Phakic IOLs

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Introduction

Artificial lenses implanted in the anterior or posterior chamber of the eye in the presence of the natural crystalline lens to correct refractive errors.
Introduction

- Phakic IOLs: an evolving technique in the field of refractive surgery for the correction of moderate to 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.
Introduction

Lasik is justifiably still the most widely practiced modality of refractive surgery because of:

- High level of comfort
- Quick recovery
- Stable predictable results
- Ability to perform bilateral treatment in one sitting
Introduction

But when it comes to higher grades of refractive error it has the following limitations:

- Significant residual error
- Loss of best spectacle corrected visual acuity
- Risk of iatrogenic keratectasia when excessive ablation done or residual bed is too thin
- Induction of tear film abnormalities
- Induction of higher order aberrations, which leads to poor contrast sensitivity
- Limitation of night vision and diminished quality of vision
Advantages of Phakic IOLS in High Refractive Errors

- Preservation of architecture of cornea
- Predictable refractive results
- Preservation of accommodation
- Predictable healing
- Rapid visual recovery
Advantages of Phakic IOLS in High Refractive Errors

- Stable post-operative refraction
- Reversible and adjustable
- Cheap, no costly equipment like a lasik unit is necessary.
- 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.
Indication for Phakic IOLs

Any refractive error which is unsuitable for LVC could be considered for phakic IOLs

- Myopia beyond -10D
- Hyperopia beyond +4D
- Initial corneal thickness < 480 microns
- Residual bed after LASIK is likely to be < 300 microns
History

- **1889**
  Clear lens extraction for the correction of myopia
  Fukula in Austria/Germany: FUKULA SURGERY
  Abandoned due to complications

- **1950s**
  Correcting myopia by inserting a concave lens into Phakic eye

- **1988**
  Baikoff: anterior chamber angle fixed IOL

- **Mid 1980s**
  Posterior chamber phakic IOLs: Fyodorov

- **1991**
  Artisan - Worst iris claw lens
Phakic IOL - Options

There are primarily three sites of fixation

- **Anterior chamber angle – supported**
  
  e.g. BAIKOFF, NUVITA lenses, CACHET

- **Anterior chamber iris – fixated**
  
  e.g. VERISYSE

- **Posterior chamber IOLs**
  
  e.g. STAAR ICL (Implantable Contact Lens) and PRL (Phakic Refractive Lens) - ICL is more widely used
## General criteria for implanting Phakic IOLs

- **Stable refraction** (less than 0.5 D change for 6 months)
- **Clear crystalline lens**
- **Ametropia not suitable/appropriate** for excimer laser surgery
- **Unsatisfactory vision with/intolerance** of contact lenses or spectacles
- **Anterior chamber depth** greater or equal to 3.2 mm for Verisyse (iris claw lens)* and angle supported PIOLs
  2.8 mm for posterior chamber PIOLs*
- **A minimum endothelial cell density** of*
  - ≥ 3500 cells/mm² at 21 years of age
  - ≥ 2800 cells/mm² at 31 years of age
  - ≥ 2200 cells/mm² at 41 years of age
  - ≥ 2000 cells/mm² at 45 years of age or more
- **No ocular pathology** (corneal disorders, glaucoma, uveitis, maculopathy, etc)

* According to FDA
## Advantages & Disadvantages of Phakic IOLs

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<tr>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
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<tbody>
<tr>
<td>Potential to treat a large range of myopic, hyperopic and astigmatism refractive error.</td>
<td>Potential risk of an intraocular procedure (e.g. endophthalmitis).</td>
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<td>Allows the crystalline lens to retain its function preserving accommodation.</td>
<td>Nonfoldable models require large incision that may result in high postoperative astigmatism.</td>
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<td>Excellent visual and refractive results (induces less coma and spherical aberration than LASIK)</td>
<td>Highly ametropic patients may require additional photorefractive surgery (Bioptics) for fine tuning the refractive outcome.</td>
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<td>Removable and exchangeable</td>
<td>May cause irreversible damage (i.e. endothelial cell loss, cataract formation, glaucomatous optic neuropathy)</td>
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<td>Frequently improves BSCVA in myopic eyes by eliminating minification effect of glasses</td>
<td>Implantation in hyperopic patients can be followed by loss of BSCVA due to loss of magnification effect of glasses.</td>
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<td>Results are predictable and stable</td>
<td>Other complications are common: pupil ovalization, induced astigmatism, chronic uveitis, pupillary block, pigment dispersion.</td>
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AC Angle supported Phakic IOL
Lowered vaulting to 20 degree
Thinned optic edge
Increased distance from endothelium 0.6 mm

New rigid PMMA lens
Total diameter – 5mm
Real optic diameter 4.5mm
Edge decreased by 20%
Other models of angle supported PIOLs

Two rigid PMMA devices:
- ZSAL-4
- Phakic 6

Three foldable hydrophilic acrylic IOLs:
- Vivarte
- I-CARE
- Acrysof Cachet

One foldable “two parts” silicone/PMMA IOL:
- Kelman-duet
Rigid PMMA angle-supported ZSAL-4 lens.

Rigid PMMA angle-supported Phakic 6 lens.
Foldable hydrophilic acrylic angle-supported Vivarte lens.
Foldable hydrophilic acrylic angle-supported I-CARE lens (A and B).

Ultrasound biomicroscopy (UBM) showing the position of the haptic in the anterior chamber angle (C).
Surgical Procedure

- Topical pilocarpine
- Topical or peribulbar anaesthesia
- Incision
- Cohesive viscoelastic
- Lens is introduced, footplate is inserted in the iridocorneal angle, second haptic is then placed, lens is then rotated in place
- Periphery iridectomy done
- Incision is closed
Complications

- Haloes and glare
- Pupillary ovalization
- Endothelial damage
- Elevation of intraocular pressure
- Uveitis
- Cataract
- Retinal detachment
- Rarely – urrets – zavalia syndrome, malignant glaucoma, endophthalmitis
Iris-fixated Phakic IOL
Iris-fixated Phakic IOL

Midperipheral fixation by a claw mechanism

Artisan/Verysise lens. Detail of the mid-peripheral iris stroma enclavated by the haptic claw.
Iris-fixated Verisyse lens in situ

Originally designed by Jan worst and named Lobster claw lenses and subsequently renamed as ARTISAN lenses and now marketed as VERISYSE.
Verisyse - Iris Clip Lenses

- Made up of PMMA and have an overall diameter of 8.5mm
- In the power range -3D to -15.5D - available in 6mm optic size
- -15.5D to -23.50D and +1D to +12D – available in 5mm optic size
- Toric versions are also available now
- Artiflex – are foldable version with silicon optics and PMMA haptics – (introduced through a 3mm incision)
In September 2004, the FDA approved the first phakic IOL.

The Verisyse (AMO/Optotec, USA Inc.) was approved for:

- Myopia ranging from -5 to -20 D
- Astigmatism ≤ 2.5 D
- Adults 21 years of age or older
- With anterior chamber depth (ACD) of 3.2 mm or greater and Shaffer grade II as determined by Gonioscopy.
Artisan/Verysise lens
{FDA-approved models}

(A) 204 (6.0 mm optic) and
(B) 206 (5.0mm optic) for
the correction of myopia.
(A) Foldable iris-fixated Artiflex lens.
(B) Foldable iris-fixated Artiflex lens.
Indications of Iris Claw lens

- Treatment of refractive errors after penetrating keratoplasty
- Treatment of Anisometropic Amblyopia in children
- Secondary implantation for Aphakia correction
- Treatment of refractive errors in patients with keratoconus
- Correction of progressive high myopia in pseudophakic children
- Postoperative anisometropia in unilateral cataract patients with bilateral high myopia
Procedure

- Topical pilocarpine
- Topical / peribulbar anaesthesia
- Incision (corneal, limbal or scleral tunnel incision)
- Cohesive viscoelastics
- IOL insertion
- Enclavation done
- Closure of incision
Complications

- Glare and haloes
- Anterior chamber inflammation/pigment dispersion
- Endothelial cell loss
- Glaucoma
- Iris atrophy or dislocation
- Cataract
- Hyphema, retinal detachment rarely
Posterior Chamber Phakic IOL
Posterior Chamber Phakic IOL

- Placed in the posterior chamber just in front of the normal crystalline lenses.

- Materials:
  - Silicone: PRL
  - Collamer: ICL
Properties desired in the IOL are:

- Allow permeability of nutrients
- Circulation of aqueous humor
- Not cause crystalline lens or zonular trauma
Posterior Chamber Phakic IOL

- Available in powers from -2D to -20D and +1D to +10D.
- The toric version can correct up to 6D of astigmatism.
- Extremely thin with optic centre measuring in thickness about 50 microns and the haptics 500-600 microns.
- Overall diameter varies between 11.5 to 13mm.
- Sizing depends on the white-to-white measurement.
In December 2005, second phakic IOL was approved by FDA.

The Visian ICL (Implantable Collamer Lens)

- Approved for correction of –
  - Myopia ranging from -3 to -20 D
  - Astigmatism <\= 2.5D
  - Adults 21-45 years of age with ACD of 3.0 mm or greater and Shaffer grade II as determined by gonioscopy.
Thank you