



Prof Graham Barrett has worked with Rayner to bring the RayOne EMV (left) IOL to market. Images: Prof Graham Barrett & Rayner.

PROF GRAHAM BARRETT'S LATEST CHAPTER

Professor Graham Barrett's indelible mark on ophthalmology continues thanks to a recent collaboration with Rayner to produce an extending range of vision intraocular lens. It features an optical design that took many years to develop and is now seeing widespread adoption among his peers.

When you look at a modern-day intraocular lens (IOL), Professor Graham Barrett's fingerprints can be found on almost any element. Early in his career, he threw himself into material science leading to the insertion of the first foldable IOL in 1983. Then he became enchanted with haptics, leading the C loop shape seen in many designs today. And, of course, there are his IOL prediction formulae used by surgeons globally.

In more recent times, Barrett has been working on a sophisticated optical design to resolve one of the biggest issues in cataract surgery – clear vision at different focal points without visual disturbances. He came up with a way to harness positive spherical aberration and after many years “knocking on doors”, the concept has been brought to life as the RayOne EMV IOL.

Barrett – a Perth-based ophthalmologist and world renowned for his work – has collaborated with UK-based IOL manufacturer Rayner to develop the lens described as an extending range of vision IOL delivering up to 1.5 D^{1,4,6} with an emmetropic target. The lens has also been created with monovision in mind – a key interest of Barrett's – offering surgeons a potentially even greater range of vision. Importantly, its non-diffractive design means the lens can offer monofocal levels of contrast sensitivity¹ and dysphotopsia^{2,5}, and high levels of patient satisfaction.³

After influencing IOL materials, haptics and formulae, for Barrett the RayOne EMV perhaps closes an IOL innovation loop on his career, leaving his mark on optics with an alternative presbyopia-correcting solution with few downsides.

“People say there's no free lunch in optics, but this is as close as you get,” he tells *Insight*.

“You can achieve excellent intermediate and some reading [vision] if you target distance in both eyes, and many surgeons start with this and are happy with the outcomes. But it comes to its own when you embrace the synergistic effect of extended depth of focus with modest monovision. It's exciting to see surgeons who have been perhaps cautious about modest monovision begin to embrace this, because it's a powerful concept in its own right.”

Although the RayOne EMV – and its toric version – has been available for a few years now, it was more than a decade ago that Barrett began devising a plan so patients could benefit beyond what monofocal or multifocal IOLs

offered. And although some designs had adopted the EDOF term, they still came with trade-offs.

“Since I implanted my first multifocal in 1989, there have been variations in design, but nothing has really changed – the limitations still exist, and I wondered whether you could enhance someone's depth of focus by adding something where the penalty is hard to distinguish,” he says.

“I looked at various optical principles and came to the conclusion that manipulating spherical aberration was my option of choice. Positive spherical aberration especially has some unique features in optics, but there's a key philosophy that you can only push it so much. My priority was to maintain optical quality.”

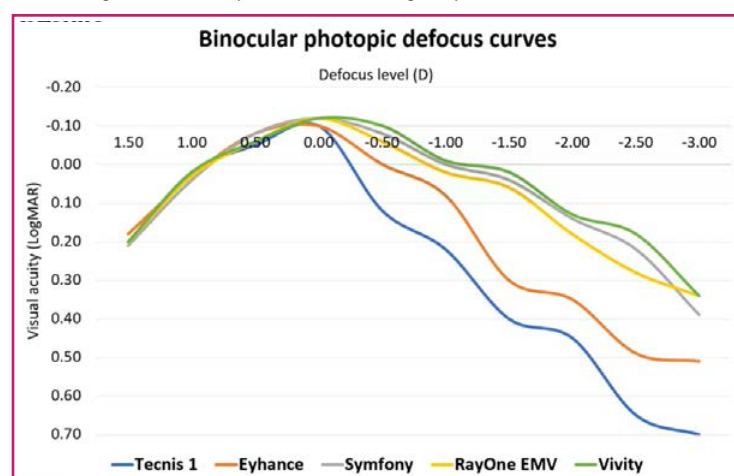
The result is a highly sophisticated optic that manipulates a mixture of fourth and sixth higher order aberrations so that the positive spherical aberration is apodised towards the periphery. In effect, when the pupil gets larger, it doesn't cause the negative impacts one might expect. Rayner says this “reduced longitudinal spherical aberration” is designed to maintain visual acuity and contrast sensitivity under mesopic conditions.

What also makes the RayOne EMV unique is the way it exploits the relationship between positive spherical aberration and residual myopia. Barrett has long been a proponent of modest monovision and is excited to combine these concepts in the RayOne EMV.

“The same principle applies, in that there's a limit as to how much myopia you can introduce – about -1.25 D – and if you take these two concepts of an extra -1.00 D to -1.50 D of spherical aberration and -1.00 D of modest monovision in one eye, suddenly you are getting a reasonable likelihood of spectacle independence – that was my thought behind this,” he says.

“When I came up with this concept, it really was the first example of extended depth of focus, but since then others have embraced the term despite a variety of different optical techniques. They are by no means homogenous, and you can't expect them to perform in the same fashion. When I coined the term and began that journey, it was about positive spherical aberration. People look at the RayOne EMV as a recent newcomer, but it actually precedes many other lenses – it's been a long journey.”

Figure 1: At the Hospital da Luz Lisboa in Lisbon, Professor Filomena Ribeiro and Professor Tiago Ferreira led a 150-patient double-arm, non-randomised prospective case series where RayOne EMV demonstrated excellent visual outcomes for distance and intermediate vision, and good visual acuity for near vision.¹ Image: Rayner.



n (Patients): Tecnis 1 = 30, Eyhance = 30, Symfony = 30, RayOne EMV = 30, Vivivity = 30

BRINGING THE CONCEPT TO MARKET

As alluded to, Barrett has expended plenty of effort to bring his concept to market with an IOL company and probably had his doubts along the way, but he counts himself fortunate to end up collaborating with Rayner. He has high praise for the company's CEO Mr Tim Clover and the way in which the company has respected the essence of his design and encouraged surgeons to consider monovision.

He regards Rayner as a highly innovative company that punches well above its weight in a competitive market segment and appreciates how close Clover is to the action.

However, progress isn't linear. After initially trialling his positive spherical aberration concept in contact lenses and discovering the performance was indistinguishable from plano contact lenses, Barrett soon began working with a different company in 2012 and performing clinical studies.

"But innovations are complicated, and finding a partner to take a new concept is a major undertaking. The stakes are high and eventually when I met Rayner and their team, it turned out to be a perfect partnership," he says.

"Rayner has a very reliable lens platform in RayOne. Making a hydrophilic acrylic with reliable haptics that are stable and perform well rotationally isn't simple, especially for toric IOLs, but Rayner has excelled, and the material is excellent.

"The idea of taking an extended depth of focus design, embracing the additional monovision concept, testing it and evaluating it – it takes an innovative company to do that."

A talking point with the RayOne EMV design is the use of hydrophilic acrylic. While the material has attracted unwanted attention over the years – some that may be unjustified – Rayner boasts a low complication rate with the material.

RayOne EMV IOLs are made from Rayacryl (Rayner's own hydrophilic acrylic material) that can be delivered through a 2.2 mm micro incision. The company has reported zero primary opacifications in more than 11 million implantations. To ensure its stability, a 360° square edge design helps reduce epithelial cell migration, including at the haptic-optic junction.⁷ According to the company, this has resulted in extremely low YAG capsulotomy rates, comparable with hydrophobic acrylic lenses with square-edge optics.⁷

"From an optical point of view, once they're implanted nothing looks as good and functions as well as a hydrophilic IOL," Barrett says. "There can be issues in certain contexts, such as DESK (Descemet stripping endothelial keratoplasty), or maybe vitrectomy with gas because calcifications have been reported.

"It's something I've asked Rayner about in-depth, and the numbers are

extremely small, but it exists. I thought in a market like Australia that is hydrophobic-oriented, this would be a challenge, but I've been surprised at how many surgeons – especially those of my vintage who have seen these issues – have embraced the material. It doesn't seem to have been a barrier and the uptake is probably greater than I would have anticipated."

LENS MATERIALS AND MORE

These days, Barrett is enjoying a sense of fulfilment since the RayOne EMV came to market. Although he has spent much time on the lectern, he's now finding pleasure sitting at the back of the room and watching his peers present their own experiences with the IOL.

"Certainly, I've heard the data from implanters, particularly in Europe, and the numbers are excellent. From the point of view of glare and halos, people claim zero and, of course I'm doubtful when it's zero, but it's certainly very low," he says.

"It's interesting because I've explained how I've been careful not to create too much extended depth of focus, but when you look at the through-focus curves and depth of focus curves (Figure 1), it compares very well to some of the more aggressive lenses whether that be diffractive or other EDOF principles. The RayOne EMV depth of focus curves have been analysed in clinical studies and compared to other IOLs in this category. It offers a significant extended depth of focus, yet the quality parameters are good. It's very easy to refract, you can get a sharp focus and patients aren't complaining of having soft distance vision or low contrast that you might get in other designs."

Each of his innovations have had an impact, and asking Barrett to choose one is like picking a favourite child.

But looking ahead, he will continue working with Rayner to promote and develop the RayOne EMV IOL. While he plans to dial down in some areas, he isn't done with ophthalmology yet.

"I'm at the stage of my career now that I'll be slowing down from a surgical point of view, but with formulae there's no limits. It takes a lot of time and deep thought, and I'm looking forward to putting more into that aspect of ophthalmology," he says.

"It's all fascinating and a privilege to be an ophthalmologist. I was talking to a patient just recently about retirement and it struck me how rewarding this field is. What we do has such impact and – beyond the innovation, ideas, and concepts – that day-to-day experience is something I'll always be grateful for." ■



The RayOne EMV IOL harnesses positive spherical aberration, but calculating the right amount is the key to the design. Image: Rayner.

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