A Phakic Intraocular Lens (P-IOL) is an artificial lens placed within the eye either immediately in front or behind the iris. P-IOLs are designed to correct refractive error without reshaping the cornea or interfering with accommodation. P-IOLs are approved by the FDA to fully correct up to 15.00 diopters (D) of myopia. People with more than 15.00 D of myopia may use a P-IOL to reduce their refractive error, but will not achieve full correction. The learning curve for P-IOL surgery is relatively short, but very steep. If for any reason the P-IOL becomes problematic or undesired, it can be surgically removed in a process essentially the reverse of implantation. P-IOLs are generally not ideal for persons over age 45 or anyone who is presbyopic.

Here we discuss the preferred practice patterns with leading experts in this field. The questions have been prepared by DOS Executive Editor Dr. Tarun Arora (TA): MD, DNB, FICO, Senior Resident, Cornea, Cataract and Refractive Surgery Services, Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi.

**Dr. Mahipal S. Sachdev (MSS):** MD, is the Director and Senior Consultant, Cataract and Refractive Surgery of Centre for Sight Group of Hospitals, New Delhi.

**Dr. D. Ramamurthy (DR):** MD, is the current Director & Senior Consultant at Eye Foundation, Coimbatore.

**Dr. Rajendra Khanna (RK):** Director, Khanna Eye Centre, Nirman Vihar, Vikas Marg, Delhi.

**Dr. Sudarshan Khokhar (SK):** MD, is currently Prof. of Ophthalmology in Cataract & Refractive Surgery Services at Dr. Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi.

**TA: What are the various investigations and prerequisites while planning a patient for phakic IOL?**

**MSS:** Phakic IOL candidates require a comprehensive workup to rule out any potential anatomic or physiological problems. We need to perform corneal topography and measures anterior chamber depth, which is critical in these patients, and screens for corneal diseases and keratoconus. The biometry is done to confirm the anterior chamber depth. The white-to-white measurement is also taken. Specular microscopy is done. Manifest refraction is very important to confirm refraction stability. Finally, dilated fundus examination and slit lamp examination is done before the final decision on the patient’s suitability for the procedure is made.

**DR:** - Complete eye examination including Refraction, BCVA, anterior segment, IOP & fundus evaluation especially macula & periphery.
  - AC depth
  - White to white
  - K readings
  - Specular microscopy
  - Topography to ensure patient is not suitable for laser vision correction & to evaluate cornea.
RK:

a: Refraction
   (i) Manifest
   (ii) Cycloplegic

b: IOP
c: Corneal Thickness
d: AC Depth from endothelium
e: Keratometry
f: White to White from mid limbus to mid limbus

SK:

The investigations for a refractive surgery include Cycloplegic refraction, UCVA, BCVA, topography, Indirect ophthalmoscopy, intraocular pressure (IOP), central corneal thickness (to find if fit for LASIK), white to white diameter (Orbscan IIz), anterior chamber depth (the usual cutoff is 2.8 mm), gonioscopy (to rule out pigment dispersion and concave iris configuration, occludable angles/angle closure).

A patient undergoing Implantable Collamer Lens (ICL) should not have irregular astigmatism (some cases of keratoconus are the newest indication), retinal lattices holes should be lasered, no history of retinal detachment or glaucoma, normal IOP, ACD>2.8 mm with open angles.

TA: Which phakic IOL do you routinely implant in your practice and what are your results with the same?

MSS: I normally use Star Visian ICL™ by Surgical. Visual outcomes are good. Now they have come up with Centraflow in which peripheral iridotomy is not required. In patients who cannot afford Implantable Phakic Contact Lens (IPCL, Phakic Lens, Care Group, India) is also an option.

DR: ICL & recently have tried a few IPCL.

The results are extremely good, with excellent correction, stability and no deterioration in the quality of vision.

RK: IPCL (Implantable Phakic Contact Lens)

The results are predictable and safe.

SK: With the introduction of V4c with Centraflow technology, we have shifted completely to its use without doing a preoperative laser iridotomy in these patients.

TA: How do you select the appropriate size of ICL?

MSS: Proper calculation of sizing very important, because sizing will determine the fit and overall success of the procedure. Selecting the appropriate lens size is based on a measurement of the patient’s white-to-white distance, which is just an indirect measurement of the sulcus-to-sulcus length. After having done a huge number of ICLs we’ve determined that the best white-to-white measurement is done with digital calipers under microscope magnification, with the patient in a reclined position.

To make selecting a lens easier, Staar has an online sizing and ordering system. The surgeon will go to a website, enter in the patient’s biometry, such as chamber depth and white-to-white measurement, and the program will select the appropriate ICL to order.

DR: Based on the data sent to them the company sends the ICL.

I cross verify primarily by White to White.

AC depth & K readings also play a role. Following is the chart I use:

<table>
<thead>
<tr>
<th>WtW (mm)</th>
<th>AC Depth</th>
<th>Visian ICL Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.65 - 11.14</td>
<td>&lt;3.5 mm</td>
<td>12.1 mm</td>
</tr>
<tr>
<td>11.15 - 11.84</td>
<td>&lt;2.95 mm</td>
<td>12.6 mm</td>
</tr>
<tr>
<td>11.15 - 11.64</td>
<td>&gt;3.0 mm</td>
<td>12.6 mm</td>
</tr>
<tr>
<td>11.65 - 12.3</td>
<td>3.0 - 3.5 mm</td>
<td>13.2 mm</td>
</tr>
<tr>
<td>11.85 – 12.5</td>
<td>&lt;3.0 mm</td>
<td>13.2 mm</td>
</tr>
<tr>
<td>12.4 - 12.9</td>
<td>&gt;3.1 mm</td>
<td>13.7 mm</td>
</tr>
</tbody>
</table>

RK: Measurement from White to White and AC Depth are important.

SK: ICL is sized based on white to white diameter calculated on Orbscan. If there is a discrepancy between the two eyes, we use calipers to confirm the white to white diameter.

TA: For what degrees of astigmatism would you prefer toric ICLs? Have you observed any rotation in postoperative periods?

MSS: We prefer to correct astigmatism up to 5 D, but IPCL can be customized for a correction of up to 10 D of astigmatism.

Toric ICLs are very stable in the post-operative period. Occasional cases may require redialing. Repeated rotation of ICL even after redialing, though rare, may be observed due to sizing issues and may require replacement of ICL (of another size).

DR: Anything beyond .75 D of astigmatism we offer Toric ICLs. Less than that we use a spherical ICL and position the 3 mm incision on the steep axis to de-bulk the astigmatism.

If the sizing is correct there is no tendency for these lenses to rotate.

RK: I prefer a Toric ICL in astigmatism from 1D to 7D. Yes, occasionally.
SK: We implant TICL in cases of regular myopic astigmatism with cylinder exceeding 1D. TICL shows good results postoperatively in such eyes with no incidence of postoperative rotation in our cases.

TA: What are the pearls and pitfalls while implanting ICL?

MSS: First and foremost proper loading of ICL should be ensured. Improper loading can lead to upside down ICL in anterior chamber and breakage of ICL. Pupil should be fully dilated and patient should be comfortable. We do this procedure under topical anaesthesia. Second important step is doing Iridectomies - One should ensure that PIs should be superior and peripheral enough to allow a patent opening, which is important, but not so large that they create glare or polyplopia.

DR: - Perfect loading
  - Incision size of 3 mm
  - Not wound assisted but with the mouth of the cartridge in the AC. Gives better control while implanting.
  - Ensure the ICL opens in the correct manner & not in the reverse
  - You retain control over the ICL even after 7/8th has been injected in AC. If tendency to open in the reverse manner, withdraw the lens, reload & re-inject.
  - Always inject in AC & then tuck the haptics behind the iris.
  - Avoid overfilling viscoelastics in AC.
  - Ensure complete visco removal at the end of surgery.
  - Avoid instrument touch on the central thin optics (50 microns).
  - In toric ICLs ensure it is well aligned at the end of surgery after removing speculum.

RK: a: Care during Loading
  b: Not to use High Molecular weight Viscoelastic
  c: Protect the natural lens and avoid touching it with any instrument While inserting IPCL
  d: Avoid touching the Optical Zone of IPCL with any instrument
  e: Visco removal at the end should be meticulous
  f: Wound sealing should not be very tight
  g: If the lens does not open properly then do not manipulate in the anterior chamber. Bring the lens out politely, Reload and Reinsert.
  h: Check IOP after 3 hrs

SK: Patient selection is the most important prerequisite for any refractive surgery.

Over-expectation by the patient should be tackled with preoperatively.

All borderline cases should be avoided.

For toric ICL, preoperative corneal axis marking is essential in a sitting position.

TA: What complications have you encountered in your phakic IOL practice? How did you manage the same?

MSS: In our practice, after doing phakic IOLs in a large number, I can say that its a very safe procedure. Though rare we have encountered few complications as glare, postoperative inflammation, transient increase in intraocular pressure, cataract which was subsequently managed with cataract surgery and implantation of IOL. In cases of Toric ICL sometimes rotation is also a problem for which redialling is required. Being a tertiary care centre we have also we have also seen retinal detachment and acute postoperative endophthalmitis. There was one referred case of bilateral acute post-operative endophthalmitis post ICL. We prefer to do one eye at a time to avoid this devastating complication.

DR: A) Raised IOP:
Causes:
- Retained viscoelastics
- Inflammation
- Excessive vaulting causing crowding of the angle (rare)
- Inadequate PI (in the older lenses without the hole)
Treatment:
- Medical management
- Enlarge PI.
B) Corneal edema & iritis - medical management
C) Inappropriate refractive outcome due to wrong positioning of ICL.
  Verify and if confirmed rotate the ICL to the right axis.
D) Anterior sub capsular cataract - (just 3 out of > 1500 in our series) where there was significant Vision drop - explant ICL, Phaco and implant IOL.
E) Retinal detachment - predisposed due to high myopia.
  -Thorough preop retinal evaluation and prophylactic treatment if necessary.
  - Avoid chamber IOP fluctuations during surgery.
  - Surgery if presents with retinal detachment.
Experts Corner: Phakic IOL

F) Low or excessive vault: observe if no cataract or raise in IOP.

RK: a: High Post Op. IOP, ... Managed with IV Mannitol
b: Left behind Visco causing reaction ..... Managed by repeating Irrigation Aspiration
c: Rotation of Toric IPCL .... Managed by realigning the IPCL
d: Ant subcapsular opacification .... Manged by wait and Watch and remove IPCL and do Refractive lens Exchange
e: Angle closure ..... Never experienced

SK: In our series of 500 odd eyes, we have seen cataract formation (2 eyes: managing conservatively), transient postoperative IOP rise (4 eyes, managed medical therapy short duration only), traumatic dislocation (1 eye: referred to retinal expert), retinal detachment (1 eye; operated vitreoretinal surgery) and invert vault (1 eye; managed by flipping over the ICL the next day).

TA: Recent publications report the successful implantation of ICLs in ACD < 2.8 mm. Does your experience support this? What is your cutoff for AC depth?

MSS: Anterior-chamber depth is crucial factor in determining the success of ICL. The recommended depth is 2.8 mm, and I think 2.7 mm is the minimum depth at which I'd feel comfortable. We have done some cases with 2.7 mm ACD and they did well after surgery.

DR: My cutoff is 2.75 mm & I strictly adhere to this.

RK: I would play safe with 2.8.

SK: We have some experience of implanting ICL in ACD < 2.8mm. Though one should always be cautious in such cases, we have implanted ICL in over-enthusiastic patients who are not fit for keratorefractive surgeries, when ACD is borderline and gonioscopy shows open angles without an element of occludability or pigment dispersion. These patients have done well over time. Based on this experience we may implant pIOL till a lower cutoff limit of 2.6mm.

TA: In case of very high refractive error not amenable to correction by ICL alone, would you prefer to combine ICL with corneal refractive procedures (Biopics) or perform Refractive lens exchange?

MSS: We prefer biopics for very high refractive errors as refractive lens exchange has a higher risk of retinal detachment.

DR: Never perform clear lens extraction in high myopia due to severe retinal complications. In extreme hyperopia clear lens extraction is an option.

RK: Corneal refractive procedure is preferable.

SK: RLE has its own complications like retinal detachment, CME, PCO formation, inflammation, haloes, requirement of near vision glasses etc. Therefore, in a young patient we prefer to perform Biopict surgery, that is combine LASIK with ICL. However in a patient who presents with presbyopic symptoms or a middle aged person with very high myopia, RLE is a better option.

TA: What is your experience of implanting phakic IOLs in ectasia? Do you perform adjunctive procedure (C3R/INTACS) with the same?

MSS: We routinely perform corneal collagen cross linking with INTACS for moderate to high keratoconus. Patients with stable keratoconus after CXL are good candidates for phakic IOL to correct moderate to high refractive error. But if asymmetry of cone is high Phakic ICL might not give good quality of vision.

DR: Once the keratoconus is stable because of cross linking or ageing and if it is a centered cone, I implant toric ICL. Prior explanation to patient about residual refractive error is important.

If Decentered cone, center it with Intacs, stabilise the cornea with CXL (same sitting) & if still significant residual refractive error implant toric ICL after a year.

RK: Have performed IPCL after C3R successfully.

SK: We have operated 2-3 eyes with stable keratoconus. It is always better to stabilize progression in keratoconus and other ectasias before proceeding for a permanent refractive procedure. Stabilization with the aid of C3R, careful monitoring of topography and refractive correction over 1 year should be followed by this procedure. In our cases, though the refractive error did not get corrected completely, but ICL implantation helped the patient in achieving a better BCVA with the aid of spectacles/ CL.

TA: Is there any role for implanting phakic IOLs in candidates with low myopia where keratorefractive surgery is not contraindiacted?

MSS: Keratorefractive surgery is the first choice as far as low to moderate myopia is concerned. Invasive procedure should not be the first choice.

DR: No. Laser vision correction by virtue of it remaining an extra ocular procedure will always be my first choice. In low myopia, with modern laser systems & aspheric ablation profiles there is no loss in quality of vision also.

Extreme dry eyes maybe a relative reason for preferring Phakic IOLs over laser vision correction even in low myopia.

RK: It’s a personal choice but Cost is a deterring factor.
SK: In cases of myopic astigmatism, the keratorefractive surgery is not contraindicated. However results of LASIK are often less predictable in eyes with myopic astigmatism than in eyes with myopia. In these cases we prefer to implant Toric pIOL compared to performing LASIK.

TA: Do you feel any difference with the results with newer models of ICL? Is the postoperative vaulting similar to the previous models?

MSS: We have experience of Centraflow and IPCL amongst the newer models. The results are by far the same. In Centraflow Peripheral iridotomy is not required.

DR: Vaulting is similar to older models. Less pigment dispersal since PI is avoided.

Refactive correction is comparable.

RK: The Vaulting is the same and IOP control better with newer model.

SK: The new ICL with the CentraFLOW design (ICL V4c) provides similar results as its predecessors without this technology for the correction of moderate to high myopia and maintenance of safe IOP levels without iridotomy. The vaulting remains similar to V4b model.

TA: What is the postoperative regimen and which tests do you perform at each follow up visit?

MSS: We give topical antibiotic and steriod eye drops and taper steroids in 4 weeks time period. We do refraction, NCT, vault measurement on ASOCT for first three visits at 1 day, 1 week and 3 weeks postoperative.

DR: - 4th generation fluoroquinolones qid for 1 week
 - 0.5% timolol bd for 1 week
 - Loteprednol qid for 1 week
 - Non preserved lubricants if necessary
Complete eye examination at postop day 1, 6th week and yearly thereafter.

RK: a: Vision
 b: IOP
 c: Slit Lamp examination to check vaulting and to see any other reaction

SK: Postoperatively, we prescribe the patients a regimen comprising of topical steroids 6/d (tapered over 3-4 weeks), topical cycloplegics tid (3 weeks) and topical antibiotics qid (3 weeks). It is always safe to assess intraocular pressure in these patients 1-2 hours after surgery and the next post-operative day by non-contact means.

Usual investigations comprise of UCVA, BCVA, refraction, IOP, slit lamp biomicroscopy (anterior chamber reaction, pigment dispersion, vaulting etc.), ASOCT (for ICL vault) and stereopsis assessment.

TA: What is the future of phakic IOLs? Will its indications widen as we continue to have greater experience with them?

MSS: Phakic IOLs over a period of time have evolved to become safer and easier to implant. In future we can expand its usage in other indications like add on piggy back lenses and to correct post corneal transplant refractive error and astigmatism.

DR: They will remain an integral part of the refractive surgeon’s armamentarium complementing laser vision correction. With the development of Multifocal lenses, one size fits all (no need to vary sizing according to anterior segment dimensions) & preloaded lenses there usage may increase.

If the price of these lenses is brought down, we will be able to offer it to more patients.

RK: Yes, the future is very bright and with newer materials and wide power range and Predictable results, it may become the treatment of choice in refractive correction.

SK: Looking at the journey of ICLs, their use has definitely widened over the years. With established data on safety, predictability and efficacy of ICLs, other than being used in myopia, hyperopia, myopic astigmatism, they are now being combined with higher refractive errors in accordance with biopics, used in stable keratoconus, pediatric myopic amblyopias etc.

The newer indications include: Stable keratoconus, pediatric population with unilateral anisometropic amblyopia

The percentage of eyes with uncorrected visual acuity (UCVA) of 20/20 or better at 12 months postoperative was not significantly different between the two groups. Phakic IOL surgery was safer than excimer laser surgical correction for moderate to high myopia as it results in significantly less loss of best spectacle corrected visual acuity (BSCVA) at 12 months postoperatively. However there is a low risk of developing early cataract with phakic IOLs. Phakic IOL surgery appears to result in better contrast sensitivity than excimer laser correction for moderate to high myopia. Phakic IOL surgery also scored more highly on patient satisfaction/preference questionnaires.

DOS Correspondent
DOS Correspondent
Tarun Arora MD, DNB, FICS
Senior Resident,
Senior Resident,
Cornea Lens and Refractive Services,
Cornea Lens and Refractive Services,
Dr Rajendra Prasad Centre for Ophthalmic Sciences,
Dr Rajendra Prasad Centre for Ophthalmic Sciences,
All India Institute of Medical Sciences, New Delhi.
All India Institute of Medical Sciences, New Delhi.