

Phakic intraocular lenses in treatment of different errors of refraction

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Contents

List of figures	
List of tables	
List of abbreviations	
Introduction and aim of work.....	1
Chapter 1.....	4
Types of Phakic IOLs	
Chapter 2.....	33
Different methods of implantations of Phakic IOLs and preoperative patient selection	
Chapter 3.....	78
Calculation of Phakic Intraocular Lens Power	
Chapter 4.....	86
Complications of phakic I.O.L.s	
Chapter 5.....	109
Special issues	
References	120

List of figures

1. Figure 1: Posterior chamber sulcus supported implantable contact lens.
2. Figure 2: Visian ICL in situ.
3. Figure 3: Toric-ICL.
4. Figure 4: Posterior chamber phakic refractive lens for myopia.
5. Figure 5: PRL IOL Tech.
6. Figure 6: Second and third generation models of the precrystalline lens.
7. Figure 7: Angle-supported Baikoff ZB5M and the NuVita MA20.
8. Figure 8: Nuvita IOL.
9. Figure 9: Rigid PMMA Angle-supported ZSAL-4 Lens.
10. Figure 10: ZSAL-4/Plus phakic lens 6 months after surgery.
11. Figure 11: Phakic 6H2 lens.
12. Figure 12: JMJ lens.
13. Figure 13: LN-2000 lens.
14. Figure 14 : The GBR/Vivarte foldable angle-fixated phakic IOL in situ.
15. Figure 15 :Foldable hydrophilic acrylic angle-supported Vivarte lens.
16. Figure 16: Foldable hydrophilic acrylic angle-supported I - CARE lens.
17. Figure 17: Alcon Acrysof anterior chamber lens before and after implantation.
18. Figure 18: cachet lens design.
19. Figure 19: cachet lens implanted.

20. Figure 20: Kelman Duet angle-supported lens.
21. Figure 21: ThinOptx angle-supported anterior chamber phakic IOL.
22. Figure 22: Ultrachoice 1.0 thin lens is not a Fresnel lens.
23. Figure 23 : The Vision Membrane.
24. Figure 24: Artisan Lens: 5-mm & 6-mm optic Artisan lens.
25. Figure 25: A rigid Artisan PIOL.
26. Figure 26: Foldable iris-fixated Artiflex lens.
27. Figure 27: Trefoil induction after Artisan PIOL implantation.
28. Figure 28: Endothelial safety distance.
29. Figure 29: Endothelial cell photography.
30. Figure 30: Anterior segment optical coherence tomography.
31. Figure 31: Pupil diameter measurement using infrared technologies.
32. Figure 32: Forward thrust of crystalline lens with ageing.
33. Figure 33: Clinical aspect of pigment dispersion behind an ARTISIAN implant.
34. Figure 34 : Different anterior chamber safety distances measured from the angle recess to recess baseline.
35. Figure 35: Kelman–McPherson forceps.
36. Figure 36: Leister-type hook.
37. Figure 37: Introduction of NuVita lens.
38. Figure 38: Implantation of phakic 6 H lens.
39. Figure 39: Implantation technique for Kelman Duet implant system.

40. Figure 40: Introduction of the GBR lens in a human eye.
41. Figure 41: Rolling and inserting an Ultrachoice 1.0 lens.
42. Figure 42: Long-angled Forceps .
43. Figure 43: Sinsky hook.
44. Figure 44: Implantation of Artisan implants.
45. Figure 45: Implantation of Artiflex by special forceps.
46. Figure 46: Inserting the ICL into the cartridge.
47. Figure 47: The Vukich ICL Manipulator.
48. Figure 48: The Deitz Tucker.
49. Figure 49: The Pallikaris Olive Tip Positioner.
50. Figure 50: Implantation of the ICL.
51. Figure 51: The PRL implantation forceps.
52. Figure 52: Implantation of PRL.
53. Figure 53: The Phakic 6 H2 Calculation Worksheet.
54. Figure 54: Inflammatory reaction after PC PIOL implantation.
55. Figure 55: Pupil ovalization following AC phakic IOL implantation.
Moderate ovalization.
56. Figure 56: Pupil ovalization following AC phakic IOL implantation.
Severe “cat pupil”-like ovalization.
57. Figure 57: First generation iris-claw lens.
58. Figure 58: Examination of the patient’s cornea.
59. Figure 59: Iris pigment defects at the site of enclavation may be one source for dispersed iris pigment.

60. Figure 60: The angle shows severe pigmentation of the angle of the anterior chamber.
61. Figure 61: Inflammatory reaction after iris-claw lens implantation.
62. Figure 62: After iris-claw AC phakic IOL implantation (Artisan), diagnostic mydriasis is possible.
63. Figure 63: Artisan lens dislocation after blunt trauma.
64. Figure 64: Induction of corneal astigmatism due to a 6-mm superior limbal incision.
65. Figure 65: Nuclear cataract in an eye with an AC phakic IOL.
66. Figure 66: Cataract formation after implantation of PC phakic IOL.
Distinct anterior subcapsular cataract in an eye with PC phakic IOL.
67. Figure 67-1. The broad hash marks of the fixation ring/gauge are centered.
- Figure 67-2. The single footplate diamond blade is inserted perpendicular to the corneal surface.
- Figure 67-3. The incision is completed 22.5 degrees to the opposite side.
- Figure 67-4. In this left eye, the steep meridian is at the 120-degree axis and has been delineated by opposing limbal marks.
- Figure 67-5. The incision is begun 20 degrees.
- Figure 67-6. The incision is completed.
- Figure 67-7. Total arc length equals 40 degrees.
- Figure 67-8. The starting point of the opposing incision is determined.
- Figure 67-9. The opposing incision is begun.

Figure 67-10. The incision is completed.

Figure 67-11 The temporal single-plane clear corneal incision is placed independent of the LRIs.

Figure 67-12 In this case, the steep meridian is at 90 degrees.

Figure 67-13 The nomogram calls for arcuate incisions of between 45 and 50 degrees.

Figure 67-14 The blade is inserted.

Figure 67-15 The incision is completed an equal distance past the centering mark.

Figure 67-16 The blade is held above the starting point of the opposite incision.

Figure 67-17 The incision is completed.

68. Figure 68: Bioptics is the combination of an intraocular lens procedure and a corneal refractive procedure.

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List of Tables

1. Table 1: Safety guidelines and incision size of different types of PIOLs according to manufacturers' instructions.
2. Table 2: Van der Heijde's Nomogram.
3. Table 3: PRL Power Calculations.

List of Abbreviations

AC: Anterior Chamber.

ACD: Anterior Chamber Depth.

AC PIOL : Anterior chamber phakic intraocular lens.

ATPIOLs: Artisan toric phakic intraocular lenses.

BCVA: Best Corrected Visual Acuity.

CNV: Choroidal Neovascularization.

DSAEK: Descemet's Stripping Automated Endothelial Keratoplasty.

ECC: Endothelial Cell Count.

ECCE: Extracapsular Cataract Extraction.

ELP: Expected Lens Position.

EPI-LASIK: Epithelial Laser In-Situ Keratomileusis.

FDA: Food and Drug Association.

ICCE: Intracapsular Cataract Extraction.

ICGA: indocyanine green angiography.

ICL: Implantable Contact Lens.

IOL: Intraocular Lens.

IOP: Intraocular Pressure.

ISCRS: Intrastromal Corneal Ring Segments.

LASEK: laser assisted sub-epithelium keratomileusis.

LASIK: laser in situ keratomileusis.

LRI: Limbal relaxing incisions.

OVD: Ophthalmic Viscosurgical Device.

Nd:YAG: Neodymium Yttrium Aluminum Garnet.

PC: Posterior Chamber.

PC PIOL: Posterior chamber phakic intraocular lens.

PCO: Posterior Capsule Opacification.

PDS: Pigment dispersion syndrome.

PI: Peripheral Iridectomy.

PIOL: Phakic Intraocular Lens.

PMMA: Polymethyle Methacrylate.

PRK: photorefractive keratectomy.

PRL: Phakic Refractive Lens.

RD: Retinal Detachment.

RK: Radial keratotomy.

RLE: Refractive Lens Exchange.

SE: Spherical Equivalent.

TICL: Toric Implantable Contact Lens.

UCVA: Uncorrected Visual Acuity.

VA: Visual Acuity.

Introduction

Emmetropia is the optical condition in which parallel rays of light from a distant object are brought to focus on the retina by an eye with relaxed accommodation. In myopia the optical power of the eye is high for the axial length and in hyperopia the optical power is low for the axial length. Spectacles used in ametropic correction result in altering the size of the retinal image of a distant object, particularly in higher ametropia. Contact lenses are an alternative that reduces image magnification and minification.¹

Nowadays, the quality of corneal refractive procedures is improving. However, lens-related procedures are getting more popular (in high myopes). They include phakic intraocular lenses and a procedure like clear lens extraction with lens implantation. Clear lens extraction is preferred if the patient is presbyope or has any degree of cataract as it causes loss of accommodation. That is why the idea of phakic intra ocular lenses (PIOL) evolved.²

Different PIOL designs exist, including anterior chamber PIOL (angle supported), iris fixated PIOL and sulcus supported (pre-crystalline) PIOL.³

The history of the PIOL to correct refractive error began in Europe in the 1950s with Strampelli, Dannheim, and Barraquer each separately attempting to design a PIOL that would be well tolerated in the eye.³

In 1977, Worst designed and used a pure iris support lens. This iris claw lens was fixed to the anterior surface of the iris. In

1986, Fechner used a negative-power iris claw lens for treating phakic myopes. Soon after, Singh used it in phakic hyperopes.⁴

In 1996, Davidorf, Zaldivar, and Oscherow presented their results with the STAAR Collamer plate haptic posterior chamber phakic IOL in phakic hyperopes.

At present, there are many presentations of small series of cases with a short long-up, with both iris claw lenses and posterior chamber refractive lenses.⁵

PIOLs offer today an excellent alternative for the correction of high and moderate myopia, hyperopia, and astigmatism. Emerging indications, still under investigation, include presbyopia and pediatric anisometropic amblyopia.⁶

The recent evolution of phakic intraocular lenses (PIOLs) has made this refractive surgical technique safer, very predictable, and effective. Due to these reasons, PIOLs have been expanding the horizon of their indications.⁶

The main limitation for the further development of PIOLs was the lack of adequate diagnostic imaging techniques to perform a precise preoperative study of the anterior segment anatomy.

Emerging diagnostic technologies based on the use of very high frequency (100 MHz) ultrasound and optical coherence tomography seem to have the most important role in the future development of PIOLs.⁶

Aim of the work

To study different types, indications, methods of implantation , methods of calculation of power and complications of phakic intra-ocular lenses.

Types of phakic IOLs

I) Posterior Chamber Lenses:

- 1-Implantable Contact Lens (ICL).**
- 2-The Toric Implantable Contact Lens.**
- 3-Phakic Refractive Lens (PRL).**
- 4-Precrystalline Lens.**

II) Angle Supported Anterior Chamber Phakic IOLs:

I-Rigid PMMA devices:

1-Baïkoff's Anterior Chamber Phakic Intraocular Lenses:

A)ZB and ZB5 M (Domilens- France).

B)NuVita MA20.

2-ZSAL-4 and ZSAL-4/PLUS PHAKIC REFRACTIVE IOLS.

3-Phakic 6H Lens.

4-JMJ Lens.

5-LN.

II -Foldable hydrophilic acrylic IOLs:

1-GBR/VIVARTE ANGLE-SUPPORTED FOLDABLE PHAKIC IOL.

2- I-Care.

3- AcrySof Cachet.

III -Foldable "Two Parts" Silicone/PMMA IOL:

Kelman Duet Lens.

IV -New Types of AC PIOL:

1-ThinOptx Ultrathin Intraocular Lenses.**2-The Vision Membrane.****III) IRIS-FIXED PHAKIC INTRAOCULAR LENS:****1- Verisyse (AMO) , Artisan (Ophtec).****2-The Artisan Toric Phakic Intraocular Lens (ATPIOL).****3- Veriflex (AMO) ,Artiflex (Ophtec).**

Currently, there are three main types of phakic IOLs in clinical use: AC angle-fixated IOLs, PC IOLs, and iris-supported IOLs.⁷

I) Posterior Chamber Lenses:

These lenses are implanted in the posterior chamber of the eye, that is, between the iris and the crystalline lens. The first phakic posterior chamber lens was the Mushroom lens designed by Fyodorov and Zuev in 1985.² However, in practice this lens was not only implanted in the posterior chamber since its butterfly shaped haptics were placed on the crystalline lens in the posterior chamber, while the optic extended beyond this through the pupil. The Mushroom lens subsequently underwent many design changes to become a posterior chamber lens exclusively, and the first prototype of most posterior chamber phakic lenses. Since they are implanted in the posterior chamber, all these lenses can produce acute glaucoma due to pupillary block, such that two Yag laser iridotomies or a wide surgical iridectomy need to be undertaken before the implant procedure.⁸

In the mid-1980s, the implantation of posterior chamber IOLs in phakic eyes was reported by Fyodorov. In 1987, the Moscow Research Institute of Eye Microsurgery reported favorably on posterior chamber IOL implantation in phakic eyes to correct high myopia. The original lens design