Commentary: Expanding indications of newer and economically viable phakic posterior chamber intraocular lens designs

The correction of a refractive error can be performed using an excimer laser corneal reshaping surgery (LASIK/PRK/SMILE) or a refractive lens exchange (RLE) or phakic intraocular lens (IOL) implantation. While excimer laser corneal surgery remains the most popular and widely performed refractive surgery, foldable posterior chamber phakic IOLs are now considered a safe, precise, and predictable alternative to laser corneal refractive surgery when treating moderate to high myopia, which also preserves the patient's ability to accommodate as compared to RLE.[1] Currently, posterior chamber phakic IOL is the most commonly used phakic implant model that came into existence in 1986 and was first developed by Dr. S. Fyodorov.[2] Published clinical studies of phakic IOLs demonstrate promising results for the correction of refractive errors not amenable to standard excimer laser refractive surgery.[2,3] Globally, the most commonly used phakic IOL is manufactured by STAAR Surgical, the Visian Implantable Collamer Lens (ICL), made of a trademark material known as "Collamer," which is a copolymer of hydroxyethyl methacrylate (99%) and porcine collagen (1%).

In India, the technique of implantation of phakic IOL (Visian ICL) was used by only a handful of ophthalmic surgeons due to several reasons; the ICL was expensive and there was a learning curve to master the ICL loading and implantation technique as well as risk of associated intra-operative (improper loading resulting in upside down ICL implantation) and postoperative complications, such as raised intraocular pressure (IOP) and anterior sub-capsular lenticular opacities.[2] The new ICL phakic IOL design (EVO Visian V4c) obviated the need for pre-op Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser peripheral iridectomy and central hole enables aqueous flow, significantly reducing the formation of anterior sub-capsular cataract.[1,4]

In last few years, Indian companies have introduced economically viable foldable posterior chamber phakic IOL designs, such as implantable phakic contact lens (IPCL; Care Group, Vadodara, India), Eyecryl phakic IOL (Biotech Vision Care, Ahmedabad, India), and refractive implantable lens (RIL; Appasamy, Chennai, India). Several ophthalmic surgeons are now started using Indian phakic IOLs for correction of myopia, toric phakic IOLs for managing myopic astigmatism and for stable keratoconus, and multifocal diffractive phakic IOLs for correction of presbyopia. The reason for the expanding indications is that, first, there is a substantial reduction in the cost of the phakic implant, and second, there is a minimal learning curve (in loading and implantation) as most of the eye surgeons are familiar with the injection system that is used for the implantation of Indian phakic IOLs. These phakic IOLs can be implanted using 2.8 mm corneal incision and these designs (with central holes) obviated the need for pre-operative Nd: YAG laser peripheral iridectomy. Indian manufacturers are also providing spare (stand by) phakic lens to surgeons, if there is any damage to phakic lens while loading and implantation. Few authors have recently reported their experience with Indian manufactured phakic IOLs with excellent visual results.[5,6]

In this issue of *Indian Journal of Ophthalmology*, Sachdev *et al*. have shared their experience with two different types of phakic IOLs, in a retrospective study.[7] The IPCL and ICL were implanted in 121 and 203 eyes, respectively, for the correction of myopia and myopic astigmatism. Inclusion criteria were: patients aged over 21, minimum endothelial cell count of 2500 cells/mm^2, and anterior chamber depth (ACD) of at least 2.8 mm. The analysis compared the pre-operative features, postoperative visual outcomes, and associated complications in detail. Each patient was thoroughly evaluated and underwent a comprehensive ocular examination before the surgery. Results of this study suggested that posterior chamber phakic IOL implantation has a high success rate. An uncorrected visual acuity of 20/32 or better was achieved in 86.5% and 88.67% of the eyes, respectively. About 90% and 94% of the eyes achieved a postoperative manifest spherical equivalent within ±0.5D. Three eyes (2.52%) in the IPCL group versus 1 eye (0.49%) in the ICL group developed a visually significant cataract requiring surgical intervention. The authors have appropriately mentioned that with the introduction of the new version of the IPCL (IPCL V2) containing a 350 microns central hole, the need for a peripheral iridectomy is obviated and it possibly brings down the incidence of cataract and pupillary block glaucoma. Studies comparing outcomes of IPCL with and without the central hole will be helpful to demonstrate the same.

As shown in aforementioned study, in the absence of contraindications, phakic IOLs represent an excellent cornea saving, reversible option for the correction of myopia and myopic astigmatism. All phakic IOL models have several advantages in common, including rapid visual recovery, excellent refractive stability, improved visual acuity, no removal of ocular tissue, retention of accommodation, and reversibility of the procedure. Small incisions (less than 3.0 mm) and the rotational stability of toric phakic IOL models allow rapid visual rehabilitation. On the whole, complications are rare and depend, to a large extent, on the phakic IOL loading, location, sizing, and placement of the phakic IOL. Inappropriate sizing of phakic implants can cause complications, under sizing leading to anterior sub-capsular cataract, rotation of lens causing refractive surprise, and oversizing resulting in increased intraocular pressure due to the blockage of aqueous outflow.

How to minimize the complications associated with phakic IOL?

Proper case selection, comprehensive ocular (anterior and posterior segment) evaluation, refraction (manifest and cycloplegic), gonioscopy, and detailed workup (for precise sizing and refractive power of the phakic implant) are mandatory to minimize complications associated with phakic IOLs. Prerequisite for appropriate case selection includes: age >21 years; stable refraction (less than 0.5D change over 1 year); clear crystalline lens; ametropia not appropriate for excimer laser surgery; unsatisfactory vision with contact lenses or spectacles; appropriate pupil size for the specified phakic IOL; adequate (2.8 mm or more) ACD; endothelial cell count of 2500 cells/mm^2 or more; and no ocular pathology, such as compromised corneal endothelium, iritis, iris atrophy, rubeosis iridis, cataract, glaucoma, and retinal disorders.[8]

Precise calculations and appropriate sizing of phakic IOL are extremely important and depend on ACD and horizontal white-to-white (WTW) diameter. ACD measurement (from corneal endothelium) can be done by anterior segment optical coherence tomography (AS-OCT), optical biometry, or Scheimpflug imaging. Measurement of precise horizontal WTW diameter is mandatory for the selection of the phakic IOL diameter and is commonly done with a digital caliper under microscope magnification, with the patient in a reclined position. However, the best method to measure sulcus-to-sulcus distance is high-frequency ultrasound biomicroscopy. Other methods, such as AS-OCT or Scheimpflug imaging, can also be used to estimate the sulcus-to-sulcus distance by measuring the WTW diameter and adding 0.5–1.0 mm.[9] Loading and implantation of Indian phakic IOLs require a minimal learning curve and this technique is quite similar to foldable posterior chamber pseudophakic IOL implantation. Most of the ophthalmic surgeons are familiar with the cartridge and the injector system and therefore, there is greater acceptability for this procedure.

Are there other indications of newer designs of phakic IOLs?

In addition to correction of myopia and myopic astigmatism, several models of customized toric phakic implants (Toric IPCL that can correct up to 10D cylinder) are now available that can be used in cases of stable keratoconus, keratoconus with corneal cross-linking, correction of residual refractive error in post-keratoplasty cases, and correction of unilateral high refractive error in pediatric cases to prevent anisometropic amblyopia.[10–12] Multifocal diffractive phakic IOLs are also available to correct presbyopia. Customized toric or multifocal phakic posterior chamber IOLs can be implanted in a piggyback manner to correct postoperative refractive surprise. We have used customized toric phakic IOLs in 8 cases of stable keratoconus and multifocal phakic IOLs in 12 cases with excellent visual outcome.[13] Customized toric phakic IOL (IPCL) can be positioned at 0–180° axis without the need of rotation. We believe that the improvements in phakic lens designs and implantation techniques and availability of economically viable and newer customized toric phakic and multifocal phakic IOLs designs by Indian manufacturers have led to greater adoption and therefore expanding the use of these implants for a variety of indications. Preloaded designs are under development to minimize complication related to loading and implantation of phakic implants. Long term follow-up of these patients is mandatory to detect and manage any sequel/complication (phakic lens vault, endothelial cell loss, raised IOP and lenticular opacity, etc.) after phakic IOL implantation.

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