Rayner is one company that has adopted the hydrophilic material for its new RayOne EMV platform.

When a surgeon selects an IOL for cataract surgery in 2023, there are usually two acrylic materials to choose from. DR BEN LAHOOD discusses their differences and why he believes calls to limit the use of one material type are unfounded.

The case FOR HYDROPHILIC IOLS

In the ongoing quest to produce an intraocular lens (IOL) that closely imitates a healthy crystalline lens, manufacturers have walked a narrow tightrope when it comes to IOL materials. Biocompatibility, clarity, foldability, and an ability to apply advanced optical designs are all vital factors when bringing a lens to market, with diminishingly less room for compromise.

Today, two categories of acrylic materials have come to dominate the IOL market: hydrophobic and hydrophilic.

At a chemical level, their differences boil down to their water content, with hydrophilic usually comprising 18–38% water compared to ≤5% for hydrophobic.[1]

But do their differences go much deeper than this? Some would say yes, when considering the surgical experience, stability, visual outcomes and complication rates of these two materials. In fact, the debate around the use of hydrophilic IOLs, in particular, has intensified to the point of some calling for a ban on the material.

How it has reached this point is perplexing to renowned cataract and refractive surgeon Dr Ben LaHood, a consultant ophthalmologist at Adelaide Eye and Laser Centre, The Queen Elizabeth Hospital in Adelaide, and senior lecturer at the University of Adelaide.

He believes the war being waged on hydrophilic acrylic IOLs is unjustified, saying the industry should be engaged in a more nuanced conversation about judicious use and the potential for optimal outcomes.

"The biggest issue that's reared its head in the last decade has been the potential for hydrophilic acrylic IOLs to absorb different molecules and become opaque. The potential for opacifications is the most publicly known downside of hydrophilic materials – and it's been so big that there's even been calls for manufacturers to stop producing them. I think that would be an unwise move because what we're talking about is the absolutely tiny risk of an absolutely tiny risk," he says.

"Hydrophilic IOLs have so many positive attributes, such as excellent optical clarity and unique optical designs. In terms of optimal outcomes, we're aiming for minimal residual refractive error; the smaller the incision, the less surgically induced astigmatism we may create. This means we can potentially leave the eye very similar to its preoperative measurement. Therefore, outcomes with hydrophilic IOLs could potentially be more predictable than a larger incision for hydrophobic implantation.[2]

"When you consider these factors, it's my view that the worry about opacities has been blown out of proportion."

THE PROS AND CONS

Looking at hydrophobic IOLs, LaHood says they too can have great optical clarity and are stiffer which can help provide long term stability within the capsular bag. However, in his experience they can be more challenging to insert safely through smaller incisions, and some designs have been more susceptible to glistenings.[3] These fluid-filled microvacuoles can scatter light resulting in dysphotopsia, decreased contrast sensitivity, and other photic phenomena that interfere with vision[1,4-6] and, in severe cases, may require explantation.

"Today we have some great hydrophobic materials that don't appear to have glistenings long-term, which is fantastic, but these lenses are still limited in the ease that manufacturers can apply more complex optical designs on to the surfaces and how easily we can fold them to insert through a tiny incision."

When it comes to hydrophilic IOLs, he says greater flexibility in the material means surgeons can insert them through smaller incisions.

"The IOL then unfolds within the eye effortlessly to assume its final position quickly,[7] which is especially useful when implanting toric IOLs where the slower unfolding or self-adherence seen with some hydrophobic acrylic IOLs can be time-consuming and may lead to rotation if the surgeon is impatient,[8-9] he says.

"Hydrophilic IOLs tend to have more complex haptic designs to maintain their position – being a softer material they can be more easily distorted by the changes of the capsular bag over time.[9]"

Hydrophilic IOLs – which have existed for some four decades – account for around a third of IOLs implanted worldwide today. From an optical design and manufacturing point of view, it is considered easier to develop advanced optics on a hydrophilic. IOL manufacturer Rayner is one company that has adopted the hydrophilic material for its new RayOne EMV platform featuring a non-diffractive design that provides patients with an enhanced range of vision.

When it comes to hydrophilic IOLs, LaHood believes the discussion should steer way from blanket bans, to thinking about patient candidates.

Studies have highlighted reports of calcification of hydrophilic IOLs in patients with a break down of their blood/eye barrier such as diabetics, who underwent procedures using intraocular instillation of air or gas, such as Descemet membrane endothelial keratoplasty (DMEK), pars plana vitrectomy or Descemet stripping endothelial keratoplasty (DSEK).[11] Since surgeons cannot predict perfectly which patients may one day require keratoplasty or pars plana vitrectomy surgeries, the suggestion emerged that surgeons should avoid hydrophilic IOL use.

In his 10 years of implanting and observing hydrophilic IOLs, LaHood has not encountered a hydrophilic IOL opacity, and struggles to think of a colleague who has as well. That's not to say these cases don't exist, but improved manufacturing processes coupled with judicious use would ensure opacities become "vanishingly rare".

If there is the potential for gas inside the eye and/or diabetes, when the intersection of those two conditions occurs, he would avoid a hydrophilic IOL.

"Specifically, in the case of a patient requiring an endothelial keratoplasty for severe Fuchs dystrophy, I would probably avoid any type of multifocal lens design because I don't want to put something diffractive behind an already irregular surface. That would leave me with my monofocal choice, a hydrophobic IOL, so it doesn't alter my thinking much there."

LaHood considers that patients who may require retinal surgery longer term are also known to be at higher risk for a breakdown of their blood vessel barrier, changing the chemistry within their eye, and gas injection, which could lead to IOL opacity.

"This is a very small group of patients where I'd be unlikely to implant a multifocal lens in anyway because of their already-compromised macula, leading to using my hydrophobic monofocal IOL of choice. It doesn't greatly alter my practice, particularly, but for surgeons who are using hydrophilic IOLs consistently, that's where they may want to consider their use," he says.

Alternatively, there has been significant advancement in adaptive techniques that serves as valuable tools in the surgeon's arsenal to safeguard IOLs against opacification, irrespective of the material employed. One approach is the reduction of air/gas exposure both in terms of volume and duration.[12-14] Additionally, irrigation with saline solution for a brief period has been proposed as a strategy to facilitate passive diffusion and remove excess of calcium ions. Furthermore, researchers are also developing IOL tests that can help identify a material's susceptibility to calcification in the eye.

In the case of posterior capsular opacification (PCO) – the most common of late postoperative cataract surgery complications – LaHood says it is accepted these rates are higher in hydrophilic IOL cases.[11] In his own clinic, YAG capsulotomies for PCO are performed on 5% of his hydrophilic patients, and 2% of his hydrophobic cases.

However, it should be noted that material alone is not the sole influencing factor when it comes to preventing PCO development, and that not all hydrophobic acrylic lenses are automatically superior in this regard. In fact, there is significant overlap, and certain hydrophilic IOLs with specially designed and optimised anti-PCO features can outperform certain hydrophobic lenses.[15]

"THIS GREATER FLEXIBILITY IN THE MATERIAL MEANS WE CAN INSERT HYDROPHILIC IOLS THROUGH SMALLER INCISIONS. THE IOL THEN UNFOLDS WITHIN THE EYE EFFORTLESSLY TO ASSUME ITS FINAL POSITION QUICKLY."

DR BEN LAHOOD
OPHTHALMOLOGIST

An implanted hydrophilic acrylic IOL.

Given the frequency and low risk of capsulotomies, LaHood doesn't believe the differences in PCO rates should be a major factor when selecting IOL materials. For some surgeons implanting advanced trifocal IOLs, this procedure is a routine step in the months following surgery anyway.

A CASE STUDY

One of the newest hydrophilic IOLs to join LaHood's armamentarium is the RayOne EMV.

Manufacturer Rayner says the platform offers up to 1.5 D increased range of focus (emmetropic targeting)[16-18], monofocal levels of contrast sensitivity[17] and dysphotopsia.[19,20] The company recently released a toric variant, developed with renowned Australian ophthalmologist Professor Graham Barrett.

RayOne EMV IOLs are made from Rayacryl (Rayner's own hydrophilic acrylic material), with the company reporting zero primary opacifications in more than 10 million implantations.

To ensure its stability, a 360° square edge design helps reduce epithelial cell migration, including at the haptic-optic junction.[21] According to the company, this has resulted in extremely low YAG capsulotomy rates, comparable with hydrophobic acrylic lenses with square-edge optics.[21]

LaHood breaks his IOL options into three main groups: a solid monofocal he's familiar with, a trusted trifocal, plus an extended range of vision/monofocal-plus IOL. RayOne EMV fits within the latter category.

The first patients he trialled the lens in were young adult patients with traumatic cataracts. He chose the RayOne IOL for its ability to provide a natural range of vision, without compromising distance visual acuity, a problem in some EDOF designs.

"It will go through a small incision, looks beautifully clear within the eye and seems to have good rotational stability so far. It does have large and unusual haptics, which is a requirement of hydrophilic IOLs to maintain the stability in the capsular bag, so there has been a learning curve when it comes to injecting it into the eye and ensuring consistent orientation," he says.

"Interestingly, none of my RayOne EMV patients have required a capsulotomy – and many of these people are at high risk of PCO. This is very important and something we want to avoid because we know one of the risk factors for retinal detachment in young people is disrupting the posterior capsule. I chose this lens for the optical outcome it provides, but this has been a nice side-effect."

NOTE: References will appear in the online version of this article, and are available upon request. ■