PHAKIC INTRA OCULAR LENS

Dr.D.Ramamurthy, MD, Dip.NB.,
The Eye Foundation, Coimbatore, Tirupur.

As modern day ophthalmologists of the third millennium we owe it to our patients to find reliable, predictable means to correct their refractive errors. But the challenge remains in the fact that most patients presenting for refractive surgery are in the prime of their productive lives and their problem could be taken care of by simple glasses or contact lenses. Any ill effects of refractive surgery could have long term disastrous complications on the entire life of an individual and hence it is important to tailor make the choice of refractive surgery to the needs of the individual patient.

For a long time refractive surgery was predominantly a single speciality procedure with initially RK, later PRK and then Lasik being the predominant procedure. Now both patients and surgeons have the 'freedom of choice' in the sense they can pick and choose from an array of options like RK, ALK LRI, Surface ablation procedures, Lasik, Phakic IOLs, Intracorneal inlays, Refractive Lens exchange, Bioptics etc. In this Phakic IOLs are fast gaining popularity as an alternative to laser refractive correction in higher grades of refractive error.

HIGH REFRACTIVE ERRORS

Patients with high myopia (above -10 diopters) constitute only about 2% of the myopic population but 13-15% of patients presenting for refractive surgery belong to this group.It is estimated that moderate myopes (-5.00 to -10.00 diopters) are 10 times more likely to present for refractive surgery than low myopes and high myopes are 16 times more likely to present for refractive surgery than low myopes. This stands to reason because higher the refractive error more is the handicap the patient faces visually and cosmetically and hence greater is the motivation to search for methods to get rid of the refractive error.

LIMITATION OF LASIK IN HIGH REFRACTIVE ERRORS

Lasik is justifiably still the most widely practiced modality of refractive surgery because of the high level of comfort, quick recovery, stable predictable results and ability to perform bilateral treatment in one sitting. But when it comes to higher grades of refractive error it has the following limitations:

a. Significant residual error.

b. Loss of Best Spectacle corrected Visual Acuity.

c. Risk of Iatrogenic Keratectasia when excessive ablation has been done or residual bed is too thin.

d. Induction of tear film abnormalities.

e. Induction of higher order aberrations especially spherical aberration, which leads to poor contrast sensitivity, limitation of night vision and diminished quality of vision.

ADVANTAGES OF PHAKIC IOLS IN HIGH REFRACTIVE ERRORS

a. Excellent refractive accuracy even with significant astigmatism.

b. Preservation of corneal sphericity and hence quality of vision.

c. Preservation of accommodation which is lost with refractive lens exchange.

d. Predictable healing.

e. Rapid visual recovery.

f. Stable post-operative refraction.

g. Being an additive procedure and not subtractive like laser vision correction, phakic IOLs are reversible and adjustable.

h. No initial investment on costly equipment like a lasik unit is necessary. Having said that, no patient walks into a clinic asking for phakic IOLs. They usually come for laser vision correction (LVC) and it is the surgeon who motivates for phakic IOLs since LVC may not be suitable. Hence LVC and phakic IOLs are complimentary to each other and access to both is necessary.

i. The technique of implanting a phakic IOL is similar in many ways to phacoemulsification and a good anterior segment surgeon can easily incorporate it is his practice.

DISADVANTAGES OF PHAKIC IOL

a. Though the first Phakic IOL procedure was performed in 1953 and the iris clip phakic IOLs have been in use since 1988 long term data is somewhat sparse.

b. Because of the limited space available to carry out the surgical maneuvers the learning curve is steep and requires significant surgical dexterity.

c. Cost of the imported phakic IOLs is very high. Indian versions of these lenses at lesser price are becoming available.

CHALLENGE IN PHAKIC IOL SURGERY

In conventional cataract surgery the crystalline lens which measures about 5 mm in the anterior posterior diameter is removed and we have about 8 mm space, when the eye ball is filled up, between the corneal endothelium and the posterior capsule to carry out all our surgical maneuvers. In phakic IOLs since the normal crystalline lens is retained there is only 3 mm space between the corneal endothelium and the anterior capsule of the crystalline lens within which all steps have to be carried out without damaging the corneal endothelium, angle of the anterior chamber, iris, pupil and lens. (Fig: 1)

INDICATION FOR PHAKIC IOLS

Any refractive error which is in unsuitable for LVC could be considered for phakic IOLs. There are surgeons who consider LVC to be inappropriate beyond -8 diopters. Our indications are:

a) Myopia beyond -12D

b) Hyperopia beyond +4D

c) When the initial corneal thickness is less than 480 microns.

d) When the residual bed after lasik is likely to be less than 280 microns.

PHAKIC IOL – OPTIONS

There are primarily three sites of fixation

a. AC Angle – BAIKOFF, NUVITA lenses : Have been largely given up because of complications like progressive pupillary distortion, UGH Syndrome and corneal decompensation. At present Alcon is conducting trials with an angle fixated IOL which may become available for clinical usage shortly.(Fig:2)

b. Iris fixated IOLs:- Originally designed by Jan worst and named Lobster claw lenses and subsequently renamed as ARTISAN lens and now marketed as VERISYSE. At present phakic IOLs of this design are also manufactured by some Indian companies.

c. Posterior chamber IOLs:- These are placed in the posterior chamber just in front of the normal crystalline lenses. The common models are STAAR ICL (Implantable Contact Lens) and PRL of which the ICL is more widely used. (Fig:3)

OPTICAL ADVANTAGES OF PHAKIC IOLS

a. The phakic IOLs are placed much closer to the nodal point of the eye. Hence the effective optic zone of the phakic IOL is 1.25 times on the corneal surface. That is, a phakic IOL of 5mm optic size will have an effective optic zone of 6.25 mm on the corneal surface. (Fig:4)

b. We are all familiar with the slight improvement in visual acuity some patients experience after surgical correction of higher grades of myopia. This is primarily because of the minification effect of the concave spectacle lenses being dispensed with. The improvement in visual acuity that patients experience after phakic IOL implantation is even more, again because of the optics of the phakic IOL being close to the nodal point of the eye.

c. Since cornea is untouched quality of vision is better after phakic IOL implants than LVC.

PREREQUISITES FOR PHAKIC IOL

A) Laser Vision Correction (LVC) is simpler and more easily accepted by patients than phakic IOLs. So phakic IOLs are essentially indicated in patients where LVC is not possible or controversial i.e.

1) Beyond – 12 D or +4D.

2) When initial corneal thickness is less than 480 microns.

3. When lasik in that particular eye will leave behind less than 270 microns in the residual bed.
4. Forme Fruste cases of keratoconus where performing LVC may dangerously weaken the cornea. Even phakic IOLs are better avoided where keratoconus is established.

B) Patients beyond the age of 18 years and refractive error stable for at least one year.

C) Endothelial cell count > 2000/sq mm.

D) AC depth (Corneal endothelium to anterior capsule) more than 3mm.

POWER CALCULATION FOR PHAKIC IOLS

There are 3 parameters that are essential for phakic IOL power calculation.

1) Spectacle power at vertex distance of 12mm.
2) AC depth.
3) Horizontal and vertical radii of curvature of cornea.

In case of IOLs horizontal white-to-white diameter measured with a calipers under a microscope and verified with an orbscan is important to get the appropriate sizing of these lenses. Sizing of the posterior chamber phakic IOLs is extremely important for getting the appropriate vault and separation between the back of phakic IOL and the anterior capsule. In iris clip lenses, one size fits all, and sizing is not important. These measures are at present sent to the manufacturer and they calculate the exact power of the phakic IOL and dispense it. (Fig: 5) For iris clip lenses the Vander Heijde formula is used. Software and nomograms are also available for the surgeon to calculate the power and tweak the powers according to their preferences.

PHAKIC IOL – OPTIONS

The two currently available options in India are the VERISYSE (iris clip lenses) and the ICL (posterior chamber lenses) and their characteristics will be briefly discussed here.

VERISYSE – IRIS CLIP LENSES

These lenses are made of PMMA and have an overall diameter of 8.5mm (Fig: 6). In the power range from -3D to -15.5D. They are available in 6mm optic size while between -15.5D to -23.50D and +1D to +12D they are available with 5mm optic size. Toric versions have become available now. The foldable version (Fig: 7) with silicon optics and PMMA haptics which can be introduced through a 3mm incision can also be obtained.

The surgery is done under peribulbar (Risky with the large myopic eyes but more comfortable for the surgeon and patient since the iris needs to be handled) or topical. The one-step that needs is to be mastered while implanting these lenses is the process of enclavation of the iris which should be adequate and significant to avoid displacement of the IOL in the postoperative period. The enclavation can be done with a needle (Fig: 8) which comes with each phakic IOL or with a forceps.

High molecular weight viscoelastics is recommended since they not only provide good space but can also be evacuated completely at the end of surgery

ICL OR IMPLANTABLE CONTACT LENS

They are made of highly biocompatible collagen copolymer with a refractive index of 1.45. They are available in powers from -2D to -20D and +1D to +10D. The toric version which is available with the myopic powers can correct upto 6D of astigmatism. The IOLs are extremely thin with the optic centre measuring in thickness (Fig: 9) about 50 microns and the haptics 500-600 microns. The overall diameter varies between 11.5 to 13mm (4 sizes) and the sizing depends on the white-to-white measurement. (Fig: 10)

The loading of these lenses has to be extremely precise and there are markers (different for the spherical and toric versions (Fig- 11) to indicate and assist in proper placement of these lenses. Surgery is done under topical or peribulbar with the pupil fully dilated and preferably through a 3.2 mm temporal clear corneal or near limbal incision.(Fig:12)

Low molecular weight viscoclastics like HPMC is only recommended both for loading the lenses and during the surgical procedure. High molecular weight viscoelastics can get entrapped between the natural lens and the IOL and could cause an intractable raise in pressure. Accurate marking of the axis on the slit lamp and positioning of these lenses during surgery is extremely important for the toric version of these lenses.(Fig:13)

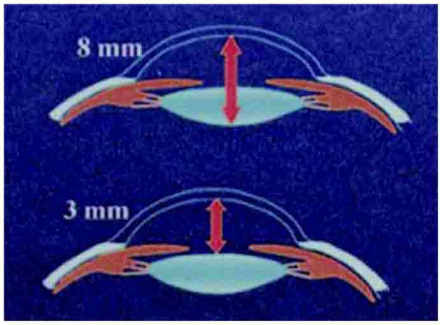

Fig 1: Difference in space available for phakic IOL and phacoemulsification

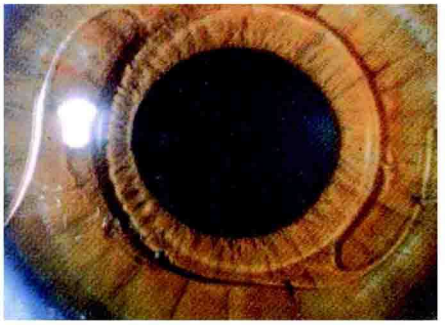

Fig: 2 Angle supported phakic IOL insitu

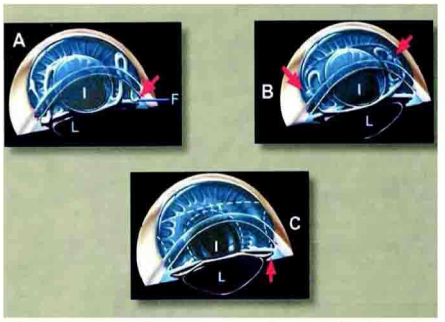

Fig 3: Schematic representation of phakic IOL locations: a. Angle supported. b. Iris clip. c. Posterior chamber shown in dotted lines.

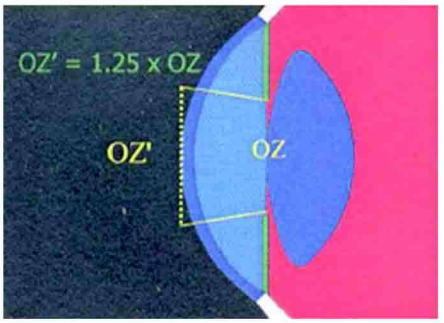

Fig 4: Effective Optical Zone : At the corneal plane is 1.25 x the optic zone of the lens.

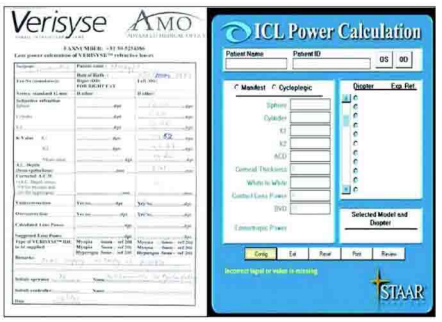

Fig 5: VERISYSE and ICL power calculation charts

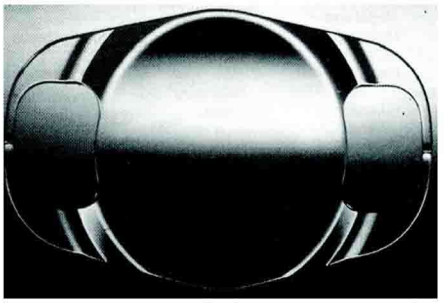

Fig: 6 VERISYSE PHAKIC IOL

Fig 7: VERIFOLD – Foldable Version of VERISYSE IMPLANT

Fig 8: Enclavation needle of VERISYSE IMPLANT

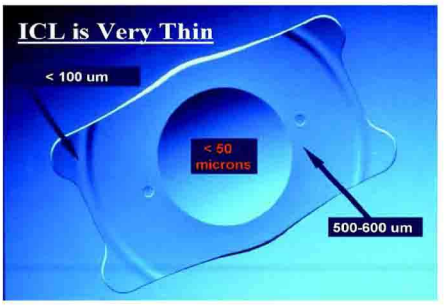

Fig 9 : ICL

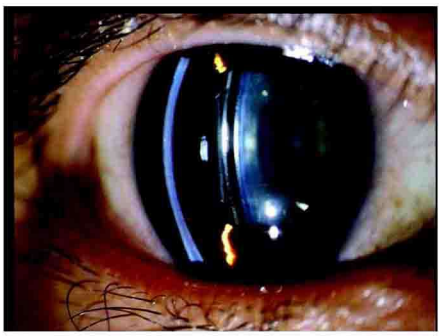

Fig 10: Ideal vaulting of the ICL with about 0.5mm separation from the anterior surface of the crystalline lens.

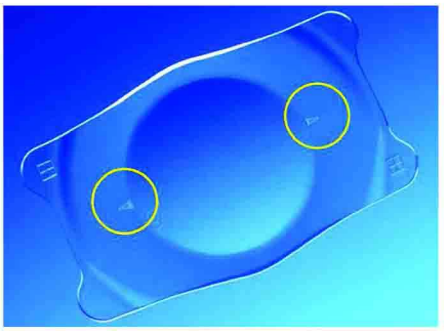

Fig 11: Different marking on toric ICL.

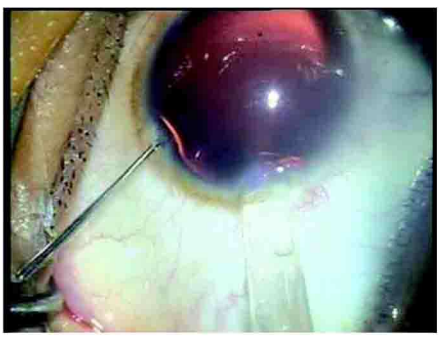

Fig 12: ICL introduction through temporal clear corneal incision.

IRIDOTOMIES

Both for iris clip and posterior chamber phakic IOLs, patent iridotomies is an essential prerequisite and these can be done either 1 week before the surgery with the YAG laser or during surgery with scissors or using the vitrectomy cutter. (Fig: 15)

COMPLICATIONS OF PHAKIC IOLS (Fig: 16, 17, 18)

a. Endothelial cell loss and corneal decompensation.
b. Cataracts.
c. Anterior Uveitis.
d. Secondary Glaucoma,
e. Displacement of the phakic IOL.
f. Decentration of IOL due to improper placement.
g. Ovalisation and distortion of the Pupil.
h. Dysphotopsia.
i. Pigment dispersion and lens deposits.

BIOPTICS

In extremes of refractive error a phakic IOL can be implanted and residual refractive error can be corrected by LVC. If it is done as a planned procedure, a microkeratome flap could be created, phakic IOL implanted and later the flap lifted for laser ablation. This is done to avoid subjecting an eye with a phakic IOL insitu to high pressure and suction during the creation of the flap.

CONCLUSION

Phakic IOLs are an important addition to the armamentarium of a modern day refractive surgeon. Though a good anterior segment surgeon can incorporate this in his or her practice there is a steep learning curve mainly because of the limited confines within which all the surgical maneuvers have to be carried out. With the torric and foldable lenses becoming available, more literature emerging on the long-term follow up of these lenses and improvement in the design of these lenses, the phakic IOLs will be a valuable adjunct in the treatment of higher grades of refractive error.

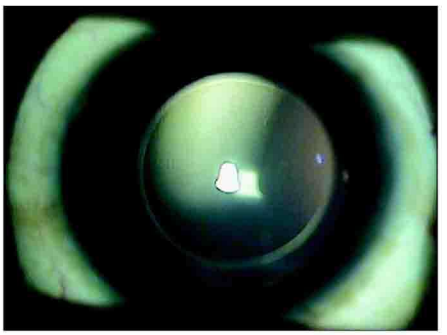

Fig 13: ICL insitu on first post-operative day

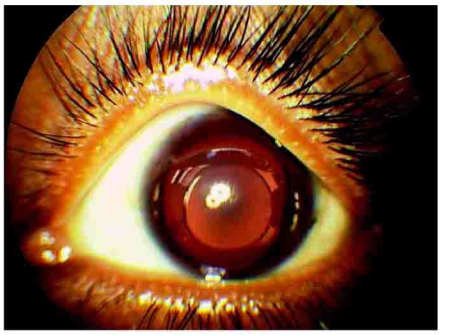

Fig 14: Full papillary dilatation since enclavation in immobile mid peripeheral iris

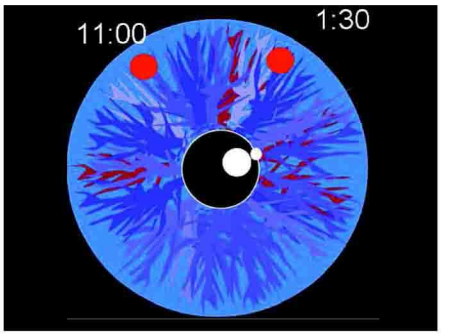

Fig 15: Ideal sites for yag iridotomies prior to phakic IOL implant.

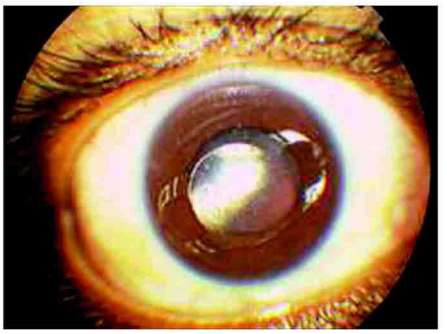

Fig 16: Deposits on the lens due to post op iridocyclitis

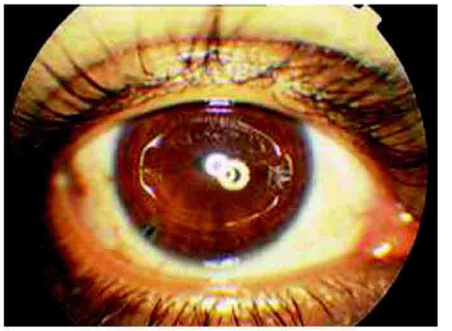

Fig 17: Iris atrophy at site of enclavation

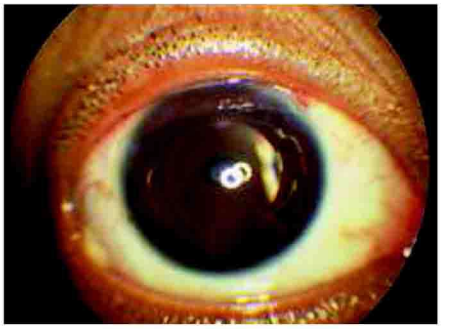

Fig 18: Corneal edema due to secondary glaucoma

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