

Emerging IOL Technology in the Digital Age

Richard C. Kho, MD

Correspondence:

Department of Ophthalmology and Visual Sciences
University of the Philippines-Philippine General Hospital
Taft Avenue, Ermita, Manila
e-mail: rich_kho@yahoo.com

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Cataract surgery has undergone radical leaps over the last 50 years. Concurrent technological developments and innovations in various aspects of this procedure transformed cataract extraction into the marvel of modern surgery that it is today.¹ From a surgical perspective, we have refined our techniques to remove the cataract through a small, almost astigmatically-neutral incision, with the least amount of ultrasonic energy delivered in the eye. And with the advent of femtosecond laser-assisted cataract surgery (FLACS), we can further decrease this energy delivery to produce clearer corneas immediately after the procedure.² Creating the ideal size and shape of capsulotomies has also become the standard, as we learned how this affects effective lens position (ELP) and final visual outcome.³ Lastly, from a functional perspective, developments in intraocular lens (IOL) design have brought us closer to restoring full and functional vision after cataract surgery.⁴ This issue of the PJO features a comparative study of three diffractive trifocal IOLs available in the local market today⁵, providing local surgeons with additional options at their disposal when choosing the right IOL for their patients.

A Brief History of IOL Innovations

Design innovations in IOL technology have come a long way since the introduction of the first lens by Sir Harold Ridley in 1949.⁶ This is a rigid lens that dominated IOL technology and design for many decades. Having only a single focus, all cataract patients were essentially rendered presbyopic after surgery. Options for functional near vision includes aiming for monovision (emmetropia in one eye, myopia in the

fellow eye) and outright aiming for bilateral myopia in patients who desire uncorrected near acuity, the latter being consigned to wearing spectacles for distance. In the succeeding years, our IOL materials became foldable to fit smaller incisions,⁷ acquired toricity to address corneal astigmatism,⁸ and attained asphericity⁹ and blue light-filtering capabilities.¹⁰ Eventually, presbyopia-correcting IOLs were introduced, bringing our long journey into IOL technology full circle.¹¹

The Era of Trifocals

Presbyopia-correcting IOLs entered the local market in 2006. Interestingly around this time, the introduction of the iPhone™ in 2007 followed by the iPad™ in 2010 were game-changers in the way we function daily. Driven by an upsurge in mobile device usage during the digital age, half of our waking time is spent on gadgets, working on the near and intermediate range. Also, jobs requiring long hours working in front of the computer have increased exponentially (e.g. call center agents, information technology (IT) and related works). Moreover, the number of presbyopes (more than 1 billion worldwide) is increasing as a result of the aging world population.¹² As the first generation presbyopia-correcting IOLs were basically bifocal lenses with only two foci, patients still needed spectacles for computer work, which mainly requires intermediate acuity (around 60-80 cm). Surgeons and IOL companies started employing various strategies to “mix and match” existing IOL designs (diffractive, refractive, pseudo-accommodating, and segmental-refractive IOLs) to achieve a better range for near and intermediate vision.¹³⁻¹⁴ The latest iteration of diffractive IOL design aimed to address this issue with

the introduction of trifocal IOLs. These new IOLs are designed to further split the two foci of light to add a 3rd focus in the intermediate distance, allowing for a more comfortable near to intermediate range.¹⁵ Interestingly, the addition of a 3rd focus was an initial design concern in terms of further degradation of acuity and potential increase in photic phenomena. Several reports (including the accompanying comparative study on trifocals) however, have shown very good clinical outcomes with these trifocals over a wider range of vision as compared to traditional multifocals.¹⁶⁻²⁰

A decade later, adoption of premium IOLs is still low (at least locally)...

For the past 15 years, the Philippine Society of Cataract and Refractive Surgery (PSCR) has continuously educated our members about these new and emerging IOL technologies, including strategies for optimal outcome. However, usage of premium IOLs among local surgeons remains low, ranging anywhere from 5-10% based on unofficial local surveys. In addition to cost issues, many local surgeons avoid presbyopia-correcting IOLs in practice because of perceived problems associated with their usage. Not least of these are anecdotal cases of “unhappy” patients after “unsatisfactory” surgical outcomes. It is worth noting that many of these issues can be avoided by careful patient selection and adequate chair time about the pros and cons of premium IOLs.^{4,13} Post-operatively, a thorough eye examination to address patients’ “complaints” is the key in handling these challenging cases. This requires addressing any corneal problems like dryness, checking for residual errors of refraction including astigmatism, looking for subclinical cystoid macular edema and posterior capsule opacity, and watching out for IOL decentration and pupillary size issues vis-a-vis the diffractive rings.^{13,21} Note that patients’ visual quality with multifocal IOLs are extremely sensitive to these issues compared to monofocal IOLs, and must be addressed early in their post-operative course.

Several ophthalmology residency training programs locally have begun to incorporate premium IOLs in surgical training. Since 2016, residents from the University of the Philippines-Philippine General Hospital-Department of Ophthalmology and Visual Sciences (UP-PGH DOVS) decked patients for premium IOL implantation. Towards the latter part of their residency (once they can produce consistent results with their phacoemulsification technique), they are trained in the nuances of incorporating premium IOLs in practice, including proper patient selection, intra-operative strategies, and post-operative care for optimal outcome. Other residency training institutions like the Eye and Vision Institute-The Medical City (EVI) have started similar programs, with more institutions following in the future. Noting the difficulties of venturing into these high-end lenses once already in private practice, the goal is to incorporate them while still under the medicolegal shield of residency training.

The future

As we bask in the splendor of current diffractive multifocal IOL technology, we are almost certain that these will not be the last IOLs in our arsenal, as more design innovations are being introduced. The era of Enhanced Depth of Focus (EDOF) IOLs may be upon us.²² These lenses elongate the focal point and allow a wider range of foci, versus only specific foci seen with traditional diffractive lenses. These lenses are also meant to address photic phenomena associated with the latter. Whether this particular design of presbyopia-correction becomes the trend and eventual norm remains to be seen. For now, we have plenty of IOL designs and technology at our disposal to offer our patients, as they navigate today’s dynamic digital world. These choices must be individually customized to a patient’s lifestyle and daily activities for best outcome. What we now have at our disposal is excellent. What we will have in the future is going to be even better. Indeed, the future of IOL technology remains bright.

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