eye, but I couldn't feel anything and was comfortable throughout.

All of a sudden, or so it seemed, I was wide-awake and upright, and was asked to swing around slowly and step off the operating chair into a wheelchair. My right eye was covered with a gauze patch, which in turn was covered with a protective transparent plastic shield. Bill was still there – it was the first time I had been aware of his presence that day – and he simply said, "All went well, Nathan, and I have put air in your eye". Great news!

I was wheeled through to the recovery area, and given sandwiches and coffee. Bill's assistant surgeon appeared after about 20 minutes, removed my eye patch, and had a peer in with his head-mounted indirect ophthalmoscope. "All looks fine… you are going to have a lot of fun with that bubble," he blurted. I was given a pre-prepared package of eye drops and ointments to administer during the post-operative recovery phase, with a bill for payment to the local chemist. I was also instructed about posturing (more about that in a later blog), and told to sleep with my left cheek against the pillow for the next few nights. And yet again, "no physical exertion" (nudge nudge, wink wink).

Suzanne then appeared in the recovery room, led me to her car, and drove me home. This was all a very slick arrangement, I thought, having been admitted at 6.30am and arriving home by 9.00am.

But I really wasn't prepared for the drama that was about to unfold…

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Houston, We Have a Problem

Having undergone a vitrectomy, followed by a revision procedure, Professor Nathan Efron thought his right eye was on the way to recovery… yet somehow the world still didn't look very clear.

As soon as I arrived home after my right eye vitrectomy I began posturing, which means looking down towards the floor. The theory is that the air bubble inside my eye will rise up and act as a tamponade; that is, exerting pressure against the back of my eye to keep my retina securely in place and minimise the risk of any post-operative detachment. I was required to 'posture' for 30 minutes every hour, and this was to continue for the next three days.

Just before retiring to bed that night, I removed the protective plastic shield and soft gauze eye pad, to reveal a very nasty looking eye. My upper eyelid was grossly swollen and distorted and my conjunctiva was very red and also swollen (grade 4 on the Efron scale). I reattached the plastic protective shield and laid down with my left cheek against the pillow, as instructed. I tried to get to sleep… without success.

When discharged from the day surgery following my vitrectomy, I had been given numerous medications, including 500mg paracetamol/codeine tablets to be used to alleviate any post-surgical pain. Now I have never been one for taking sedatives or analgesics, but my eye was becoming very uncomfortable and it was keeping me awake. So I took two of these tablets, and they knocked me right out. I slept soundly for the rest of the night.

A RUDE AWAKENING

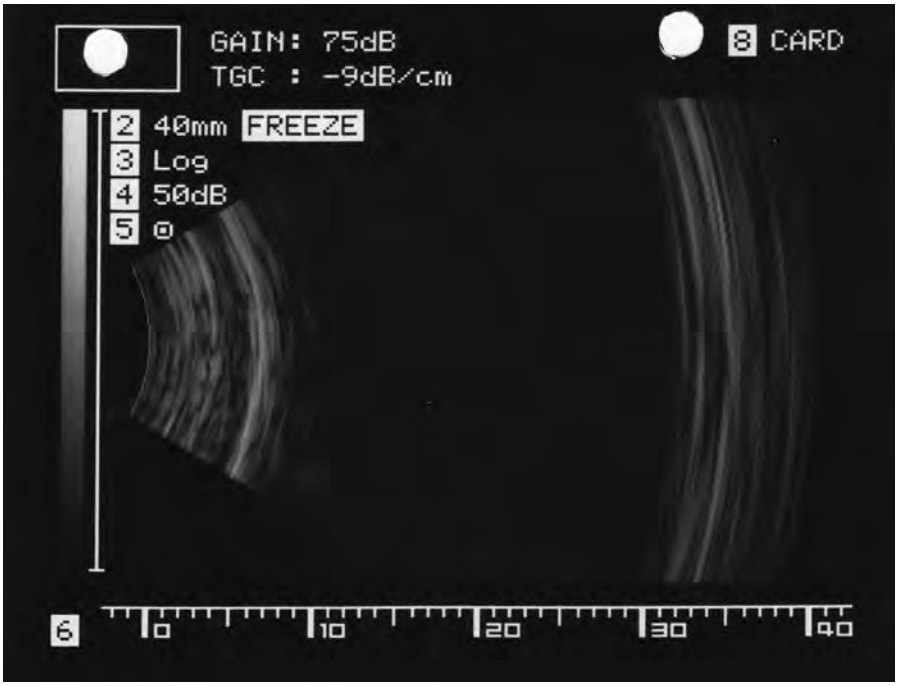
I awoke the following morning (it was Saturday) to a beautiful sunny day. I couldn't see anything out of my right eye – not that I had expected to see much because I had a huge air bubble in my eye – but I wasn't expecting the dull orange-brown haze. I proceeded to insert my prescribed eye drops, and when I tilted my head right back to do this, I noticed something that scared the daylights out of me… ink in the sky!

As I looked up at the ceiling, I could see three or four parallel lines of what looked like black ink dribbling in from the superior periphery towards my central point of fixation. I had an immediate sense of déjà vu… this was very similar to the 'ink in the sky' episode I experienced a couple of years earlier, when I had my initial retinal tears.

I started to feel a little faint, and developed a sickly feeling in the pit of my stomach. I blurted out to Suzanne that something was amiss, and explained what I was seeing. Suzanne also felt faint, and had to sit down. We quickly realised that there must be bleeding inside my eye, and that this should not be happening. Silence followed. What to do next?

I called the emergency phone number for the clinic, which I had been given when discharged. There was no answer, so I left a recorded message. About an hour later

Figure 1. Scan of my right eye captured using B-scan ultrasound, showing my retina to be securely attached.



Mike returned my call, and after a brief discussion, asked me to come straight in to the clinic. He said he would call Bill to see if he could come in to the clinic also. Suzanne drove me there, and Mike arrived at about the same time. He led me to the consulting room and proceeded to examine my eye, which was nicely dilated because I had already instilled 2 per cent homatropine as part of my post-operative medication protocol.

Both Mike and Bill examined my eye and declared that they really couldn't see my fundus through the thick haze. Slit lamp examination revealed the presence of a 1 mm hyphaema, and red blood cells could be seen floating around in the anterior chamber. This confirmed my initial self-diagnosis that there had been bleeding inside my eye. Bill advised that there was a possibility that this would clear spontaneously, which was comforting. Mike was concerned about the level of swelling of my eyelid, and suggested I may have had an adverse reaction to Chlorsig. As a precaution he prescribed the use of Tobrex instead. I was advised to come in again two days later for a recheck.

When Mike examined me on the Monday, he reported he still could not see my fundus, which was consistent with the thick orange-brown haze I was observing. Vision was recorded as 'light perception only'. My intraocular pressure (IOP) had dropped to 2 mmHg, so Mike advised that I stop taking Azopt, and increase the frequency of pred forte to six times per day.

Two days later, my IOP was 3 mmHg (measured by Suzanne), but the following day, when I saw Mike again, it had shot up to 15 mmHg. I recommenced Azopt. After a further two days, my IOP was 13 mmHg, and remained at that level thereafter. The hyphaema had cleared and Mike advised me to revert back to instilling pred forte four times per day.

Bill's main concern was not the drop in IOP or lack of vision, but the question of whether my retina was still attached. To check this, he performed a B-scan ultrasound examination, which confirmed that all was fine in this regard (Figure 1).

Bill sent me off to get my bloods taken for a thorough assessment of my blood clotting capability. At that time – and still today – I wasn't taking aspirin or any blood thinners. I had stopped taking aspirin two years prior in view of emerging evidence – related to me by my endocrinologist – suggesting an absence of a proven benefit of regular aspirin. Blood tests revealed no abnormalities in respect of blood clotting.

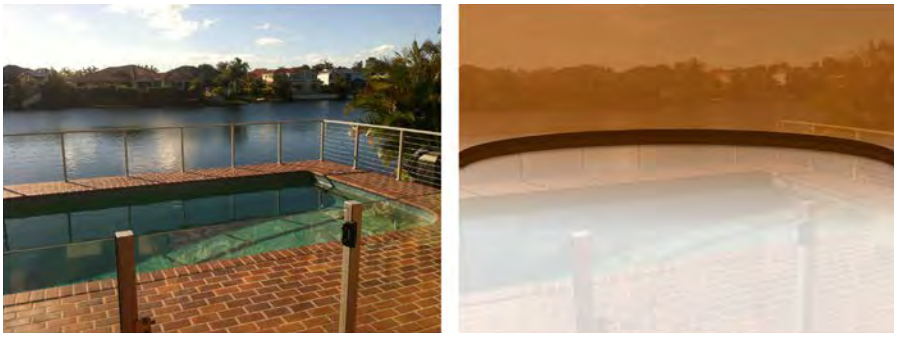
Nine days after my vitrectomy, I was still only seeing a murky orange-brown haze, and vision was recorded as 'hand movements'. Bill advised that a revision procedure was indicated, which would involve draining the bloodied fluid out of my eye and reinserting another air bubble. I was to come back in two days for this procedure.

As the saying goes, Bill was 'beside himself'. "Of all people, why did this have to happen to you, Nathan?" he asked rhetorically. He was to repeat this sentiment, relating to my post-vitrectory bleed, a number of times over the next few months.

REVISION SURGERY

I had a different anaesthetist for the revision surgery, and found myself under a lighter sedation, but still comfortable and pain-free during the operation. Following the procedure, Bill told me he had identified the source of the bleeding. There was a small blood clot at the location of one of the original access ports, which was probably nicked when withdrawing the operating instruments. Apparently this can occur in up to 10 per cent of vitrectomy procedures.

Figure 2. Left: The normal view from the back veranda of our house. Right: Simulation of the same view 3 days after the revision procedure. The thick black line is the top of the bubble.



Bill told me that after flushing out my eye, he decided to again reinsert an air bubble, rather than silicone oil. He also lasered the new port sites to prevent further bleeding. His final comment to me, as I was wheeled out of the surgery, was "Let's hope lightning doesn't strike twice in the same place". And again "Of all people, why you …?"

I slept well on the first night following this re-procedure, without sedatives or analgesics, and the first thing I did upon awakening the following morning was to tilt my head back to see if there was more ink in the sky. Thankfully, there wasn't any. Vision was still poor, as expected. There was an orange-brown haze, but much less intense than that observed following the first procedure. At least, I thought to myself, we have avoided significant intraocular bleeding this time.

At the clinic the next day, IOP was a little low at 7 mmHg, but Mike didn't seem at all concerned about this. I had some nasal bruising. Over the next few days my vision improved, but more slowly than expected, and I was getting very worried that something more sinister might be wrong. Vision at day three was still only 'count fingers'. The bubble was reducing in size as expected, but the world was still hazy brown (Figure 2).

I went into the clinic to see Mike on day seven. Vision had improved to 6/60, and IOP was 12 mmHg. Mike reported that he could see my fundus with the Volk lens, although it was still quite hazy. My peripheral retina appeared to be attached, but Mike still couldn't get a clear view of my macula. My media was still too cloudy to perform optical coherence tomography.

I was aware of the bubble inside my eye slowly getting smaller day by day, and by day 13 it was gone. However, vision at this stage was still only 6/18, with a slight orange tinge. My vision continued to improve over the following week, and although I ended up with acuity of 6/5+, the world somehow didn't look very clear.

It was at this stage that I noticed a kind of after-image just below the point of fixation in my right (operated) eye. Maybe I hadn't escaped unscathed … mi

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The Flying Angel of Death

Following his eventful vitrectomy, Professor Nathan Efron is troubled by a small but annoying blind spot on his personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

Now that's one hell of a melodramatic title for a blog, and it comes with a warning: if you are the type that gets nightmares after reading scary stories, you might just want to skip over this article and read on.

Avid followers of miblog will recall that the last instalment ended with my observation that, following my right eye vitrectomy revision procedure, I noticed a kind of 'after-image' just below the point of fixation. I was first aware of this visual anomaly during the immediate post-operative recovery phase, when my vision was about 6/18. Both Mike and Bill quite confidently proclaimed that vision is often disturbed following a vitrectomy and epiretinal membrane peel, and that vision can take anything from six to 18 months to return to normal.

Aside from the after-image, which I shall explain in more detail a little later, my vision just didn't seem quite right. Mike mentioned to me that patients who have had the same procedure often reported imperfect vision, and some have stated that the quality of vision is akin to watching a high definition television screen with lots of pixels missing. Well, that's exactly how it seemed to me.

FINDING AN EXPLANATION

I figured if many patients complain of sub-optimal vision following an epiretinal membrane peel, then there must be something in the literature about this. Certainly patient blogs referred to imperfect vision following this procedure, but I wanted some hard evidence, and good explanations. Sure enough, I found one paper where the authors concluded "Although visual acuity and macular edema were improved after… (a vitrectomy and epiretinal peel)…, macular function, as indicated by multifocal electroretinography, had limited recovery at 12 months".[1] They added "This incomplete recovery may explain patients' reports of blurred vision despite relatively good visual acuity after epiretinal membrane peel surgery".

So, this had me quite worried. Was I really going to have some form of visual defect for the next 12 months? Or even worse, was I going to be stuck with this anomaly forever? Lim and colleagues were unable to identify the precise cause of the abnormal retinal responses they observed.[1] Whatever the answer to these unknowns, I decided to set out to try and determine the extent of my apparent visual compromise, and contemplate the cause.

First, I thought I would take a look at my pre- and post surgery optical coherence tomography scans (Figure 1). Compared to the pre-surgical scan, my retina appeared a little 'spongy' and oedematous after surgery. However, the macula was still well-defined and attached, and certainly Mike and Bill did not seem at all concerned.

A CURIOUS APPARITION

Back to the 'after image'. A month or so after the vitrectomy, my vision had returned to

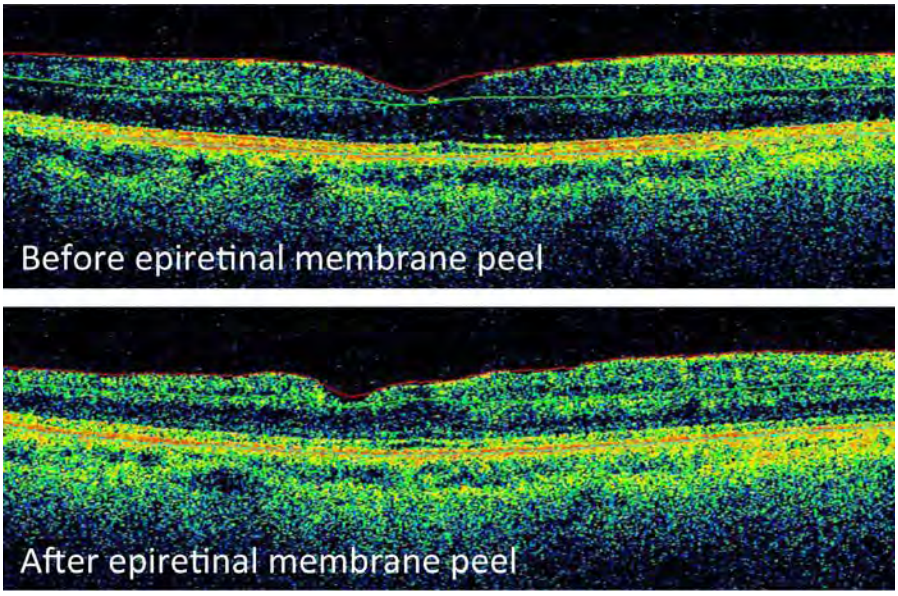


Figure 1. Optical coherence tomography scans of the retina of my right eye before (top) and after (bottom) the epiretinal membrane peel

Figure 2 (a) Shape and location of my flying angel of death. This visual defect does not obscure a 6/60 letter (b), but could make a 6/6 letter 'E' look like a letter 'F' (c)

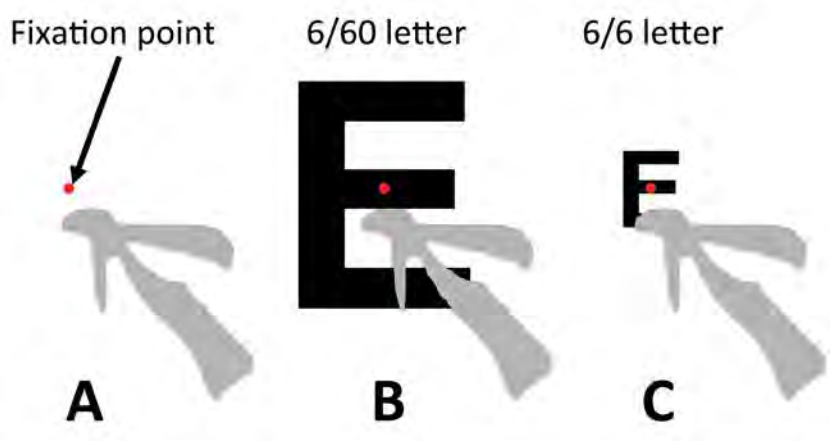
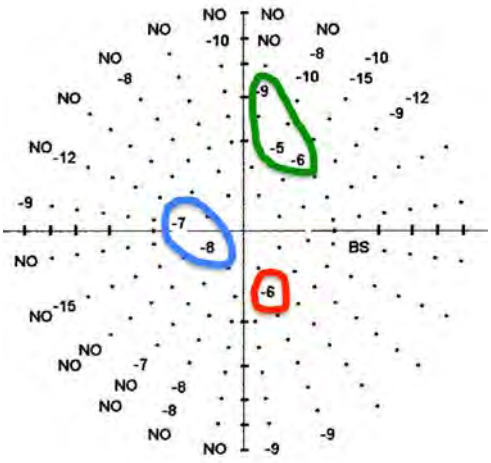


Figure 3. Right eye 'hill of vision deviation' visual field plot. The red region corresponds to the location of my flying angel of death, whereas the nasal (blue) and superior-temporal (green) defects are not readily noticeable with general viewing



6/5^{+}, but the world was still 'pixel deficient' and I was still aware of this persistent after-image, especially when I went looking for it. I soon discovered that this was a small blind spot, just infero-temporal to my point of fixation. I could clearly and accurately make out the shape of this blind spot by looking at a fixation point on an otherwise blank field and blinking rapidly.

And here's the spooky bit… this blind spot was in the form of a flying or winged angel (Figure 2). Given that it was also black and presumably represented a defined region of 'dead' receptor cells, I immediately coined the term 'flying angel of death' to describe it.

You might be wondering how I could see 6/5^{+} given that my flying angel of death partly obscures a 6/6-sized letter, as shown in Figure 2c. The answer must be 'microsaccades'. Thus, when I stare at a 6/6-sized letter, natural tiny eye movements allow a rapid scanning of all parts of the letter, allowing me to establish that it is an 'E', rather than, say, an 'F'. Thus, I consider my right eye visual acuity to be a 'slow 6/5^{+}'.

I experienced similar problems reading. Because my flying angel of death sits to the right of my fixation point, upcoming text is partially obscured as I scan from left to right while reading. So, although I can read small print, I consider myself to be capable of reading a 'slow N6'.

I took my artwork depicting my flying angel of death to show Mike and Bill. They were somewhat perplexed. Bill asked "Is it really that big?" I explained it was; that it seemed to be about the size of a 6/60 letter on an eye chart viewed at 6m, but that it fortunately did not overlap the macula. Both Mike and Bill again expressed their confidence that this would go away before long. Every time I presented for an examination after that, they asked me if I was still troubled by my flying angel of death.

> "And here's the spooky bit… this blind spot was in the form of a flying or winged angel"

MORE BLIND SPOTS

After a while, I sensed that my visual deficit was a little worse than first thought. I couldn't really see any gaps in the Amsler Grid, so I developed my own more sensitive technique of exploring my visual field. I simply fixated on a red spot while moving a ball point pen slowly around my central field, concentrating on observing the tip of the pen. Sure enough, I detected another small area of reduced visual sensitivity, along the mid-line on the nasal side.

To check out this field loss more thoroughly, I asked Suzanne to perform a field test on me, so she did a Medmont fast-threshold full-test. The results, shown in Figure 3, not only confirmed the location of my flying angel of death and the nasal defect, but also found a small superior-temporal defect (which I couldn't really locate with my pen test).

The small nasal and superior field defects were not really noticeable when looking around generally, but probably explain the notion of 'missing pixels'. However, the flying angel of death was really worrying, especially since I was still seeing it three months after surgery.

As to the cause of these visual defects? My guess is that when an epiretinal membrane is peeled away, minor damage can occur to the underlying retina. Based on extensive comment on internet patient forums of poor vision following this procedure, as well as my own experience, I suspect that epiretinal membrane peels carry a substantial intrinsic risk of minor visual decrement, which has yet to be fully documented in the literature.

Anyway, all I could do now was play a waiting game to see if Bill and Mike would be right in predicting that this would go away in 12 to 18 months. mi

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The Tedium of Drops and Ointments

While recovering from his vitrectomy, Professor Nathan Efron found his eye drop and ointment regimen to be a tedious episode during his personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

Although eye care practitioners undoubtedly take great care in considering the right combination, dosage and application frequency of topical eye medications they prescribe, I suspect only scant attention is paid to the practicalities of how patients ought to go about instilling eye drops and ointments. We just take this for granted: of course, everyone knows how to do this... don't they?

Well, in my case, and I suspect in the case of many patients, the answer is 'no'. Having never had to self-administer eye drops or ointments before, I was at a total loss as to how to do this. Not only did I have to develop techniques for getting these medications into my eye, but I also had to deal with sometimes complex logistical arrangements for instilling different drops at different frequencies.

RECIPE FOR CONFUSION

Following both my initial vitrectomy and revision procedure, I was sent home with the following panoply of concoctions:

- Paracetamol/Codeine (500/9.6mg) – two tablets every four hours while pain persists.
- Isopto Homatropine 2 per cent eye drops (Alcon) – four times per day for one week.
- Prednefrin Forte eye drops (prednisolone acetate 10mg; phenylephrine hydrochloride 1.2mg per 1 ml) (Allergan) – four times per day for eight weeks.
- Azopt 1 per cent eye drops (Brinzolamide 10mg/ml) (Alcon) – twice per day for four weeks.
- Tobrex ointment 0.3 per cent (Tobramycin 3mg/ml) (Alcon) – four times per day until tube is empty.
- Lacri-Lube eye ointment – four times per day after ceasing Tobrex, as required.

Various guidelines need to be borne in mind when using eye drops and ointments, including 'use by' dates and 'expiration after opening' time frames. The order that these medications are applied may be pertinent; I was advised to apply ointments last. Some eye drops need to be shaken vigorously immediately before use; Prednefrin Forte, which has elements of the formulation incorporated as a suspension, is a case in point.

Most of these medications were to be taken four times a day. So I set four alarms on my iPhone, for 8am, noon, 4pm and 8pm. That part was easy. However, one of the few instructions I did receive about instilling drops and ointments was to wait at least three minutes between applications to avoid flooding my eye. That means at least nine minutes to instil all medications. I found this to be a tedious intrusion into my day.

My eye medication regimen became more complex during the recovery period following my first vitrectomy. My intraocular pressure had dropped to two mmHg and I had a hyphaema and flare in my anterior chamber. Appropriately, I was advised to cease taking Azopt but increase the frequency of Prednefrin Forte to six drops per day. This meant I had so set up nine iPhone alarms throughout the day. In the following sequence, the asterisk symbol* indicates the time to instil Prednefrin Forte, and the sword symbol† indicates the time to instil the other medications: 7am*, 8am†, 10am*, noon†, 1pm*, 4pm*†, 7pm*, 8pm† and 10pm*. To avoid confusion, I drew up a schedule listing what drops I had to take at what time. What a palaver!

"I had so set up nine iPhone alarms throughout the day... To avoid confusion, I drew up a schedule listing what drops I had to take at what time. What a palaver!

THE EFRON TECHNIQUE

Suzanne was kind enough to instil my eye drops and apply my ointments first thing in the morning. It can be very useful having a wife who is a therapeutically-endorsed optometrist! But after Suzanne headed off, I was left 'home alone', having to devise my own technique for getting these medications into my eye.

Figure 1. Facing up to the daunting prospect of getting all these medications into my eye

I found the most difficult aspect was avoiding the natural aversion blink reflex when a huge liquid eye drop is heading straight for your eyeball. Yes, I know the advised technique is to pull down your lower eyelid and insert the drop there, but I found this really hard. You can't work out exactly where the dropper is relative to your everted lower lid when looking directly upwards. I found numerous instructional video clips on eye drop instillation on YouTube, but none were very helpful. So I had to develop my own technique, and you might find this useful when instructing others how to self-administer eye drops...

Basically, I developed a two-handed technique, as shown in Figure 2. This sequence depicts instilling drops into my right eye from a dropper held in my right hand (after washing both hands first, of course). Rest the left hand on the cheek below the right eye and gently pull down the lower lid with the left index finger, while looking directly ahead into a mirror (2A). Hold the dropper between the thumb and index finger of the right hand and bring that hand to rest on the back of the left hand (2B), pointing the dropper horizontally and directly towards the lower canthus (2C) (you may need to turn your head slightly to the side to confirm alignment of the dropper with the lower lid). Fix both hands and head as a single unit, and tilt your combined head-hands unit back (2D&E) until you are looking directly upwards (2F). At this point, the dropper will be directly and vertically aligned with your lower canthus. Simply squeeze the dropper to instil the drop.

I found that with a little practice, this technique worked almost every time!

APPLYING OINTMENTS

I quickly discovered that an entirely different but much simpler approach was required for applying ointments. My first few attempts at applying ointment were thwarted by the peculiar way in which ointment oozes from the tip of the tube. I found that when I squeezed the tube slowly, the ointment tended to curl back on itself, leaving a big blob of curled up ointment on the tip of the tube. When I tried to touch this blob of ointment onto my lower lid, the ointment didn't seem to want to release. That is an unacceptable approach anyway, as it is important to avoid contact of the tip of the dropper or ointment tube with the eye or lids to prevent contamination. Nevertheless, I tried to coax the ointment into my lower cul-de-sac, but ended up with ointment everywhere except in my eye. Again, I needed to develop a viable technique...

The solution was surprisingly simple. I would adopt the same posture as per Figure 2A-C, but instead of tilting my 'head-hands' unit backwards, I quickly and forcibly squeezed the ointment tube, resulting in a linear stream of ointment shooting into my lower canthus. Although this technique can result in more ointment entering the eye than intended, at least the ointment ended up in the designated location! Anyway, there seemed to be enough ointment in the tube to last for a week using my 'explosive burst' technique.

LIFESTYLE INTRUSION

While some of my topical eye medications only needed to be applied for the first week after surgery, Azopt and Prednefrin Forte eye drops had to be used post-surgically for four and eight weeks, respectively. Of course I understand the reason for this, but nevertheless, instilling eye drops four times a day for eight weeks is a long time, and quite an intrusion into one's lifestyle. I stayed at home for two weeks following my revision vitrectomy surgery, and taking these medications while domiciled was not really a problem. Having to remember to apply the drops at work and when going about leisurely activities on the weekend for the next six weeks was the problem!

I guess the whole point of this particular blog is that, as eye care practitioners, we shouldn't take for granted the potential difficulties regarding the use of eye drops and ointments that confront our patients. Instilling eye drops and ointments into another person's eye is easy. We do it all the time in routine clinical practice. We could do it in our sleep. But self-administration of eye drops and ointments – in terms of application technique, logistical organisation and lifestyle intrusion – can be a real challenge, as this professor of optometry found out. mi

Professor Nathan Efron is a researcher at the Institute of Health and Biomedical Innovation and School of Optometry and Vision Science, Queensland University of Technology. He is currently president of the Australian College of Optometry and vice-president of the International Society for Contact Lens Research.

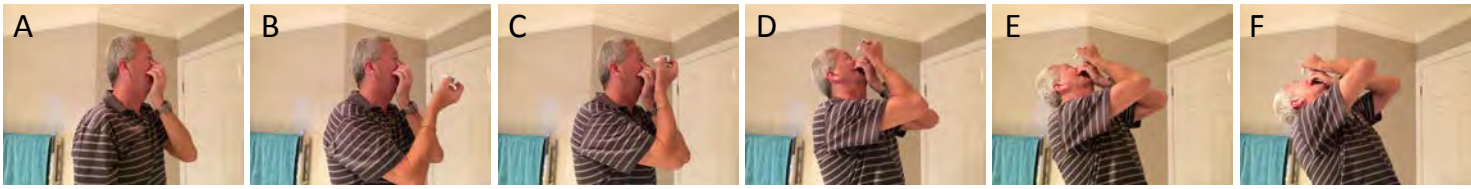

Figure 2. The 'Efron Technique' for self-instillation of eye drops. See the text for a full description

The Beauty of Stereopsis

On many occasions during his personal journey of retinopexy, cryopexy, vitrectomy and IOL surgery, Professor Nathan Efron found that he had to get by using one eye only… That made him realise the beauty of (normally) having two eyes.

For the benefit of those reading this blog who are not ophthalmic practitioners, 'stereopsis' refers to the process by which our two eyes and brain work together to create the perception of a three-dimensional world. Perhaps the best illustration of this phenomenon is when we go to the cinema to watch a 3D movie. The amazing 3D depth sequences, which are essentially exaggerated stereopsis effects, suddenly cease to occur when you cover one eye, or remove your special 3D glasses.

The essence of stereopsis is that you need two healthy eyes with reasonably good vision to be working together to create a three dimensional stereoscopic world. This is the basis of clinical tests of stereopsis, such as the Titmus Stereotest. Reduced or absent stereopsis, as revealed by such tests, indicates a defect in binocular vision.

The problem I am having during various phases of my eye surgery is that, for extended periods, I only have the effective use of one eye. For example, following the initial vitrectomy in my right eye, which subsequently filled with blood, I was essentially blind in that eye for almost two weeks. After I had the revision surgery, it took another two weeks before vision in that eye returned to near normality. During these periods, I was deprived of stereopsis!

So what's the big deal about that, you ask? And maybe that is not an unreasonable question. Many people in this world have only one eye, because the other is blind, or has been removed due to congenital abnormality, disease or accident. They can function perfectly well with only one eye. Many of us have been forced to use one eye for brief periods when the other eye is incapacitated due to injury or a severe eye infection.

Of course, the world still looks three-dimensional when you use only one eye, but this is not because of stereopsis. Many other factors are involved. First, you know the world has depth from experience. Second, there are numerous so-called 'monocular cues' that signal depth, such as relative size, interposition of objects, linear perspective, aerial perspective, light and shade and monocular motion parallax.

So why should I complain about being deprived of the use of one eye for a limited period? Well, I guess the point is that I am not so much 'complaining', as coming to the realisation that stereopsis is a useful attribute. I remember my undergraduate lectures in visual physiology, where we explored the concept and neural basis of stereopsis in great detail. In practical classes we would conduct experiments to demonstrate stereopsis and investigate the visual conditions under which it becomes apparent. As it turns out, stereopsis takes effect at distances of up to 18m away.

In my last blog I discussed my frustration with the practical and logistical difficulties in using eye drops and ointments (using both eyes), and conveyed the sentiment that we ought to have empathy with our patients to whom we prescribe these treatments. Well, the same applies for our patients who are about to become monocular for a period of time. A few words of encouragement, and advice to take care when doing things up close that require judgement of distances, would not go astray. Let me illustrate this with personal experiences during my many surgically-induced monocular phases. There have been various incidents, albeit relatively inconsequential in the big picture of life, of being flummoxed by the absence of stereopsis.

> "Ever tried shaving with one eye? I don't recommend it! I ended up with a couple of small cuts around my lips and nose"

TROUBLE IN THE KITCHEN

The morning after my first vitrectomy, when I sat down at the breakfast table and proceeded to pour milk into my cereal bowl, I couldn't be sure exactly where I was pouring the milk, and how high the milk bottle was from the bowl. I had to grab the bowl so as to provide additional orientation cues, relating to where my two hands were with respect to each other. No real problem, but I found myself having to proceed a little more carefully than usual.

Again in the kitchen – our cappuccino maker requires water to be poured into the

narrow neck of the boiler. You guessed it… water everywhere except in the boiler the first time I tried to do this (Figure 1A). I developed a strategy of resting the lip of my water jug against the neck of the boiler to ensure accurate pouring.

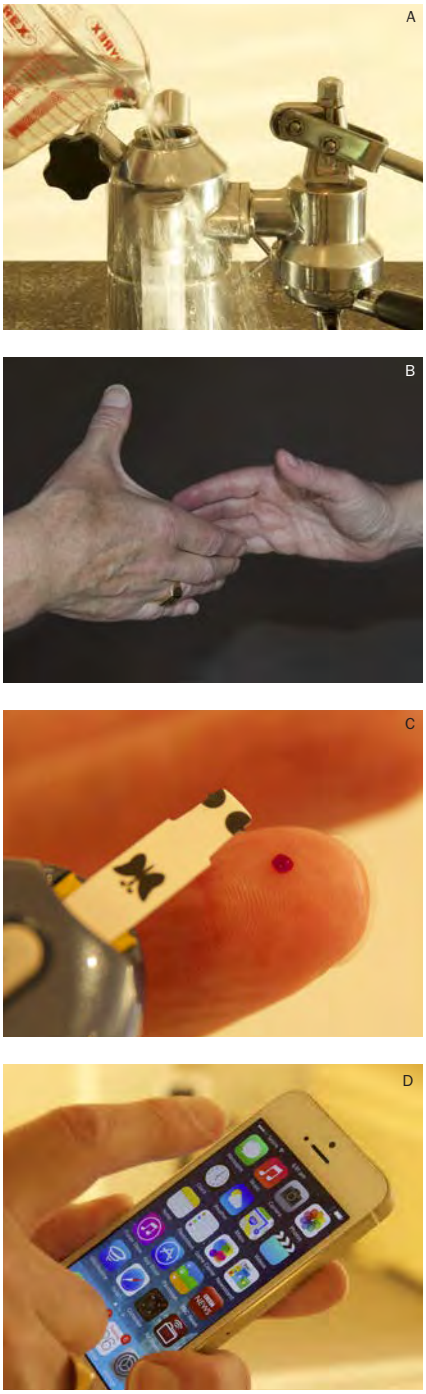

Figure 1.The absence of stereopsis caused frustration when filling my cappuccino machine with water (A), attempting a hand shake (B), touching a blood glucose measuring test strip against a droplet of blood on my finger (C) and using the touch pad on my iPhone (D).

As a well brought up individual, I was accustomed to greeting Bill with a handshake at the beginning of each of my consultations. When I went to shake Bill's hand following my vitrectomy, I missed making the hand connection (Figure 1B). It happened momentarily, and only required a slight readjustment to complete the hand shake. I am sure Bill didn't even notice that this occurred, but it was nevertheless slightly unnerving for me.

Having Type 2 diabetes, I check my blood sugar levels every Sunday morning. This has become a challenge with only one eye. Blood sugar monitoring requires pricking the tip of my finger with a fine lancet and allowing a small droplet of blood to form. Then the end of a 3cm long plastic sensor strip must be dipped into the blood droplet for a few seconds until the blood sugar level readout appears on the digital monitor into which the other end of the sensor strip is inserted (Figure 1C). I found this extremely difficult, as I couldn't tell if I was approaching the blood drop too high or low, and ended up smearing blood all over the place. Again, no great drama, but a reminder of my lack of stereopsis.

Using the touch screen on my iPhone became quite awkward. Try it yourself after covering one eye. The difficulty is created by not knowing how far your finger is from the touch pad. If the screen is at a slight angle to the line of view, then sometimes the tap target is missed (Figure 1D). In frustration I sometimes resorted to using Siri (automated voice recognition software on the iPhone) to assist with such tasks.

Ever tried shaving with one eye? I don't recommend it! I ended up with a couple of small cuts around my lips and nose due to an impaired ability to accurately place the razor on the desired part of my face. Very frustrating. If you don't believe me, don an eye patch next time you have a shave and see how you fare!

Of more immediate relevance to my eye problems is the instillation of eye drops and ointments, which I find even more difficult with the use of only one eye. The problem is especially acute with the application of ointments because I am unsure of the distance of the tip of the ointment tube's nozzle from the rim of my lower eyelid. I know it is important not to touch the nozzle against my eye to avoid contamination, but I ended up repeatedly touching my eye by accident.

THE FRUSTRATION OF MONOCULARITY

Perhaps this may have been a better title for this blog, because there are more disadvantages that come with being deprived of the use of one eye than the mere absence of stereopsis. I am referring here to the restricted field of view.

> "Of course, the world still looks three-dimensional when you use only one eye, but this is not because of stereopsis"

In the immediate aftermath of my right eye vitrectomy, I had a restricted view of everything out to my right hand side (with my head in a fixed position and gazing straight ahead). Of course, this deficit could be overcome simply by rotating my head to the right, and to a lesser extent by moving my eyeball about to extreme positions of gaze, but this is unnatural behaviour. On many occasions during this period I was consciously aware of executing an exaggerated turn of my head to the right to see what was happening on that side.

TAKING THINGS FOR GRANTED

Back in optometry school one of my classmates had only one eye. She used to despair during our stereopsis practical classes at being unable to appreciate or really understand what stereopsis means. I remember being a little bemused by this and shrugging off her concerns, but it is only now – after having been forced to cope with one eye for days and weeks at a time as a result of my eye surgeries – that I have developed a healthy respect for the fascinating and most useful physiological trait that is stereopsis.

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Time for IOL Surgery

Following on from his retinopexy, cryopexy and double vitrectomy procedures, galloping myopia has essentially forced Professor Nathan Efron to enter the next challenging phase of his personal ophthalmic journey – IOL surgery.

My right eye had settled down following a double vitrectomy and epiretinal membrane peel, so Bill advised he would review me again in four months' time. I knew it was inevitable that my crystalline lens would eventually develop a degree of opacification, which would necessitate intra-ocular lens (IOL) surgery, but in reading the literature I discovered this could take anything from a few months to three years. As it turned out, another factor came into play that rapidly accelerated this time frame…

GALLOPING MYOPIA

About three weeks following my vitrectomy procedures, I noticed my right eye had appeared to become a bit more myopic. Distance objects seemed clearer when I pushed my spectacles closer to my face, and I could see things clearly up close through the top (distance) portion of my varifocals.

I went with Suzanne into her practice so that we could work out what was happening. Now, before the vitrectomy procedures, my right eye refraction was -6.50/-1.25 x 175. It was now -8.25/-1.00 x 165 – a myopic shift of -1.75D. Vision was a 'slow 6/7.5', and the 'flying angel of death' (the term I use to describe a pesky little blind spot near my right macula) was still present. Given that my left eye refraction had unsurprisingly remained steady at -5.50/-1.50 x 170, I now had about 2.75D of anisometropia. For the time being, this optical conundrum was easy to solve; because I was wearing a monovision contact lens correction, all I had to do was order a new box of contact lenses for my right 'reading' eye that gave me a +1.75D add.

Intraocular pressures were fine at R15 L12mmHg, but on the slit lamp Suzanne observed substantially more yellowing in the posterior of my right crystalline lens than in my left eye. Examination of sequential post-vitrectomy OCT images showed that the slight post-surgical macular oedema had largely, but not completely, resolved.

We also ordered a new pair of varifocals in a non-rimless frame to make future lens changes easy. When these spectacles arrived a week later, I was surprised not to observe any untoward aniseikonia (visual distortion) resulting from the sizeable (2.75D) anisometropia.

Over the next three months, I noticed a further deterioration in my distance vision. On the day of my appointment with Bill, I went to Suzanne's practice to recheck my refraction. My right eye was now -10.00/-1.00 x 165 – representing a whopping 3.50D myopic shift in a little under four months! This meant I was now 4.50D anisometropic, which was becoming optically and perceptually unmanageable. Clearly, we were going to have to proceed with IOL surgery.

PLANNING FOR IOL SURGERY

Knowing that IOL surgery was imminent, I had to make a decision as to my desired post-surgical refractive outcome. As a successful and happy monovision contact lens wearer, I had been thinking for quite some time that the best outcome would be R -1.75DS L Plano. However, I now had to bring my flying angel of death into the equation. If I opted for monovision, what's the use of a near corrected eye with only 'slow N6' near acuity? Maybe it would be better to aim for emmetropia in both eyes and use reading glasses for near?

> "what's the use of a near corrected eye with only 'slow N6' near acuity?"

After ruminating over this for some time, I concluded that near vision is about far more than just reading. It's just as much about 'general' near vision activities; eating meals, looking at the time on your watch, shuffling things around on your desk, taking a quick look at your iPhone, generally inspecting objects at near etc. So I decided to take a bit of a risk and go for 'surgical monovision' as per my original plan, hoping that near acuity in my right eye would at least end up being reasonable for computer work, as well as generally looking at things at near.

When I saw Bill later that day, he confirmed the myopic shift and accelerated lens yellowing in my right eye, and agreed that it was time to go ahead with IOL surgery. A key point of discussion was how to deal with my astigmatism. Prior to my two vitrectomy procedures Suzanne had determined, using a Medmont E300 Corneal Topographer, that I had 1.3D corneal astigmatism, axis 160. Interestingly, in a recent newsletter that Suzanne had

received from Bill (which he periodically sends to all optometric colleagues), he declared "For patients with greater than 1.75D astigmatism, we use a toric IOL. The interesting thing is that for patients with lower levels of astigmatism, the results with limbal relaxing incisions (or arcuate keratotomy) are very good."

Well, I have never been a fan of the idea of making corneal incisions to alter refraction; I guess the old days of radial keratotomy are still clear in my mind. So, after discussing this issue with Bill, he agreed to use a toric IOL, despite this being below his preferred threshold for using toric IOLs. When my flying angel of death came up in discussion, Bill asked hopefully "So that still hasn't gone away yet?"

Bill then directed his support staff to do a work-up for IOL surgery, and things started moving fast: auto-refractor, OCT, IOL Master, Pentacam, hand-held keratometry and A-scan, all in quick succession. The Retinal Acuity Meter, which uses pinhole-type technology to help determine if unexplained vision loss is due to maculopathy or cataract, predicted that, despite my flying angel of death, I would end up with distance visual acuity in my right eye of $6/6^{-2}$. This was somewhat comforting.

Bill also said that during surgery he would give an intraocular injection of Avastin (Bevacizumab). Given that I have a trace amount of background diabetic retinopathy, this seemed to me like a sensible prophylactic measure.

I was then handed over to Elaine (not her real name), Bill's optometric assistant that day, for a 'pre-surgical chat'. Elaine knew who she was speaking to, and said "I don't need to tell you this, but I'll tell you anyway", and then proceeded to explain cataract surgery in very basic lay terms, and the risks attached. I sat there patiently and somewhat bemused as she went through her usual spiel, assuming that she was essentially doing this for medico-legal reasons.

After completing the pre-surgical work-up, I was handed over to the reception staff to complete consent formalities, receive the pre-surgery information pack, and make an appointment for the surgery. We decided to go ahead with surgery the following week.

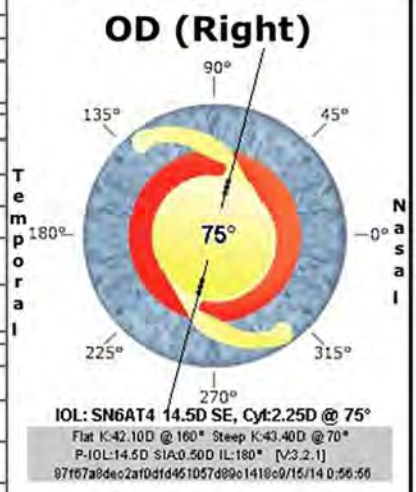
ALARM BELLS

Just as I was leaving Bill's rooms, I asked Elaine what IOL Bill would be inserting. I was told it would be a +14.50D Alcon SN6AT5 Acrysof IQ Toric IOL.

ACRYSOF IQ TORIC ASTIGMATISM IOL — Alcon CE

Lens Recommendation

Surgeon & Patient Information	
Surgeon Name	Bill
Patient Name	Nathan Efron
Additional Patient Information (I.D., Case, etc.)	Nice chap
Lens Details	
AcrySof® IQ Toric IOL	SN6AT4
IOL Spherical Equivalent (SE)	14.5 D
Axis of Placement	75°
Cylinder Power (IOL Plane)	2.25 D
Cylinder Power (Corneal Plane)	1.55 D
Calculation Details	
Pre-Op Corneal Astigmatism:	1.30 D X 70°
Surgically Induced Astigmatism:	0.50 D X 90°
Crossed-Cylinder Result (corneal plane):	1.71 D X 75°
Anticipated Residual Astigmatism:	0.16 D X 75°



Pre-Op Information

Patient Data	
Flat K	42.10 D
@ Flat Axis	160°
Steep K	43.40 D
@ Steep Axis	70°
IOL Spherical Power (P-IOL)	14.5 D
Surgically Induced Astigmatism (SIA)	0.50 D
Incision Location (IL)	180°

Notes:

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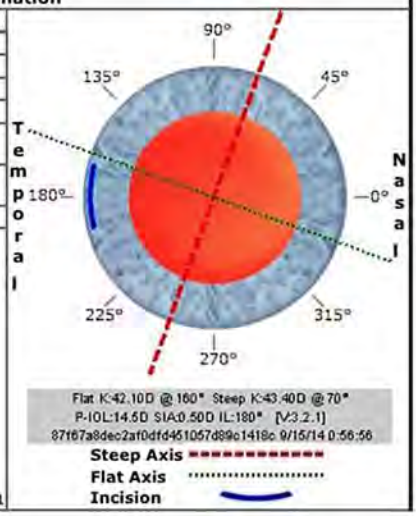

Figure 1. My own analysis using the online Alcon Acrysof IQ Toric IOL Calculator, indicating that an SN6AT4 IOL is required for my right eye.

When I arrived home that evening, I decided to read up on this IOL and found the Alcon website which had a handy on-line calculator for determining the appropriate IOL. I opened this and entered the values I had to hand, from Suzanne's pre-vitrectomy corneal topography analysis, and assumed a correction of 0.50D for surgically induced astigmatism (based on a 180° limbal incision). Suzanne stood behind me checking my input data. The result was that I would end up with 1.55D of corneal astigmatism after surgery, which should be corrected with an SN6AT4 IOL. This would result in residual post-surgical astigmatism of 0.16D x 75 (Figure 1).

Alarm bells started ringing. I looked up at Suzanne. Suzanne looked at me. Why was Bill planning to insert a SN6AT5 IOL, which is designed to correct corneal astigmatism in the range 2.06D to 2.56D?

Maybe I was missing something here. I hadn't being paying attention to the corneal topography/keratometry readings obtained by Bill's support staff in the flurry of pre-surgical work-up earlier that day. Maybe corneal topography is altered by vitrectomy, and Bill's more recent corneal topography findings were different from Suzanne's pre-vitrectomy measurements.

So what should I do? I didn't have all the facts. Did Bill and his team know something I didn't know? After all, they do this type of surgery maybe five to ten times a week. They must know what's going on. But notwithstanding this, should I pick up the telephone anyway just to double check?

I decided not to make the call. It's a decision I shall regret for the rest of my life… mi

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Surgical Chaos

Professor Nathan Efron's personal ophthalmic journey of retinopexy, cryopexy, double vitrectomy and IOL surgery was temporarily delayed by chaotic scenes of traffic congestion on the Gold Coast due to the annual V8 supercar races.

I had a good night's sleep, and was up bright and early, ready for my intraocular lens (IOL) surgery. As instructed, I (actually Suzanne) instilled a drop of mydriatic into my right eye one hour before the appointment time. The main thing I dislike about morning operations is that you can't have anything to eat or drink after waking, and I love my early morning bowl of cereal. So, with rumbling tummy, Suzanne drove me off to the surgery, which is usually only 10 minutes away.

CHAOS ON THE GOLD COAST

We arrived at the surgery at 7.45am for my 8.00am appointment, to scenes of organisational chaos. But the chaos was not caused by any misdoing in the surgical clinic. It was a Friday, and day one of the V8 Supercars Gold Coast 600 race, which was playing havoc with local traffic. Unfortunately, the racing circuit was about a kilometre away, and there were road blocks and diversions everywhere. Surgeons, anaesthetists, nurses and patients alike were all running late. In the end, this caused a one hour delay, and I wasn't taken through to the prep room until 9.15am. I donned my red hair net, dark blue gown and light blue shoe covers, and a black arrow was drawn on my forehead above my right eye. All set.

The admitting nurse asked if I had performed my diabetes checks that morning. She obviously didn't appreciate the difference between type 1 diabetic patients (who need to monitor bloods regularly) versus type 2 diabetic patients like me (who generally check blood sugars very occasionally). She measured my blood glucose level, which was abnormally high at 7.8 mmol/L, especially since I hadn't had anything to eat or drink since 7.00 pm the night before. She then measured my blood pressure, which was abnormally low for these circumstances at 110/70; I suppose I must be getting used to all this, so there is no more 'white coat' anxiety phenomenon. She instilled more mydriatic and some topical anaesthetic as well. I again issued my now customary warning on the admission form that the attending theatre staff should avoid bumping or leaning against the operating table during surgery.

The assisting surgeon (a first year ophthalmology resident) proceeded to mark my anaesthetised cornea to indicate IOL alignment. He said the target cylinder alignment was 89°. I thought this was off, because the minus cyl axis in my refraction is 175°. Could they have made a transposition error and were about to insert my cyl axis 90° off? Then I figured they must be working with the power axis rather than the cyl axis.

More mydriatics instilled, and I was directed to swallow two Panadol tablets. Apparently the anaesthetist on duty prefers this approach. A cannula was then inserted into my forearm, and I was lead through to the operating theatre. The anaesthetist told me there would be no retrobulbar block – just topical and subconjunctival anaesthesia.

The assisting nurse said 'got a million frequent flyer points yet?' I didn't get the joke at first, but then realised she was referring to the fact that mine was a very familiar name, having been to this surgery five times now.

The anaesthetist then said that he saw my note about not bumping the operating table, and assured me that the surgical team would be specifically briefed about my concern. He then pumped in some sedative through the pre-inserted cannula. I recall feeling a little woozy within a few seconds.

> "I donned my red hair net, dark blue gown and light blue shoe covers, and a black arrow was drawn on my forehead above my right eye"

INSUFFICIENT SEDATIVE

Facial covers were put around my eye, and before I could say 'Bob's your uncle', Bill appeared and got straight to work. I seemed to be wide awake this time, and was very aware of Bill 'fiddling around'. This was different from when I had my vitrectomy four months earlier, when I was under such heavy sedation that I wasn't really aware of anything. Noticing this difference, I said to Bill "Am I fully sedated?" He asked if I would like to be more heavily sedated,

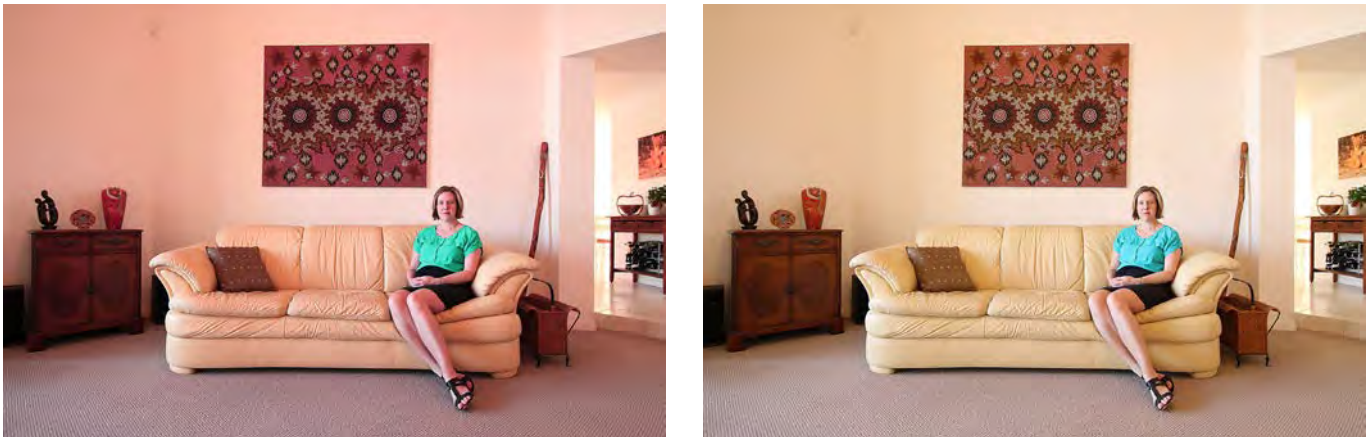

Figure 1. My wife, Suzanne, sitting beneath our 'Bushfire Dreaming' painting. Simulated appearance of this scene as viewed with my unoperated left eye, with its yellowing 59 year old crystalline lens (left), and my newly pseudophakic right eye, with its brand new, clear acrylic IOL (right).

and before I could answer, he called for the anaesthetist to administer more sedative.

But after receiving this extra sedative, I still seemed wide awake. I was surprised not to hear the whirring of the phaco machine. I remember seeing vignettes of surgical instruments moving around in my anterior chamber, but that's about it. All seemed to go very quickly. Bill apparently gave me an intraocular injection of Avastin for good measure, and before I knew it, I was being transferred to a wheelchair and taken through to the post-surgical room. I was given my customary coffee and sandwiches, which was nice, but I would have preferred a bowl of cereal!

After about 10 minutes, a tech walked me over to the slit lamp. She removed my eye patch, and everything seemed hazy and white out of my operated eye. I asked her to tell me what she was seeing (she knew who I was), and she reported observing slight corneal haze (probably oedema) and slight flare in the anterior chamber. My pupil was still large (obviously), and the IOL was sitting stable and correctly. All other signs were OK. The assistant surgeon joined us and declared that the surgery went well and as planned. I was then given my post-surgical medication regimen (Chloramphenicol and Prednisolone forte), and Suzanne drove me home, arriving at 11.30am.

By 12.45 pm, my eye was starting to feel a little sore. I took two Paracetamol/ Codeine tablets, which made me feel a lot better (but very drowsy). Vision slowly began to return. Everything was initially a little blurry, but distance vision seemed reasonable! Then I thought – I hope they haven't erroneously corrected me for distance instead of leaving me -1.75D for reading, which was the intended plan! A small bubble was visible for about three hours, and then resolved. Unsurprisingly, my flying angel of death was still present.

A NEW VISUAL WORLD

The following morning I received my customary telephone call from the tech to see how I was progressing. I reported that my pupil was still very large; I was experiencing slight discomfort and I had infero-temporal redness; but my eyelids were not puffy as they were following my previous vitrectomy surgery. The refraction seemed good, because I could now ascertain that things were clearer at arms' length than in the distance. However, near acuity still seemed reduced, and although I could read text on my computer screen, it wasn't sharp. The tech repeated the mantra that it can take a few weeks for vision to stabilise following IOL surgery, and up to 18 months following a vitrectomy. I really am hanging on to that hope.

When looking around inside my house, alternating viewing with my right and left eyes, I noticed that everything appeared a little darker and slightly browner with my unoperated left eye compared with my newly pseudophakic right eye. My favourite painting, Bushfire Dreaming, by acclaimed Yuendumu artist Maureen Hudson Nampajinpa, also looked different (Figure 1). I put this contrast down to the difference between looking at the world through an age-induced, yellowing, 59-year-old crystalline lens in my left eye, versus a clear acrylic IOL in my pseudophakic right eye. Apparently the chromophore tint in my IOL does not impact colour vision.[1]

I was now confronted with the conundrum of what to do refractively in the interim before my next scheduled surgery – a left eye vitrectomy – tentatively scheduled for two months away. I figured that wearing a distance contact lens in my left eye, and nothing in my right 'reading' eye, should suffice for generally getting around. With apologies to optometric colleagues reading this blog, I bought two pairs of ready-readers with prescriptions of +2.00D and +2.50D for computer and close work, respectively. Only $8.00 per pair! But maybe I shouldn't feel guilty about buying ready readers; after all, it's only an interim measure… and I bet every presbyopic optometrist has at some stage bought a pair of ready readers – say, in an emergency or when away on holidays having forgotten to take their reading glasses.

I popped out the right lenses of my varifocal and computer glasses for use when not wearing the contact lens in my left eye. This worked OK for my computer glasses, but I felt visually disoriented when wearing the single varifocal lens. I decided to try and wear my left contact lens all day if possible. I was already becoming anxious to get on with sorting out my left eye… mi

Reference

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Refractive Surprise (Not)

Well into his ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery, Professor Nathan Efron's pauses to undertake a forensic examination of his clinical records to identify the source of his refractive surprise.

'Refractive surprise' is a quaint term coined by eye surgeons to denote an unexpected, and generally unwelcome, refractive and visual outcome following an ophthalmic procedure designed to correct vision – usually intraocular lens implantation or laser refractive surgery. The refractive surprise that I was about to experience was perhaps not all that unexpected.

Upon waking on the Monday following my right eye cataract surgery, which was performed three days earlier, I was surprised to find that everything was clear in the distance out of my highly myopic left eye. I suddenly realised I had mistakenly slept in my contact lens! I put this down to post-operative confusion in a new visual world. Everything would have looked reasonably clear the night before, because I could see moderately well in the distance out of my mildly myopic pseudophakic right eye, leading me to forget that I had a contact lens in my left eye.

While gazing into the mirror after removing my contact lens, I noticed that my right pupil was miotic. I thought I had better consult the literature, and sure enough, I discovered that diabetic patients (such as me) can develop transient pupil size anomalies following intra-ocular (IOL) surgery, perhaps due to neuropathic changes to the sympathetic nervous system.[1]

TRACKING MY REFRACTION

Later that morning I headed to the eye clinic for my post-surgical check-up. The tech examined my eye and confirmed the miotic right pupil. My right eye was recorded as having distance vision 6/9; reading vision N6 (slow), subjective refraction -1.25/-0.50 x 70, corrected distance visual acuity 6/5^{-1} and near acuity N5 (slow) with a +2.25D add. Intra ocular pressures were normal at R&L 11mmHg.

Mike then examined my eyes with the slit lamp and Volk lens and declared all was OK. He suggested that refractive change can occur – typically in the myopic direction – for up to two months after surgery, as the IOL and capsule settle. It was only three days after surgery, so I'd just have to be patient and wait for the final refractive outcome.

Anxious to keep track of my progress, I resorted to having either Suzanne do a refraction on me, or measuring my own refraction in my lab at work, every week or so. To my horror, the astigmatism in my right eye kept increasing over the next few weeks, peaking at -1.75D at one stage! However, the refraction eventually stabilised to -1.25/-1.00 x 75, with distance visual acuity of 6/5.

But of course, the intended outcome of the surgery in my right eye was that this would be my 'reading eye', perfectly corrected for computer screen distance. However, I noticed a significant improvement when looking at a computer screen through the above prescription in a trail frame. And my flying angel of death (a small blind spot near my right macula) didn't help the situation. Does this mean I will forever need to wear glasses for computer work?

HUNTING THE SOURCE OF MY REFRACTIVE SURPRISE

My refractive surprise of 1.00D astigmatism in my right eye was not especially welcome. And in a sense, this wasn't really a surprise, either. You may recall from a previous blog that Suzanne and I suspected that the toric power of the IOL inserted into my right eye was too high, and it seems we were right. So, I had to find out what went wrong.

Bill very graciously gave me full access to my clinical records, so Suzanne and I went into the eye clinic, sat down with a pot of strong coffee, and proceeded to forensically examine the files. It didn't take long to track down the source of my unwanted astigmatism.

Essentially, the problem was that multiple measurements of my corneal curvature (power) using various techniques gave conflicting results. We listed all corneal measurements obtained over the previous four year period undertaken at both Suzanne's optometry practice and Bill's clinic, using instruments including a Humphrey Instruments Autorefractor, Zeiss IOL Master, hand-held keratometer and Medmont corneal topographer. Recorded cylinder powers inexplicably varied between 1.00D to 2.00D, although the minus cylinder axis was constantly between 170° to 180°.

We determined from the records that a cylinder power of 2.00D was used for calculating the desired IOL power. Now, it is quite some time since I have done a refraction on anyone in anger, but I clearly recall the optometric principle of always erring, if in doubt, on the side of choosing a lower cylinder power for incorporating in spectacles. Based on the conflicting corneal topography findings, I would have suggested a 'compromise' reduced cylinder power of

perhaps 1.50D upon which to base IOL calculations, had I had the courage to made that call prior to IOL surgery. But as they say, it's always easier in hindsight…

Another issue that Suzanne and I unearthed is that Bill allowed 0.50D for surgically-induced astigmatism. Based on a comparison of corneal topography before and after IOL surgery, it emerged that only 0.20D of astigmatism was induced. So, this can account for 0.30D of my 'refractive surprise'. Of course, it is impossible to accurately predict the amount of surgically-induced astigmatism, but had we based the IOL calculation on 1.50D (instead of 2.00D) of astigmatism and 0.20D (instead of 0.50D) of surgically-induced astigmatism, I probably would have ended up with the desired outcome of very close to -1.75D sphere.

YAG LASER CAPSULOTOMY

When I visited the eye clinic for my one-month post-surgical follow-up visit, Mike examined my eyes on the slit lamp, and observed some fibrosis and wrinkling of posterior capsule. Bill then entered the room, took a look, confirmed Mike's observation and suggested we perform a Nd:YAG (Neodymium-doped yttrium aluminium garnet) laser capsulotomy there and then. Some say you should wait six months after IOL surgery before having a YAG procedure, but apparently Bill often does it sooner. He added that he was confident that my quality of vision would improve following this procedure.

I was taken off to sign consent forms, and then lead into a tiny, non-descript room, with what looked like an ordinary slit lamp. But this was no ordinary slit lamp. It was the YAG laser set up. The tech carefully positioned me behind the instrument and adjusted various switches and dials to the desired settings. Bill entered the room, checked the settings, and within about 20 seconds he had lined up the laser, and started firing away. I could hear many tiny clicks, each of which was accompanied by a bright red light flash. Presumably each click corresponded to a laser blast.

I asked "What if I blink while you shoot a laser beam… will I end up with a hole in my eyelid?". Bill said there is no harm if the laser strikes the eyelid during a blink. Just to be safe, I concentrated on keeping my eye open throughout the procedure. As well, Bill occasionally paused and told me to take a few blinks and then open my eyes wide before firing some more.

When my flying angel of death came up in discussion, Bill asked hopefully "So that still hasn't gone away yet?". As an aside; I am always trying to find out as much as I can about my flying angel of death, and a few months after this visit, came across a new instrument at a conference trade display in the USA that can image the retina at a cellular level – the rtx1 Adaptive Optics Retinal Camera (Imagine Eyes, Orsay, France). We captured an image of the macular area of my right eye (Figure 1). Truly stunning! Individual receptor cells can be clearly observed. But there was nothing apparently untoward that could explain my small paramacular defect.

Over the next couple of days, I noticed a few small random floaters. Presumably this was due to bits of tissue debris left over from the laser blast. After a few days those floaters were gone, most likely because the bits of tissue dissolved away, or were lysed or phagocytosed.

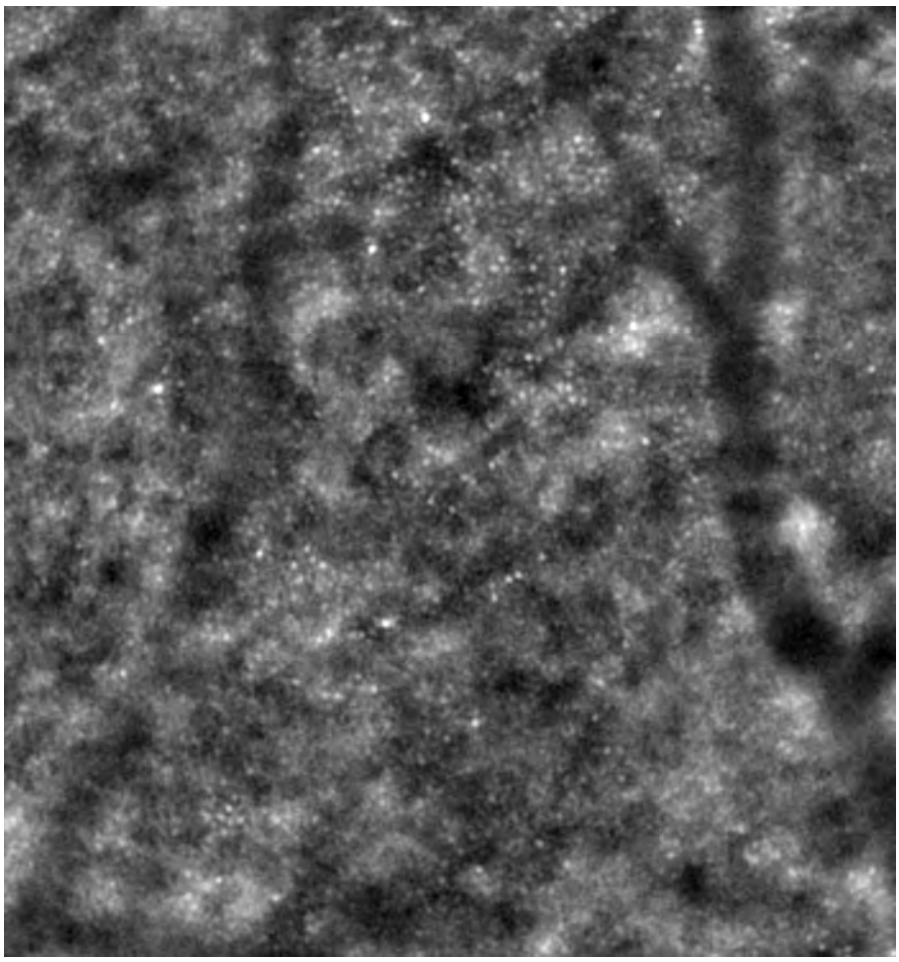
Contrary to Bill's optimistic prediction, my 1.00D astigmatism was unaltered by the YAG laser capsulotomy, and my uncorrected near vision was still degraded to the same extent. My thoughts now began to focus – with some trepidation due to the previous problematic vitrectomy surgery in my right eye – towards the next stage of my ophthalmic surgery... a left eye vitrectomy. mi

Professor Nathan Efron is a researcher at the Institute of Health and Biomedical Innovation and School of Optometry and Vision Science, Queensland University of Technology. He is currently president of the Australian College of Optometry and vice-president of the International Society for Contact Lens Research.

Reference

1. Mirza SA, Alexandridou A, Marshall T, Stavrou P. Surgically induced miosis during phacoemulsification in patients with diabetes mellitus. Eye 2003; 17: 194–199.

Figure 1. Macular area of my right eye imaged with an rtx1 Adaptive Optics Retinal Camera. Individual retinal receptor cells (tiny round dots) are clearly observed.



Now For a Vasectomy

At this delicate stage of his ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery, Professor Nathan Efron contemplates what might have been if his surgical records had been maintained electronically.

The AutoCorrect function in Microsoft Word can be so frustrating, don't you think? As a fastidious blogger, I constantly strive to ensure my blogs are well written with correct spelling. To assist with this, I usually type my blogs with AutoCorrect turned on. However, a constant challenge that I (and other technical writers) face is that AutoCorrect often does not recognise scientific or medical words, and substitutes these with its closest guess. When writing this blog, AutoCorrect did not recognise the word 'vitrectomy', and kept replacing it with 'vasectomy'.

My attempts to force AutoCorrect to recognise 'vitrectomy' failed; I have never managed to sort out custom dictionaries. This was driving me crazy, so as a two-fingered salute to Microsoft, I have left the title of this blog the way AutoCorrect insisted it should be. I suppose I should be thankful that the surgical staff didn't prepare their pre-operative notes for my forthcoming vitrectomy electronically using AutoCorrect… otherwise I might have ended up with a very unexpected surgical outcome!

PRIMUM NON NOCERE

Primum non nocere is a Latin phrase that means 'first do no harm'. Non-maleficence, which is derived from this maxim, is a principal precept of medical ethics that all trainee doctors are taught and is a fundamental principle for emergency medical services. Another way to state it is that, given an existing problem, it may be better not to do something, or even to do nothing at all, than to risk causing more harm than good. It is invoked when contemplating the use of an intervention that carries an obvious risk of harm but a less certain chance of benefit.

This principle was of immediate relevance to my pending epiretinal membrane peel, which was to be conducted in conjunction with the vitrectomy in my left eye, especially following my previous 'flying angel of death' (small focal vision loss) experience in my right eye. I am also mindful of anecdotal blogs and scientific literature describing vision deficits following such procedures. I discussed this at length with Bill prior to surgery. His view, as before, was that the membrane would probably keep progressing, so it was better to do the peel earlier rather than later.

I started to wonder: if both eyes had a peel resulting in tiny 'gaps' in the visual field of each eye, would gaps in one eye be compensated by corresponding healthy retinal regions in the other eye? Probably not, I concluded. Maybe the deficit in my right eye was a freak event, unlikely to be repeated… Certainly, the appearance of a flying angel of death in both eyes would be disastrous. Anyway, I decided to put my faith in Bill and let him do as he thought best. Bill said he would peel the membrane more peripherally, but spare the macular region if the membrane was not lifting easily. He also said he intended inserting an air bubble (rather than silicone oil) at the end of the operation, like last time, which pleased me.

> "This set off alarm bells in my mind, because there was now the possibility that I would end up with another flying angel of death"

HERE WE GO

The day scheduled for my vitrectomy was our wedding anniversary and Suzanne's birthday. Hopefully, I thought, that would be a good omen (not that I am superstitious)!

I will not bore you once again with details of the pre-surgical work-up. I have described this ad nauseam in previous blogs, and everything was basically the same this time, including my customary warning for theatre staff not to bump the operating table during surgery (further to my earlier episode which has clearly scarred me for life). However, there were a few interesting differences…

Presumably sensitive to the anxiety I suffered arising from complications following my previous right eye vitrectomy, the anaesthetist suggested a general anaesthetic. After some discussion, we instead agreed that a deep sedation, as used previously, would be preferable. However, the sedation must have been heavy, because I hardly remember anything that happened during the procedure. All I remember

is Bill twice saying, "Now don't move, Nathan". I have no idea what I was doing that constituted excessive movement, but each time he uttered this, I said "OK" and concentrated, as much as is possible under heavy sedation, on staying still.

As I was being wheeled out of surgery, Bill said everything went very well, and his assisting surgeon confirmed this, noting that the entire epiretinal membrane had been removed. It apparently came off easily. This set off alarm bells in my mind, because there was now the possibility that I would end up with another flying angel of death. Well, we'll have to wait and see.

In the recovery room following surgery, I produced some unopened bottles of eye drops left over from last time – everything except antibiotic. I had unused Pred Forte, Homatropine, Azopt, and Lacrilube. The nurse had a spare unopened bottle of Chlorsig, and gave that to me gratis. Thus, by not having to buy all those drops again, I saved over $100.

CELEBRITY STATUS

While munching on my post-surgical sandwiches and biscuits, and sipping coffee in the recovery room, I realised I had become a bit of a celebrity. Apparently, most of the attending nurses had read one or more of my blogs that had already been published in *mivision*. Two actually presented for a chat with the journal in their hands. This made me aware that anyone in the eye industry could be reading these blogs, and that I had better be careful, to some extent, about what I write in future!

"While munching on my post-surgical sandwiches and biscuits, and sipping coffee in the recovery room, I realised I had become a bit of a celebrity"

The assisting surgeon removed my patch, inspected my eye with a head-borne indirect ophthalmoscope, and declared that all looked fine. I was given my 'posturing' instructions: head down every 30 minutes for 30 minutes at a time, for three days (I will have a lot more to say about this most unpleasant procedure in my next blog). I was also advised to wear an eye patch and protective plastic shell until the following morning, when I would be required to start my eye drops regime, and to sleep on my right cheek for the next few days.

I had arrived at the surgery at 6.30am and was out at 8.30am. Apparently the actual procedure took just under one hour. As soon as I got home I noticed subtle entoptic phenomena, even though my left eye was closed and patched. If I looked up, I saw what seemed like a superior shimmering line of water. My nose was running quite a lot, especially when down-posturing… I'm not sure why.

By early afternoon my eye was starting to feel a little uncomfortable, with a tender sensation during blinking, presumably because the anaesthetic was wearing off. I decided to take some codeine/paracetamol tablets, which helped a lot, but made me feel very drowsy.

A BIT OF OPTICS FOR YOU

By late afternoon, the eye patch was becoming very annoying and uncomfortable, so I decided to remove both the patch and protective shell and just wear my glasses (but sleep with the shell in place). It was then that I noticed a bizarre phenomenon out of my operated eye – huge big gelatinous blobs. What could this be?

To explain this, let me fast forward two weeks, when I was back in my office at Queensland University of Technology. Fortunately, the person who occupies an office immediately adjacent to mine is Professor David Atchison, an eminent, world-renowned expert in visual optics. David loves a challenge, and within a few minutes produced an optical ray tracing diagram through a schematic eye to explain what was happening (Figure 1). Simply put, David constructed a classical 4-surface Le Grand schematic eye and replaced the 1.336 vitreous refractive index by 1.0, corresponding to air, which now filled my vitreous chamber. The result was that my eyeball was acting like a whopping +61D magnifying glass, with a working distance from the front of my cornea of 16.4 mm, which by sheer coincidence roughly corresponds with the back vertex distance of my glasses! This confirmed what I thought I had been looking at when I first noticed these big 'gelatinous blobs' – they were in fact minute spots of grime on the back surface of my spectacle lens! It also confirmed my observation that the blobs moved synchronously with slight movements of my glasses.

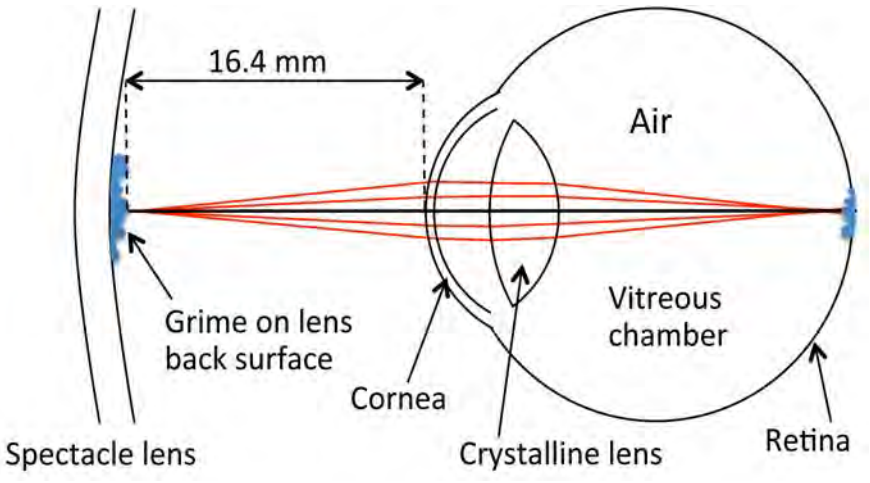


Figure 1. Optical ray trace diagram through a classical 4-surface Le Grand schematic eye, explaining why I could see grime on the back surface of my glasses. The air-filled vitreous chamber caused my eye to act as an extremely powerful (+61D) magnifying glass with a focal distance of 16.4 mm in front of the cornea (courtesy of Professor David Atchison).

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Not Waterboarding… Posturing!

On three occasions during the course of his ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery, Professor Nathan Efron was forced to endure a horrible procedure known as 'posturing'.

The Saturday morning after my left eye vitrectomy, I woke up to great relief. Unlike my right eye vitrectomy six months previously, there was no appearance of 'ink in the sky' or any other visual phenomena that might suggest intraocular bleeding. I was aware of the large air bubble in my eye, but there was no brown haze like last time. Everything was bright and clear, albeit optically blurry as expected due to my high myopia and the presence of a large air bubble inside my eye. I could make out large objects, which had a shimmering appearance, like looking through water. I guess this is due to the fact I was partly looking through aqueous humour that was slowly beginning to fill my vitreous chamber.

At least my macula was attached and working, it appeared. I couldn't really tell if I had another flying angel of death (my pet name for an annoying small blind spot in my right eye); that assessment would have to wait until the bubble resolved in 10 days to be sure.

Later in the morning I received the customary phone call from the tech at the eye clinic checking that everything was OK. I reported that I was fine, and that fortunately there was no repeat of the post-surgical intra-ocular bleeding that plagued my previous right eye vitrectomy. She reconfirmed my appointment for Monday morning, and wished me well with my posturing…

Posturing Torture

For three days following a vitrectomy and epiretinal membrane peel, it is necessary to undergo a procedure known as 'posturing'. Now, if the CIA is ever looking for a new method of interrogation to replace waterboarding, I would highly recommend posturing. It is a truly horrible business.

For the uninitiated, the theory of posturing is simply this: you have just had surgery performed on your retina, a very delicate tissue that is easily torn and has a propensity to detach from the back of your eye, leading to vision loss. The large air bubble inserted into your eye following a vitrectomy slowly gets replaced by aqueous fluid, but while the air bubble is present, it will always rise upwards because it is lighter than the surrounding fluid (Figure 1). It is desirable that the air bubble presses against the posterior pole (the very back of the eye) to hold the retina in place as well as temporarily sealing off small holes that may be present. This is especially important around the macular area, which subserves sharp vision. Thus, you have to adopt a face-down posture.

> "It didn't take long to get used to watching doubly reversed cricket in the mirror, and I would recommend this anti-boredom strategy to anyone"

The upward pressure of the air bubble against the retina is referred to as a tamponade. The tamponade effect gradually wears off over the next 10 to 12 days as the globe fills with aqueous, which is associated with a commensurate decrease in the size of the air bubble. After three days the bubble is no longer large enough to act as an effective tamponade.

My instruction was to adopt a head-down posture for 30 minutes every hour for three days while awake; that is, the rest of the Friday after my early morning left eye vitrectomy, and all day Saturday and Sunday. Given that I had already been through a right eye vitrectomy and repeat procedure in the same eye, I was now about to endure my third stint of three-day posturing.

Given the brutality of this procedure, anything one can do to alleviate the two key annoyances associated with posturing are worth contemplating. These two annoyances are (a) physical discomfort of the head, shoulders, neck and arms, and (b) sheer boredom. I shall deal with these one at a time.

ALLEVIATING PHYSICAL DISCOMFORT

The body is not designed to support a head positioned parallel to the ground, so additional means of support are required. In discussions with the tech at the eye clinic prior to surgery, I was told that it was possible to hire cushioned frames that would sit on a low table and support my head as I leant forward to rest my chin and

brow upon it. Alternatively, I could hire a full length padded bench with a face-sized hole, through which I would peer when lying face down on the bench. The alternative to using such appliances, I was told, was to simply lean forward and rest my head on my hands while looking down.

I chose the last option. After much trial and error, I figured the best set up was to sit on a firm chair, place a cushion on each thigh, rest my elbows on these cushions, and rest my head in my hands. Figure 2 shows me adopting this configuration for my very first posturing session following my left eye vitrectomy.

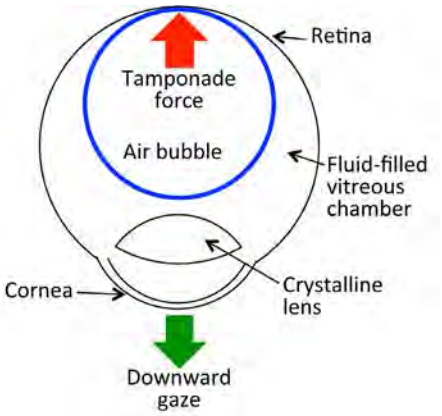

Figure 1. Theory underpinning posturing. When looking down, the air bubble inside the eye rises up within the partially fluid-filled vitreous chamber to press against the retina at the posterior pole of the eye, exerting a tamponade effect.

Figure 2. Posturing set up. My elbows rest upon cushions on my thighs and my hands support my head. A large mirror supported by two cushions and a wooden beam (to prevent slippage of the base of the mirror on the floor) is positioned between my legs and angled at 45 degrees, so that I can watch cricket on the TV positioned behind me. A box of tissues is on hand to wipe my runny nose.

This approach was only partially successful, as I developed great discomfort at the base of my neck and shoulders, which worsened over the three days of posturing. I tried various iterations of this basic technique (different chair, more cushions, supporting my head differently etc.), but to no avail; no matter what I did, the discomfort persisted. It took about two weeks before my neck and shoulder soreness had completely dissipated. Also, for some reason my nose kept running when looking down.

Think about it. Thirty minutes of this every waking hour for three consecutive days. Horrible! The rest of my daily activities – eating meals, having a drink, inserting eye drops, going to the toilet, showering, checking e-mails, making telephone calls etc. – had to be crammed into the alternate 'non-posturing' 30 minutes each hour.

There is another aspect of posturing that is equally important – and that is, what do you do when sleeping, which amounts to about one third of your day? It is, of course, impractical to sleep face down… one needs to breathe! So, this means sleeping with either the left or right cheek against your pillow. I was instructed to sleep with my right cheek down. Sleeping in essentially one position all night is a real pain. You tend to want to shift around subconsciously when asleep, so to avoid this you kind of have to be half awake to ensure that you don't change positions. Two restless nights ensued.

DEALING WITH BOREDOM

Gazing down at the floor for 50 per cent of the time over three days is no fun, so an anti-boredom strategy was needed. One option was to watch movies on an iPad on the floor below. This could have worked, but I didn't feel like watching movies.

As it turned out, a cricket test match was under way, and I am a big cricket fan. But how could I watch TV when gazing downwards. I thought of using a mirror angled at 45 degrees, but figured that everything would be upside down. When I ruminated over this out loud to my family, my son Bruce said that if looked through a mirror facing a TV positioned behind me, then this would amount to a double–reversal of the image and the TV would appear normal and upright. How he figured this out I will never know. Bruce is in the third year of a combined law/psychology degree, and knows nothing about optics. Why couldn't I, the optometry professor, have worked that out?

So, I got hold of a small hand mirror and gave this a try. As it happens, Bruce was only half right. Everything does indeed appear the right way up, but the image is laterally transposed (i.e. left and right are swapped around).

SOME TRIVIA FOR CRICKET TRAGICS

I adopted Bruce's suggestion by positioning a large mirror angled at 45 degrees between my legs, facing a large screen TV behind me that could be viewed beneath my open frame chair (Figure 2). Watching cricket like this for three days was enjoyable and certainly alleviated the boredom, but there were some interesting challenges…

Any text on the TV, such as the score strip at the bottom of the screen, was back to front and thus difficult to read. If you are a cricket tragic like me you will appreciate the following observations. Right hand batsmen and bowlers appeared left handed, and vice versa, and the Freemantle Doctor (refreshing afternoon ocean breeze over Perth) comes in from the east instead of the west. However, positions on the field as called by the commentators were 'correct', because of course all cricket positions are specified with respect to the positioning of the batsman's legs. So, mid-off, gully, point, cover, silly mid-on, deep fine leg, square leg etc. all appeared in the correct location relative to the batsman. Similarly, a bowler's off-spin and leg-spin appeared the right way around. It didn't take long to get used to watching doubly reversed cricket in the mirror, and I would recommend this anti-boredom strategy to anyone (but especially cricket tragics) who has to posture following a vitrectomy!

For 12 days after my vitrectomy surgery, the air bubble inside my eye slowly reduced in size and eventually disappeared, but provided endless episodes of entertainment while it was there… but that's another story, which I'll tell you all about in my next blog. mi

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Bubble Play

Observing peculiar entoptic phenomena relating to a large air bubble inside his eye provided a little comedy relief for Professor Nathan Efron during his otherwise taxing ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery.

During each of my three vitrectomy procedures I have had a large air bubble inserted into my eye to act as a tamponade. I was given two key instructions: (a) do three days of posturing (which I told you about in my last blog), and (b) don't go climbing mountains or flying anywhere in aeroplanes until the bubble has resolved. The reason for the latter instruction is that outside air pressure decreases with altitude, so the higher you ascend, the more the bubble inside your eye will expand.

Now I think it is unlikely that the air bubble would expand to such an extent that it could damage the internal ocular structures, and it would be impossible for my eye to explode because the eyeball has been demonstrated to be able to withstand an internal pressure of 60 atmospheres before rupturing. Notwithstanding these considerations, I decided to heed to this advice: no mountain climbing or flying for me over the next fortnight! This did mean, however, that I had to carefully schedule my vitrectomy surgeries around my busy travel schedule; I am often flying interstate or overseas for conferences.

When the air bubble is inserted towards the end of a vitrectomy procedure, it almost completely fills the vitreous chamber, then gradually resolves into a progressively smaller bubble over a period of about 11 days. I will never forget the casual remark made by Bill's assisting surgeon immediately following my first vitrectomy. Referring to the bubble in my eye, he said "You'll have a lot of fun with that". How prophetic that comment was!

Observing the world with a bubble in my eye evoked long-forgotten memories of esoteric concepts that I was forced to grapple with when studying Physiological Optics 101 some 40 years ago, relating to visuospatial perception – concepts such egocentric, oculocentric and head-centric localisation. These theories, which in general relate to how you perceive the direction of objects, were turned on their head because all of a sudden I had a new intraocular point of reference – a large air bubble.

OVER OR UNDER?

The first dilemma I had to get my brain around was the question of whether I was looking over or under the bubble during the first few post-vitrectomy days when the bubble was very large. I remember Bill mentioning to me that for the first few days after the vitrectomy I would gradually start seeing more of the world over the top of the bubble. Well, that's how it actually looked… except that I knew that the bubble inside my eye was rising upwards, and I should have been seeing under the bubble, not over it. But then I recalled perhaps the most fundamental principle of visual optics, which is that the world is imaged on your retina upside down, with the brain interpreting what you see as being the correct way up.

> "Frightened by the thought that I could do further damage to my retina, I concluded that discretion is the better part of valour"

So, the reason I could see 'over' the bubble, is because light was passing under the bubble forming a partial image on my inferior retina, which was then perceived as viewing over the top of the bubble.

Over the first few days following my vitrectomy, I could see more and more of the world above the bubble, albeit shimmery like looking through water. The curve of the bubble became more pronounced as it reduced in size. Of course, this view was only possible when wearing glasses to correct my high myopia. By about four days following surgery, I realised that I could see the entire bubble if I looked down to the floor, because looking down centred the bubble within my eye.

While looking down one day I decided to check the time and was surprised to observe a significant magnification effect. When viewed through the bubble, my wrist watch seemed a little darker and still had a shimmering appearance. It also appeared to double in size. So, it was like looking through a tinted magnifier made of water! (Figure 1). I figured that this was a somewhat diminished version of the high magnification effect that Professor David Atchison explained to me

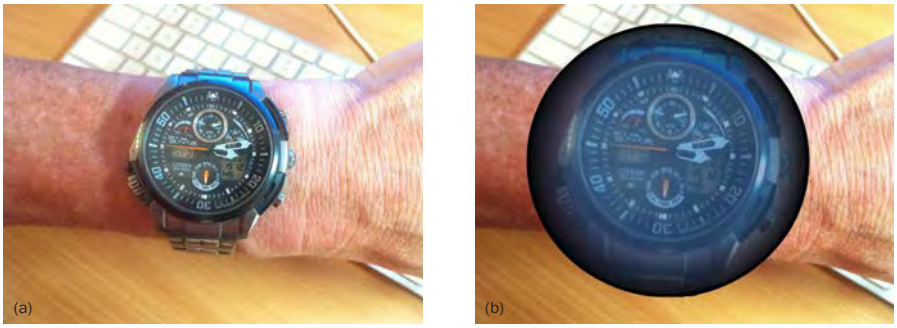

Figure 1. Appearance when looking downwards at my wrist watch (a) as it normally appears and (b) as viewed through a large air bubble inside my eye about four days post-vitrectomy.

in relation to my experience of viewing grime on the back of my spectacle lens a few hours after my vitrectomy.

It occurred to me that my macula was apparently attached and working, and there was no flying angel of death, although my overall vision still was not good enough to be certain about this.

I also noticed other peculiar entoptic phenomena when the bubble was still large. In certain lighting conditions, I observed strange faint, parallel, vertical striations in my superior visual field; I attributed this to light reflections off the inferior surface of the bubble reflecting onto my inferior retina. Again, in certain lighting conditions, I observed a strong image of my retinal vessels (which fortunately looked in good shape). I noticed that I could see the dark edge of the bubble even with my eyes closed when looking towards bright light.

PECULIAR BUBBLE FORMATIONS

From day four through to day eight post-vitrectomy, the bubble was free to move around a lot and occasionally adopted different appearances, as depicted in Figure 2. Sometimes a small bubble would appear next to the main large bubble; this was the 'mother and baby' appearance. The bubble sometimes split evenly, conjuring up notions of mitotic division. Two small satellite bubbles resting against the large bubble reminded me of the black Mickey Mouse ears I once owned (about 55 years ago). Numerous tiny bubbles resting on the single large bubble was the mother with octuplets. Oh what fun!

Another interesting observation when the bubble was small was that if I looked down and kept very still, I could observe a very obvious two-phase wobble of the bubble in synchrony with my heart beat. The two phases of the bubble wobble presumably were caused by hopefully normal sequential ventricular contractions. Counting the number of bubble wobbles over a fixed time period was a much simpler way of measuring heart rate than feeling for a pulse in my wrist.

On day nine post-vitrectomy, I decided that the bubble was so small I could go about my normal activities, and perhaps even return to work. It was a Sunday, so I decided to go for a walk on the beach with Suzanne. As I commenced my walk, I noticed that, with each step, the tiny bubble ricocheted around inside my eye at great speed. At first I was bemused by this, but then quickly became concerned. I figured that, according to the same principle by which a large bubble acts as a tamponade, a small bubble violently ricocheting around inside my eye might be having the same physical effect as a small stone bouncing around inside my eye; that is, there may be some form of physical effect of this small bubble hitting against my retina.

No-one at the clinic warned me of this; I formed the impression that once the bubble was small enough, I could resume normal activities, unlike immediately following my vitrectomy when 'intense physical activity' was prohibited (nudge nudge, wink wink). Frightened by the thought that I could do further damage to my retina, I concluded that discretion is the better part of valour, discontinued my walk and sat on a bench while Suzanne continued on. I wonder whether those undergoing a vitrectomy should be warned about this, and advised to refrain from all forms of physical activity until the bubble has completely subsided.

The bubble eventually become so small that it appeared as a tiny black dot, moving around very slowly. Then, right on cue on day 11, just as I was advised, the bubble had vanished.

I had quite enjoyed my bubble play. mi

"While looking down one day I decided to check the time and was surprised to observe a significant magnification effect"

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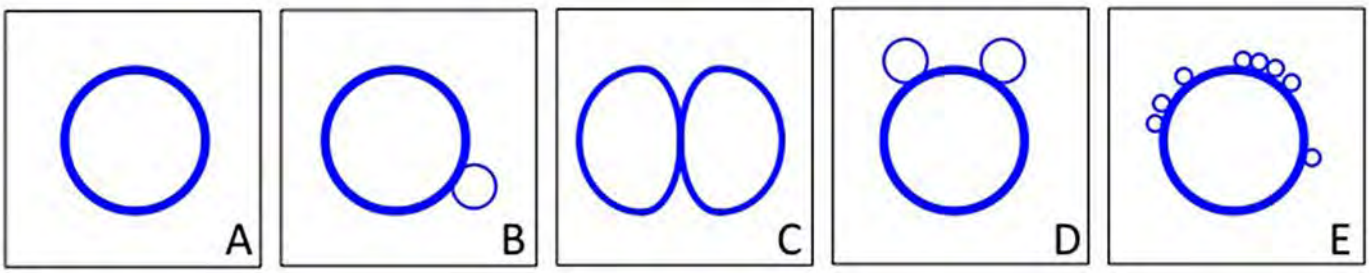

Figure 2. Various bubble appearances (a) whole bubble, (b) 'mother and baby' bubble, (c) 'mitotic' bubbles, (d) 'mickey mouse ears' bubbles and (e) 'mother and octuplet' bubbles.

Visual No-Man's Land

Professor Nathan Efron recounts his experience in 'visual no-man's land' – a particularly stressful phase of his ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery attributed to extreme surgically-induced anisometropia.

Three days after my left eye vitrectomy it was time to return to the clinic for a post-operative evaluation. At this stage I still had a large air bubble in my eye, but I was starting to see the world over the top of the bubble. The tech measured my visual acuity as R 6/5^{-3} L 6/18^{+1}. Intra-ocular pressures were R 13 L 7 mmHg. I then saw Mike (the optometrist who works in the clinic), who had a good look around with the Volk lens and declared all looked as it should three days after a vitrectomy. It was not possible to perform optical coherence tomography (OCT) at this stage as the bubble was still too large. Mike said that he would see me again after two weeks and then both he and Bill (my ophthalmologist) would see me after four weeks.

Ten days after my vitrectomy, when my air bubble was very small, I went to Suzanne's optometric practice to see if we could do OCT. Visual acuity was now R 6/5 L 6/9, and my intra-ocular pressures were R 14 L 14 mmHg. We could in fact get a good OCT image of my left eye, which revealed an intact retina, albeit with a little oedema at the macular area, which was not unexpected. Using the anterior eye attachment on the OCT, central corneal thickness was measured at about 530 µm in each eye.

> **"the front of the patch had brightly coloured stripes, a design… which was not really suitable for wearing in public as an adult"**

Sensing that I might be getting an IOL placed in my left eye sooner rather than later, I asked Suzanne to get a good handle on my level of corneal astigmatism. The Nidek Autokeratometer/autorefractor showed a 1.25D corneal cyl. The Medmont Topographer indicated a 1.20D cyl and then 1.00D cyl on a repeat reading. I made a careful note of this for subsequent comparisons with what Bill's team would find when I would be eventually worked up for IOL surgery.

GALLOPING MYOPIA (AGAIN)

When I saw Mike again two weeks later (now 17 days post vitrectomy), we discovered that there had been a 1.50D myopic shift in my operated left eye. This also was not unexpected, as a similar myopic shift had occurred following my right eye vitrectomy. My refraction was now R -1.25/-1.25 x 90 L -7.00/-1.50 x 170; visual acuity was measured as R 6/6^{-2} L 6/5^{-2} and my intraocular pressures were R 13 L 11 mmHg. Early nuclear sclerosis was noted in my left crystalline lens. He also performed OCT and declared that all looked fine.

Now visually, I was facing somewhat of a dilemma. The large myopic shift in my left eye meant that I had to somehow deal with 5.50D of anisometropia. With the full correction in both eyes in a trial frame, I was unable to fuse the two images to achieve binocular vision. I also noticed that everything seemed about 20 per cent smaller when looking with my highly myopic left eye compared with my right eye. So how was I going to cope visually?

Well, there was no easy answer. Mike didn't bother discussing this with me, presumably because he knew I was an optometrist and would be well aware of all possible options. I recalled from my optics training 40 years ago that aniseikonia is significantly reduced with contact lenses. However, I didn't want to wear a contact lens in my recently operated left eye. So, one option would be to wear a distance contact lens in my right eye, leave my left eye uncorrected, and pop on a pair of +2.00D ready readers for close work. This worked to some extent, but I felt uneasy using my right eye for distance vision given that I had been using this eye for near vision for the past decade with monovision contact lenses.

After putting up with this for about a week I became fed up and decided to try something different. It was now three weeks since my left eye vitrectomy and I felt confident to insert a contact lens in my left eye. So I managed to acquire a box of daily disposable contact lenses to use as a left eye distance correction, and wear nothing in my now-pseudophakic right eye which was corrected for near. And true to what I had learned in Optics 101, there was no noticeable aniseikonia.

A remaining problem was what to do in the evenings. By this stage I was back at work and I did not want to over wear the contact lens in my left eye. I am an early riser, so by 5pm I had been wearing my contact lens for about 12 hours. I didn't want to have a spectacle lens made up to correct my left eye as it was probably going to keep getting more myopic. I already had glasses made up that corrected my right eye for distance, but I was unable to wear these due to eikonic effects and general visual disorientation, even with the left lens removed. So what to do now?

The only real option was to wear my glasses with a tissue in place over the left lens that would block the view from that eye. However, this was uncomfortable as I found the tissue irritating. At this point Suzanne recalled that at work she had a specially designed occluding patch to cover one eye of a spectacle lens for children undergoing orthoptic treatment.

Suzanne brought the patch home the next day and it worked perfectly. However, the front of the patch had brightly coloured stripes, a design that probably works fine by way of appeasing children, but one which was not really suitable for wearing in public as an adult. Anyway, I decided, I could get through the evenings OK with this solution for now…

IOL REPLACEMENT SOONER RATHER THAN LATER

Five weeks after my left eye vitrectomy I fronted up to the clinic, this time to see Bill. This was the first time I would be seeing him following the vitrectomy. After being worked up in the usual way by the tech and one of the attending optometrists, I met with Bill and bemoaned my discomfort at being in 'visual no-man's land'. He fully understood my dilemma.

Bill carefully examined my eyes with the good old Volk lens, and confirmed that all was fine. After scanning though my clinical records he paused, looked me in the eye and asked, in hopeful anticipation, if the flying angel of death was still noticeable in my right eye. "Alas, it's still there," I replied to his disappointment.

Bill went on to say that for refractive reasons alone it was worthwhile going ahead with IOL surgery in my left eye right away. He added that I would need to have this procedure sooner or later as a posterior subcapsular cataract would inevitably form following my vitrectomy. Although that process can take up to 18 months, there was no requirement to wait this length of time. I queried whether a period of five weeks was too soon after a vitrectomy to be having another operation, but Bill assured me that my eye was now quite stable and proceeding with IOL surgery would not pose any problems.

It was Wednesday, and we agreed to go ahead with surgery two days later, on the Friday. I was very happy with this decision, as I could now see the light at the end of the tunnel.

> "I recalled from my optics training 40 years ago that aniseikonia is significantly reduced with contact lenses"

Before I knew it, I was handed over to the techs to have the usual pre-surgical work-up. There was a flurry of activity, but I insisted on writing down all corneal power findings. Both the Humphrey Autorefractor/Autokeratometer and Nidek Hand-Held Keratometer indicated astigmatism of 1.25D; the Zeiss IOL Master indicated 1.67D, and the Pentacam gave a value of 1.20D.

I was then handed over to the surgical administrative team, who gave me the usual briefing and information packages, and the now familiar warning not to engage in strenuous physical activity for a few weeks following surgery (nudge, nudge, wink, wink). I was also handed a single dose of mydriatic to instil in my left eye one hour before my surgical appointment time. Once again I asked for the earliest surgical slot, and this wish was granted.

The big challenge now was to try and choose an IOL that would render me perfectly emmetropic in my left eye. I was determined this time to fully involve myself in that decision-making process. The last thing I wanted was to end up with residual astigmatism, as occurred previously in my right eye following IOL surgery. Combining Suzanne's earlier measurements and these findings, my corneal astigmatism could be anywhere between 1.20D and 1.67D – over a half dioptre spread. Not a good start!

Anyway, Mike said that if Suzanne and I could come back to the clinic at the end of the day after his last appointment, he would be able to sit down with us and 'negotiate' a suitable set of IOL specifications. We gratefully accepted his offer. mi

Figure 1. Wearing my rainbow coloured eye patch.

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Eeny Meeny Miny Moe

In the closing stages of his ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery, Professor Nathan Efron sits down in a conference room to negotiate IOL selection for his left eye.

After a whole raft of measurements were performed on my left eye in preparation for IOL surgery, Suzanne and I returned to the clinic to meet up with Mike. He ushered us into the conference room and laid out all the relevant record cards and instrument print-outs containing measurements of ocular parameters that would be used to choose an IOL of appropriate specifications.

Our aim was emmetropia. I already had an Acrysof IQ Toric IOL inserted in my right eye, so we were certainly going to stick to the same lens type. We needed to determine the parameters to input into the Alcon IOL online calculator for the Acrysof lens. The Holladay one, Holladay two and 'SRK/T' calculations all pointed towards a 13.50D lens. That was easy.

But now came the choice of cylinder power. You will recall that I ended up with an unwanted cyl of about 1.00D in my right eye, although this was not the final cyl as my refraction still had not completely stabilised in that eye. Three weeks previously Suzanne measured my corneal astigmatism on two different instruments, which revealed values between 1.00D and 1.25D. On the day of decision making, the techs recorded values ranging from 1.20D to 1.67D. So, with a total spread of 0.67D, how was one supposed to choose an appropriate cylinder power? I penned the following adaptation of an old children's rhyme to express my frustration:

Eeny, meeny, miny, moe

Choose an IOL to go

First pick power, then a cyl

And guess the axis if you will.

After some discussion, we decided to rely on the results of the Humphrey Autorefractor/Autokeratometer for cyl power, and opted for a 1.25D cyl correction. We also factored in predicted surgically-induced astigmatism of 0.2D, as this is what Suzanne and I calculated had occurred for the right eye. So, the on-line calculator spat out this result: Acrysof IQ Toric IOL 13.50D SN6AT3 Axis 94. This would result in an anticipated residual cyl of 0.42D axis 95. Now I could look forward to my (hopefully) final eye operation in two days' time.

BENEFITS OF FOREARM CURLS

Admission time was 6.30am, so I rose at 5.30am to instil a drop of Cyclopentolate Hydrochloride 1 per cent into my left eye, as instructed. I was feeling very relaxed, as I was about to experience the same pre-surgical ritual that I had been through five times over the past year or so. I filled out the admission form, chuckling to myself as I yet again entered the instruction for theatre staff not to bump the operating table during surgery. So here we go: shoe covers, gown, red hat, two paracetamol tablets, blood pressures taken, finger prick blood glucose test, pre-surgical mydriatic and anaesthetic. All set.

I was quickly taken through to the operating theatre where the assisting surgeon was pottering around making preparations for surgery. I seized the opportunity and asked him to verify they were inserting the correct IOL power; he obliged and we both cross-referenced his pre-surgical notes with the label on the IOL container. All good.

"Eeny, meeny, miny, moe
Choose an IOL to go
First pick power,
then a cyl
And guess the axis
if you will"

The anaesthetist soon arrived and proceeded to examine my arm in search of a suitable site to insert the anaesthetic feed. While doing so he remarked to my surprise, "These are pretty healthy looking forearms you have, Nathan. Do you play some sort of sport?" I blurted out a quick answer to the effect that I try and keep fit.

But in fact, it goes further than that. Ever since being diagnosed with type 2 diabetes in my early 30s, I have maintained a strict regimen of diet, exercise, weight control and medication compliance. As part of all this, I do a one hour work out in the gym about four times per week, with each session being

50 per cent aerobics and 50 per cent weights. For the past couple of years, somewhat arbitrarily, I have been doing forearm curls to strengthen my wrists and forearms. This involves resting my forearm on my thigh while seated, and raising and lowering a 15kg dumbbell just by flexing my wrist (Figure 1). This exercise is repeated 12 times each side, and then done two more times (i.e. three sets of 12 reps).

I guess anaesthetists must spend a lot of time examining forearms, so when my anaesthetist commented on the healthy state of my forearms, I was particularly chuffed [this is a quaint British expression meaning 'pleased'; I picked it up after having living in the UK for 16 years (1990–2005)]. All those forearm curls had been worth it, at least from an anaesthetist's aesthetic standpoint!

REASSURING BUZZ OF THE PHACO MACHINE

As soon as the anaesthetic was administered, Bill turned up and got straight into it. I seemed to be quite conscious throughout. I could hear the faint buzz of the phaco machine and at one point I heard Bill saying he was carefully positioning the IOL axis. Before I knew it, I was being wheeled into the recovery room. The procedure could not have taken more than 15 minutes.

After scoffing down my coffee, sandwiches and biscuits in the recovery room, the assistant surgeon checked my eye using a binocular indirect ophthalmoscope. He declared that all looked good. I was given the usual pack of drugs: Chlorsig – four drops a day for two weeks; Pred Forte – four drops a day for four weeks, then two drops a day for another four weeks; Panadeine (500mg paracetamol and 10mg codeine phosphate) – to be taken if I was experiencing pain; and Lacrilube – up to four times a day as required if my eye felt dry and/or gritty.

I departed one hour and 40 minutes after entering the pre-surgical area. That's what I call efficiency! My eye was starting to get a little uncomfortable, so I took two Panadeine tablets every four hours throughout the rest of the day. There was considerable tearing until early afternoon. By early evening my vision had gradually begun to return, but my pupils were still widely dilated, resulting in broad halos around lights.

By mid-evening I was getting very tired, so I decided to go to bed early. It had been a long day. As I dozed off, I wondered what my vision would be like the next day, as a bilateral pseudophake with clear vitreous chambers and pupils back to their normal size…

> "I sat there in stunned silence, almost unable to speak. Everything was very clear and I had to keep reminding myself that I was not wearing glasses or contact lenses "

A WHOLE NEW VISUAL WORLD

I woke up the next morning to a beautiful sunny day on the Gold Coast, with a cloudless, stark blue sky. After a quick bowl of cereal, Suzanne and I brewed up a nice frothy cappuccino and settled down on our back portico, overlooking a large still lake with smart houses lining the opposite bank about 200m away.

I sat there in stunned silence, almost unable to speak. Everything was very clear and I had to keep reminding myself that I was not wearing glasses or contact lenses. We have a beautiful vista out onto the lake and I was viewing all this unaided, on a glorious day, without any optical aids. I had not had a visual experience like this since I was about 14. It was indeed an emotional experience. I just sat there for about two hours in awe of the wonders of ophthalmic surgery.

The tranquillity of this enticing visual experience was rudely interrupted by the telephone ringing. It was one of the techs from the clinic, making her usual next-day, post-surgical, follow-up phone call. I reported that all was fine, and we reconfirmed my appointment at the clinic on Monday.

Figure 1. Doing my forearm curls

I decided to do a rough and ready check of my refraction. I put on a pair of +2.50D ready readers, closed my right eye, and held some fine print about 40cm away. It was a little unclear, but became clearer when I held the print a bit closer to my eye. "That's great," I thought. The literature suggests that there is typically a myopic shift following IOL surgery, which resolves over the following few weeks. So if that happens to me, I thought, then maybe I will be heading for emmetropia.

But the big question was whether or not there was any residual astigmatism. The literature also suggests that it can take two or three months for a refraction to stabilise following IOL surgery, so I was just going to have to be patient… mi

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Those Pesky Cyls

Professor Nathan Efron

wonders whether his ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery really is over, or whether he will require further refractive surgery to eliminate residual astigmatism in each eye.

I returned to the clinic a week after my left eye intraocular lens (IOL) surgery with excited anticipation. This would be my first chance to have a refraction performed and to discover how close I ended up to our goal of perfect emmetropia in that eye. At this visit I was only going to be seen by the tech.

We started with the Humphrey Autorefractor, which gave a readout of R -1.00/-1.00 x 78 L +0.50/-0.25 x 20. We then proceeded to do a subjective refraction, which was R -1.00/-1.00 x 90 L +0.25/-0.25 x 20. Vision was recorded as R 6/6 L 6/5.

> "The only other viable solution was glasses, which I had been trying so hard to avoid"

This finding of almost perfect emmetropia in my left eye was not necessarily good news. You see, it was only one week since my operation, and it would be a while before my eyeball fully recovered and my refraction fully stabilised. Given that my right eye shifted about -0.75 in the three months following IOL surgery in that eye, would this mean that I was going to end up more myopic in my left eye, perhaps with a greater cyl?

Well, there is no quick answer; it is impossible to predict the final refractive outcome. If there is one thing I have learned in this long ophthalmic journey, it is that one has to be patient and give the eye time to settle following any procedure.

The tech completed further testing, including intra-ocular pressure measurement –R&L 11 mmHg; slit lamp biomicroscopy – slight oedema around the area of the limbal incision but otherwise all looked quiet; and optical coherence tomography – slight macular oedema and still not a complete foveal pit, but otherwise fine. I was advised to return for a follow-up examination in one week, when I would also see Bill.

When I presented for my follow-up visit 12 days later, my refraction had not changed. Bill confirmed the posterior capsular wrinkling and suggested we go ahead with YAG laser capsulotomy straight away. Even through it was only 12 days since my cataract operation, he could see no reason to delay the procedure.

We also discussed what I considered to be sub-optimal vision in my right eye. Bill suggested I think about trying to eliminate the residual astigmatism in that eye with laser refractive surgery. Maybe my ophthalmic journey was not yet over after all… but more on that later.

After signing a consent form, I was led into the small YAG lasering room. About three minutes later it was all over. It was a repeat experience of loud clicking and bright red flashes. I was left with a few random floaters that I hoped would dissipate after a few days, just as happened with my right eye. I was prescribed an eye drop regime of Pred Forte four times per day, but since I was already doing this following my IOL surgery, I did not need to alter my eye drop regimen.

FAST FORWARD SIXTEEN MONTHS

When I started writing miblogs, they were more or less contemporaneous with what was actually happening in real time. However, with the accelerated time frame of my various operations, largely to alleviate visual discomfort, these blogs are now lagging somewhat behind my surgical escapades. So, I can now declare that, as I write this blog, it is 16 months since my final ophthalmic procedure.

Fortunately, my retinas are anatomically intact. Figure 1 shows full retinal thickness maps, generated using optical coherence tomography, at various stages of my ophthalmic journey. The slightly bluish hues in the far right maps reveal my retinas to be a little thinner compared to when I started, presumably as a result of the bilateral epiretinal membrane peels. The uneven thickness profile of the final map for my right eye is perhaps consistent with the sub-optimal vision in that eye.

Unfortunately, my final stabilised refractive status is not an entirely happy situation.

My refraction eventually stabilised about nine months following my final surgical procedure, and has not altered to this day. Uncorrected vision is recorded as R 6/30^{-1} L 6/5. My refraction has ended up as

R-1.25/-1.00 x 75 L +0.25/-0.50 x 45, and corrected visual acuity is R 6/5 L 6/4.

In terms of best sphere refraction, the outcome is exactly as planned, with a -1.75D myopic reading right eye and Plano distance left eye. But sadly, I am left with pesky cyls of 1.00D in my right eye and 0.50D in my left eye.

For generally getting around and going about my normal day-to-day activities, that amount of astigmatism is not really a problem. Everything in the distance generally looks clear, including television.

The problem is that my vision is somewhat degraded at near. Unaided near vision is R N6 (slow) L N14. Corrected near vision is R N4 (slow) L N4. The reduced unaided vision in my right eye is due to the 'double jeopardy' situation, whereby near vision is degraded by 1.00D astigmatism as well as my annoying flying angel of death. Even in good lighting, seeing text on my iPhone, scrutinising dials, readouts and the LCD display on my digital camera, and reading small newspaper print, is all a bit of a struggle. When I looked at a test card with a near correction in a trial frame, everything seemed so much clearer.

"Unfortunately, my final stabilised refractive status it is not an entirely happy situation"

With all of this in mind, I recently decided that I needed to find an optical solution to improve my near vision. A key motivation for proceeding with all these eye operations was to avoid having to rely on glasses or contact lenses, which I had been doing for the past 45 years. I tried a contact lens to correct the astigmatism in my right reading eye, but this helped only marginally and of course failed to obviate the adverse impact of my flying angel of death.

Another option was an anterior chamber intra-ocular lens. I did a little reading around this and was not convinced that a satisfactory visual outcome could be achieved. And anyway, I had had enough of ocular surgery!

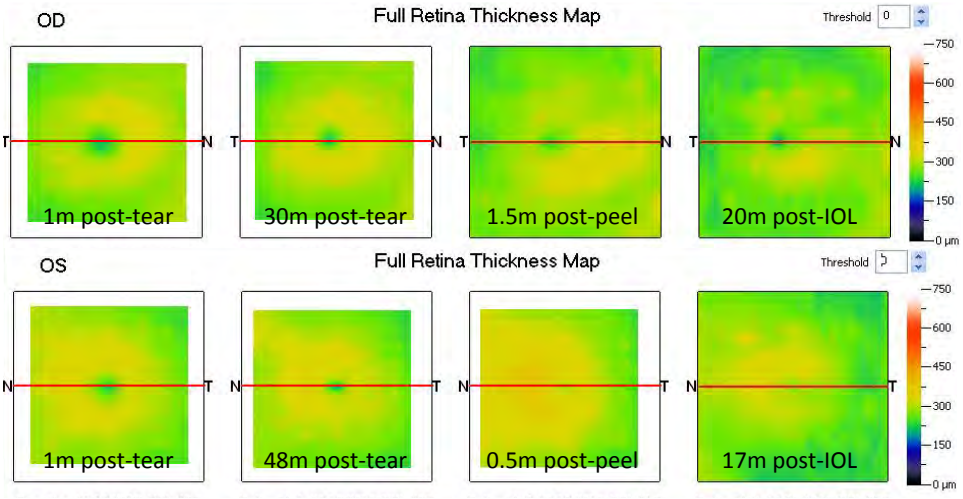

Figure 1. Optical coherence tomography full retinal thickness maps for my right eye (top row) and left eye (bottom row) at various stages of my ophthalmic journey. Maps were captured at the following time points (left to right): 1 month following the retinal tears; R30/L48 months following the retinal tears; R1/L0.5 months post-vitrectomy; and R20m/L17months post intra-ocular lens insertion.

For a while I seriously contemplated laser refractive surgery. Bill referred to this as 'ASLA' – an acronym I had not heard before, which I was told stands for 'advanced surface laser ablation'. From what I can gather, this is just a fancy name for photorefractive keratectomy (PRK). I decided against this for four reasons: (1) I was not convinced that the accuracy of this technique, or any other refractive surgery procedure for that matter, is sufficient to guarantee the elimination of all astigmatism; (2) I have had enough eye surgery already; (3) it is painful; and (4) I am acutely aware of the physiological damage caused by laser refractive surgery, and am not particularly keen to subject my eye to this.

FRIGHTENED BY MY OWN RESEARCH

Let me expand on this last point. The cornea contains a rich plexus of nerves at the base of the epithelium, just anterior to Bowman's layer. I happen to know this because I have been researching this tissue layer for the past 15 years using a laser scanning corneal confocal microscope. In fact, I was the first to describe this layer in the literature 14 years ago, in what has become one of my most highly cited papers.[1]

I have also published papers on the impact of laser ablation surgery on this nerve layer, and the results are not pretty![2,3] PRK, or ASLA as it is now called, causes complete ablation of this nerve layer, resulting in substantially reduced corneal sensitivity and dry eye symptoms for 12 months following the procedure. And on top of this, it takes about five years for subbasal nerve plexus to fully regenerate back to normal. I could not countenance the thought of obliterating such a beautiful tissue structure – that I have long been so passionate about in a research context – in my own eyes.

The only other viable solution was glasses, which I had been trying so hard to avoid. I will tell you about my 'back to the future' experience wearing glasses in my next, penultimate blog. mi

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No More Glasses! (Not)

As he approaches the end of his epic ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery, Professor Nathan Efron rues the fact that he is still partially dependent on glasses.

Forty-seven years. That's a big chunk out of anyone's life. Forty-seven years. For me, it is the number of consecutive years of my life, from age 14 to 61, that I have had to either balance a pair of glasses on my face, or insert contact lenses into my eyes. Forty-seven years.

As challenging as my ophthalmic journey has been, there was always the light at the end of the tunnel of being free from glasses or contact lenses. In fact, it was this tantalising prospect that tipped the balance in favour of going ahead with my vitrectomy procedures in the first place. Getting rid of those horribly annoying floaters was one thing, but ending up with a pair of 'designer monovision eyes' – one eye corrected for distance and one for near – and ending up being free of glasses, was equally motivating.

Disappointingly, it hasn't ended up like that. Rather than rejoicing at being free from optical aids, I now have seven pairs of glasses! Now that might sound like a bit of an over-kill, and I suppose it is. As is the case with all ophthalmic practitioners, being 'in the trade', and having private health insurance, gives me access to reduced-cost or no-cost eye wear and accords me the luxury of adopting multiple and sometimes redundant optical solutions.

So let me explain how and why I have ended up with seven pairs of glasses. They are individually numbered in Figure 1, and throughout this blog I shall refer to each pair of glasses by the corresponding number in square brackets.

RATIONALE FOR MY VAST COLLECTION

Let's start with my refraction, which has ended up as R -1.25/-1.00 x 75 L +0.25/ -0.50 x 45. For all intents and purposes, my left eye is perfectly emmetropic. This gives me beautiful, crisp vision for distance. Absolutely no complaints there!

However, my right 'reading eye' is the problem; although it has the intended best sphere correction of -1.75D, my right eye is encumbered with a pesky 1.00D of astigmatism. Furthermore, my vision in this eye is plagued by a small paramacular blind spot, to which I have been referring throughout this series as my 'flying angel of death'. While I can sort of read my iPhone and text on my computer screen, near vision out of my right eye is not clear and is much sharper when corrected. It is sharper still when I am binocularly corrected.

My favourite pair of glasses [1] are my look-overs. These have a +2.00 add over the distance prescription. An important part of my work is attending meetings of various kinds – from small group chats with my research team at QUT, to larger boards and committees within and outside the university. More often than not I

Figure 1. The seven pairs of glasses I have ended up with. The numbers correspond to an explanation of the purpose of each pair in the text of the blog.

chair these meetings. As Chair, I like to eyeball my colleagues while matters are being discussed, and I much prefer to do this directly, without looking through a lens or having my eyes circumscribed by a spectacle frame. Interestingly, I found it hard sourcing a look-over frame; they seem to have gone out of fashion.

I tried wearing varifocal lenses [2], but these were a complete disaster, and perhaps I should have anticipated the problem. The idea of varifocals was to afford sharp distance vision for critical viewing, such as at the football or attending a concert or live theatre, as well as good close vision to read the program. Although distance vision with varifocals was good when looking directly ahead through the 'sweet spot' of the lens, any eye excursion away from the lens centre resulted in significantly degraded vision.

Now, I had worn varifocal lenses successfully in the past for correcting my 7.00D or thereabouts of myopic astigmatism. The big difference between that experience and now is that, with a high prescription, although off-axis viewing is slightly degraded, it is still far superior than being uncorrected. In that scenario, the off-axis optical degradation was unnoticeable.

With my low prescription, the off-axis aberrations outside of the small non-aberrated optics of the distance portion of the varifocal lenses resulted in vision that was worse than no lenses at all! After persisting with this for a couple of weeks I gave up, and had the lenses in these frames changed to D-seg bifocals, which work well.

As an enthusiastic spectator of sports, critically sharp distance vision is important for me. Although I am very happy with the uncorrected distance vision of 6/4 in my left eye, things look even sharper with both eyes corrected, presumably because our brain is more comfortable with a binocular lock. So, for full-field sports spectating without the restriction of an inferior bifocal segment, I also have a pair of single vision distance glasses [3].

CHAINED TO THE COMPUTER

As an academic and author of scientific papers, books, articles and blogs, probably 80 per cent of my typical working day is at the computer, so a good optical solution for computer work is an absolute requirement. I therefore designed myself a special pair of computing glasses [4], which are D-seg bifocals with an intermediate correction (+1.75D) in the top half and an extra add of +0.75D in the near D-segment.

The extra +0.75D add, which results in a near correction of +2.50D in the D-seg, is useful when someone hands me some printed material, or I need to consult a textbook, printed journal article or indeed any document with small print, or to sign papers etc. I found this optical solution so useful that I had a duplicate pair made up [5] – one for the office at QUT and one for my home office.

> "Rather than rejoicing at being free from optical aids, I now have seven pairs of glasses"

NOW A SUNGLASSES ADDICT

When I started going on my long beach walks following my first intra-ocular lens (IOL) replacement operation in my right eye, I found bright light a bit difficult to tolerate and started to wear plano 'off the shelf' sunglasses. Following my left eye IOL replacement, the sun glare was even more intense and I needed a good optical solution for this.

I had always worn contact lenses with UV blockers, which provided triple protection against developing pterygium, accelerated crystalline lens yellowing and retinal damage. My new IOLs have a UV blocker, so my retina is still protected. However, without contact lenses, I am at increased risk of developing pterygium. So, wearing sunglasses outdoors would serve three purposes: reducing the strong glare due to more light entering my eye in the absence of yellowing crystalline lenses, minimising my risk of developing pterygium, and sharpening vision via a full binocular optical correction.

I had a nice pair of brown polaroid single vision lenses made up in a designer frame [6]. They are fantastic: great sun glare protection with the polaroid lenses working to great effect on the beach front, enhancing the visual aesthetics of the sun, sea, surf, sand and sky. However, it occurred to me that a near add could be useful… but it is here that I made a costly mistake.

Since I already had brown polaroid sunglasses, I decided to opt for blue polaroid varifocal lenses in a stylish wrap-around frame [7]. Unfortunately, I did this at the same time as ordering my clear varifocal glasses, which as I explained above, ended up being a disaster due to degraded off-axis distance vision. Well, unsurprisingly, the same happened with the varifocal sunglasses, but the problem was exacerbated by the highly curved 'wrap around' lens form. I persisted for three weeks with these sunglasses, but found the off-axis visual degradation very disorienting, and eventually gave up and replaced the varifocal lenses with single vision lenses.

Interestingly, I had hardly ever worn sunglasses until now. I never felt I needed then for sun glare protection, or as a fashion accessory. Now I am addicted to them. I wondered, however, if I would ever 'adapt' to all this sun glare I was now noticing with my pseudophakic eyes. I put this question to my good friend Professor James Wolffsohn from Aston University in the UK, who happened to be visiting me on the Gold Coast.

Over the past decade, James has conducted extensive research on vision following cataract surgery. He told me that patients generally report that sun glare is especially problematic for the first two or three months following cataract surgery, but they eventually 'adapt' after that. Whether this is true physiological adaptation, or just psychologically 'getting used to it', is unclear.

I told James that the same seemed to happen to me. After a few months, the glare didn't seem to bother me as much. Nevertheless, sunglasses still do make a difference both in terms of reducing sun glare and enhancing vision. Indeed, I feel totally relaxed and comfortable wearing sunglasses outdoors – especially at the beach and when driving – so I think sunglasses are going to be a constant feature of my new image from now on.

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The Reveal

In this final blog documenting his arduous ophthalmic journey of retinopexy, cryopexy, vitrectomy and IOL surgery, Professor Nathan Efron reveals the true identity of those who treated him.

In order to preserve confidentiality when writing these blogs, I resorted to using various nom de plumes for those who delivered my eye care. They now have kindly agreed to allow me to reveal their true identity, so here we go…

When I first noticed ink in the sky – which I knew straight away meant intraocular bleeding – my optometrist wife Suzanne (that's her real name, by the way) rushed me to the nearest optometrist to try and work out what was going on. That optometrist, who I named 'Pete', was Michael Hare from Southport. All Michael could see was haze, so he quickly arranged for me to be despatched to the ophthalmologist's room.

It was actually Suzanne who suggested that I see the prominent Gold Coast retinal specialist, who I have been calling 'Bill', but who is actually Robert 'Bob' Bourke. He saw me at Vision Eye Institute. I have more to say about Bob below. I attended Bob's clinics at the Bermuda Point building at Varsity Lakes and at the Short Street Clinic in Southport. All of my operations were performed at the Short Street Day Surgery in Southport, which is in the same building as the clinic. In July of this year, a company controlled by Bob purchased Gold Coast's Vision Eye Institute, which now operates under the name Eye Specialist Institute.

I was probably seen by a total of five different optometrists at Bob's clinics, but most of my consultations were with two of them – 'Mike', who is really Mark Bourne, and 'Elaine', who is Eleanor Smith. They were both very patient with me, going to great lengths to explain Bob's particular approach to the pending surgical procedures; listening carefully to, and trying to interpret, descriptions of my flying angel of death; helping me interpret my OCT images; preparing me for post-vitrectomy posturing, and so on.

REFLECTING ON BOB'S CARE

The way the Eye Specialist Institute operates is truly remarkable. It is essentially a four layered system, where at various stages you are looked after by reception staff, the 'techs', optometrists and then the ophthalmologist – in my case, Bob. While this arrangement is somewhat manpower-heavy, it means every patient has had three examinations and two to three opinions as to the state of their eyes. This minimises the possibility of error and seems to me to be the epitome of efficient and effective eye care. Indeed, it is a superb model for interdisciplinary health care, optimally utilising and integrating the respective skills of those delivering this service.

Those of you who have followed this series of blogs will know that my journey has not been smooth sailing. You may also be wondering what I make of Bob's ophthalmological capabilities. From an overall perspective, I would without hesitation say 'first class'! Bob has a comforting chair-side manner – confident yet reassuring. I am a great admirer of his general approach, which is to make careful decisions, and then simply get on with it. No dilly-dallying around. That's pretty much my approach to life, too.

My ophthalmic journey was not without difficulties; in fact, there were three sub-optimal events/outcomes, all in my right eye: (1) having to undergo a repeat vitrectomy and washout due to intraocular bleeding; (2) my 'flying angel of death' – an annoying paramacular field defect; and (3) 1.00D of residual astigmatism. The combined effects of (2) and (3) mean that I need to wear glasses for reading and computer work.

> **"My ophthalmic journey was not without difficulties; in fact, there were three sub-optimal events/outcomes, all in my right eye…"**

So, were the above outcomes a result of a ham-fisted approach to surgery? I think not. I believe Bob is a brilliant surgeon, and I say this for two reasons. First, he basically saved me from literally going blind (more on this below). Second, Suzanne frequently sees the aftermath of retinal surgery by all of the specialists on the Gold Coast, and while she has observed that standards are generally high, Suzanne has always rated Bob's surgical outcomes as the cleanest and neatest of them all.

Ophthalmologist Bob Bourke (left), optometrist Eleanor Smith (right) and me.

As for the intraocular bleeding – well, this can happen to anyone. The risks are low, and I was just unlucky. Can any retinal surgeon claim that this has never happened to them?

As for my flying angel of death – of course we can't be certain of the cause, but my feeling is that this probably occurred while the epiretinal membrane was being peeled off in my right eye. Was this a fault of Bob? I don't believe so. I think this is just a reflection of the state-of-the-art of that procedure. Peeling a membrane directly from the retina is a perilous undertaking, and no matter how carefully it is performed, there just has to be a small risk of micro-attachments of the membrane to the underlying neural retinal elements that can be damaged at a cellular level. The ophthalmic literature and patient internet blogs abound with reports of non-specific sub-optimal vision following epiretinal membrane peels. Perhaps the observation of my flying angel of death is a function of my knowledge base that has allowed me to self-investigate and articulate a phenomenon that in fact many patients experience.

And as for the 1.00D residual astigmatism in my right eye? Well, perhaps that could have been avoided, but I blame myself for not picking up the phone and calling the clinic when I realised, after having had all my ocular biometry performed a few days prior to surgery, that the numbers didn't seem to add up.

JOURNEY'S END

So let's recap my ophthalmic journey, which is summarised in the accompanying table. Since observing 'ink in the sky' on 21 October 2009, I was subjected to 12 single or combined procedures, of which seven were performed under various combinations of local anaesthesia/heavy sedation in a hospital operating theatre, and five were conducted in a clinical consulting room without anaesthesia. The total length of my ophthalmic journey – from the first procedure (left eye retinopexy and cryopexy) performed on the same day I noticed ink in the sky, to the final left eye YAG laser capsulotomy – was four years, three months and eight days.

That was quite a journey!

Summary of my ophthalmic journey

DATE	EYE	EVENT/PROCEDURE	LOCATION
21 Oct 09	L	Noticed 'ink in the sky'	Home
21 Oct 09	L	Retinopexy and cryopexy	Surgery
23 Oct 09	R	Retinopexy and cryopexy	Surgery
14 Jul 10	L	Green laser	Clinic
12 Oct 10	L	Retinopexy	Clinic
19 Oct 10	R	Retinopexy	Clinic
14 Jun 13	R	Vitrectomy and ERM peel	Surgery
25 Jun 13	R	Repeat vitrectomy and washout	Surgery
25 Oct 13	R	Cataract extraction and IOL insertion	Surgery
27 Nov 13	R	YAG laser capsulotomy	Clinic
13 Dec 13	L	Vitrectomy and ERM peel	Surgery
17 Jan 14	L	Cataract extraction and IOL insertion	Surgery
29 Jan 14	L	YAG laser capsulotomy	Clinic

ERM, epiretinal membrane; IOL, intra-ocular lens; YAG, yttrium aluminium garnet.

OVERALL VERDICT

There have been so many facets of this journey that to sum up, I need to look at the big picture. My journey started with me being a moderately high myope, with a refraction of R -6.50/-1.25 x 175 L -5.75/-1.25 x 180, with visual acuity of R&L 6/4. I developed acute idiopathic retinal tears that were quite large and could have resulted in blindness. I battled through this journey and ended up with a final 'intended monovision' refraction of R -1.25/-1.00 x 75 L +0.25/-0.50 x 45 and visual acuity of R 6/5 L 6/4, but I have an annoying flying angel of death in my right eye.

My retinas are intact and securely attached, with only trace evidence of diabetic retinopathy. Basically, I now have a handy pair of general purpose eye balls, and I'm thankful for that. When I go on my beach walks, the world is beautifully sharp and clear, without annoying floaters. Sure I have to use glasses for computer work, but so do most people of my age.

So what is my overall verdict now that I have completed my ophthalmic journey? I'm 90 per cent happy.

The end.

Professor Nathan Efron AC is a researcher at the Institute of Health and Biomedical Innovation and School of Optometry and Vision Science, Queensland University of Technology. He is currently President of the Australian College of Optometry and Vice-President of the International Society for Contact Lens Research.

A Word of Thanks…

I would like to take this opportunity to acknowledge the many people who have assisted me throughout my ophthalmic journey, and have helped me write this blog over the past two years. With apologies to those who I may have overlooked, special thanks to:

- **Michael Hare for his prompt and decisive action in referring me to Bob to deal with my large retinal tears.**
- **Optometrists Mark Bourne and Eleanor Smith for their care, attention and understanding.**
- **Bob Bourke for saving my sight and giving me a good surgical outcome.**
- **The techs and other support staff at Vision Eye Institute for their efficient and professional service.**
- **The nurses, anaesthetists, assisting surgeons and other support staff at the Short Street Day Surgery (except the theatre nurse who kept bumping the surgical bed while Bob was operating on me the first time) for seeing me through my numerous surgical procedures.**
- **Kerrin and Faye Woods of Eyecare Plus at Mermaid Beach for making available their optometry consulting rooms so that Suzanne and I could independently monitor my progress.**
- **Mark Cushway and Nikki Byrne from *mivision* for their editorial assistance in publishing these blogs.**
- **And last but not least… my wife Suzanne for her loving support and assuring advice at all stages.** mi