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Objectives

- Know basics of imaging and measurement techniques
- Understand the pros and cons of common intra-ocular lens (IOL) selections
- Discuss IOL repositioning, exchange, and secondary IOL implants

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Why Do Cataract Surgery?

The primary indication for surgery is

- visual function that:
 1. no longer meets the patient's needs
 2. cataract surgery provides a reasonable likelihood of improved vision.

Other indications for a cataract removal include the following:

- clinically significant anisometropia in the presence of a cataract
- lens opacity interferes with optimal diagnosis or management of posterior segment conditions
- lens causes inflammation or secondary glaucoma
- lens induces or risks angle closure

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Before You Begin

- What is the patient bringing to the table?
- Do you have sufficient information on the patient?
- What is the best “game plan” for that type of patient?
- Know your anatomy as a reference point from which to proof your work



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Basics: Think about it

What's missing from this cataract workup?

- Patient history & assessment of visual function
- Visual acuity with current correction
- Measurement of best-corrected distance visual acuity
- Glare testing when indicated
- Assessment of pupillary function
- Examination of ocular alignment and motility
- Measurement of intraocular pressure (IOP)
- External examination
- Slit-lamp exam

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Complete Workup

- Patient history, assessment of functional status, pertinent medical conditions, medications currently used, and other risk factors that can affect the surgical plan or outcome of surgery (e.g., immunosuppressive conditions, use of systemic alpha-1 antagonists, diabetes)
- Visual acuity with or without current correction (the power of the present correction recorded) at distance and, when appropriate, at near
- Measurement of best-corrected distance visual acuity
- Assessment of the degree of anisometropia after refraction
- Glare testing when indicated
- Assessment of pupillary function
- Examination of ocular alignment and motility
- Measurement of intraocular pressure (IOP)
- External examination
- Slit-lamp exam
- Assessment of relevant aspects of the patient's mental and physical status (i.e., cooperation and ability to lie flat)
- Assessment of any barriers to communication (language or hearing impairment)
- Biometry

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Complete Workup: Biometry

- Minimum requirements to achieve targeted post-operative outcome
 1. Axial length
 2. Central corneal power
- Combine these with:
 - Appropriate power calculation formula
 - Appropriate IOL selection

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Axial Length Measurement two types

Ultrasound

- Applanation
 - Prone to compression error – particularly in shorter eyes
 - 1 mm = 1.75 to 3.75 D
 - Must adjust for silicone
- Immersion
 - Minimize compression error

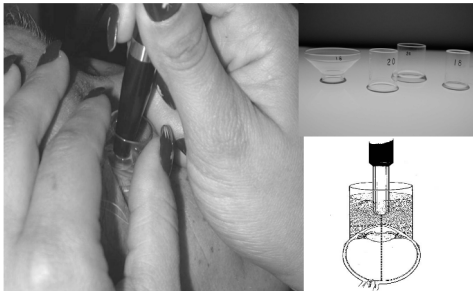
Optical Coherence Biometry (OCB)

- More precise
- Simultaneous measurement of other components
- Requires:
 - patient fixation
 - clear (enough) media

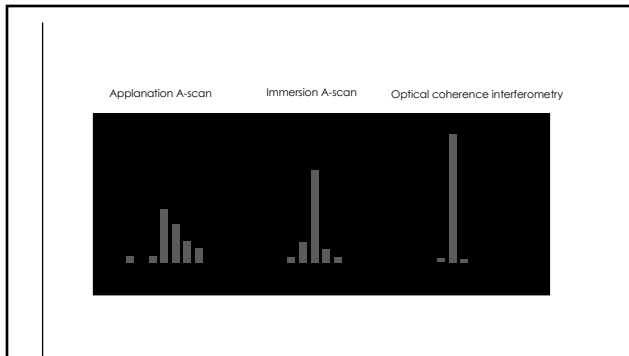


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Immersion Method



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**Where
OCB
exceeds
Ultrasound**

- In the presence of posterior chamber silicone
- In the extreme myopic, staphylomatous eye
- In the extreme short, nanophthalmic eye
- In pseudophakic with various types of IOL's with differing designs and properties

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Limitations of Optical Coherence Biometry

Limited measurement of axial length in the case of:

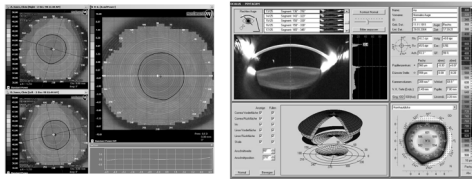
- Corneal scars
- Dense cataracts, especially posterior subcapsular cataracts
- Vitreous hemorrhage
- Any significant media opacity

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Biometry - Keratometry

- Manual keratometry
- Auto keratometry (Autorefractor, IOL Master)
- Corneal topography – anterior surface curvature
 - Placido disc (ie Humphrey Atlas, Medmont)
- Corneal tomography – anterior and posterior, 3D analysis/reconstruction
 - horizontal slit scanning, rotational Scheimpflug imaging, arc scanning with very high-frequency ultrasound, and optical coherence
 - Orbscan (slit scanning), Pentacam (Scheimpflug camera)

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Topography
(Medmont)

Tomography
(Pentacam)

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Additional Workup

Assessment of the corneal contour using topography or tomography

- Both determine whether irregularities in corneal power and shape are contributing to visual impairment
- Both assist in assessment of regular and irregular astigmatism

Tomography

- Scheimpflug devices can evaluate posterior corneal astigmatism to aid in toric IOL selection or astigmatism management.

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WHEN DO YOU CONSIDER REPEAT BIOMETRY?

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Biometry Proof Sheet #1

Measurement	Criteria
Axial	Correct Measurement Model (phakic, aphakic, pseudo...) At least 5 measurements within 0.5 mm OD/OS Axial within .33 mm AI consistent with oldest or pre cataract RX Immersion: Good, perpendicular echospikes OCB: Good waveform (Primary maxima), Double peaks
Keratometry	Ocular surface requires artificial tears? K1 and K2 readings within .25D in each meridian Keratometry astigmatism and refractive cyl axis conform? Astigmatism for each eye < 3.50 D Average K power for both eyes within 1.50 D Average K power < 48.00 D or > 48.00 D
ACD Measurement	Aphakic and pseudophakic: do not measure OCB: 5 consistent measurements ACD > 4.2 mm or < 4.2 mm
White to White	3 measurements within 0.2mm OD & OS within 0.3mm patient fixating centrally

Source: doctorhill.com

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Biometry Proof Sheet #2

Exception	Additional Task
Axial Length < 22.00 mm or > 30.00 mm	Immersion A scan/ bring to MD attention
Difference in Axial length OD/OS >0.33 mm	Justify, remeasure, bring to MD attention
Astigmatism >3.50 D	Corneal Topography
Average K's : > 1.5 D between eyes	Justify, remeasure, bring to MD attention
Average K power >48.00 D or <40.00 D	Justify, remeasure, bring to MD attention
ACD < 2.2 mm or > 4.2 mm	Justify, remeasure, bring to MD attention
White to White < 10.2 or >12.9	Remeasure, bring to MD attention

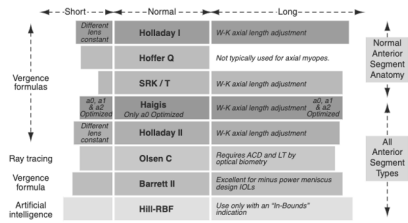
Source: doctorhill.com

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Repeat biometry

- Previous keratorefractive surgery (K's); Ask for prior records, glasses, or MRx
- Axial length or K's don't correlate with refractive error and or topography. Be sure to use the oldest refractive data.
 - Myopes: AL > 24.0 mm
 - Hyperopes: AL < 24.0 mm.
 - Exceptions to this rule involve steep, or flat corneas
- Possible staphyloma or variable AL measurements
- There is a difference in IOL or K power between eyes of > 1 D

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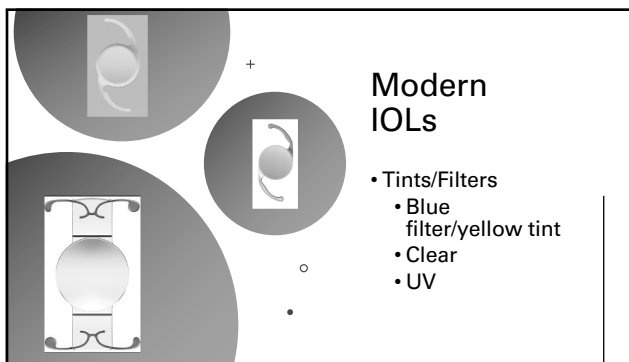
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IOL Power Calculated for In-the-Bag Placement	Power Adjustment for Sulcus Placement
+28.50 D to +30.00 D	Subtract 1.50 D
+17.50 D to +28.00 D	Subtract 1.00 D
+9.50 D to +17.00 D	Subtract 0.50 D
+5.00 D to +9.00 D	No change

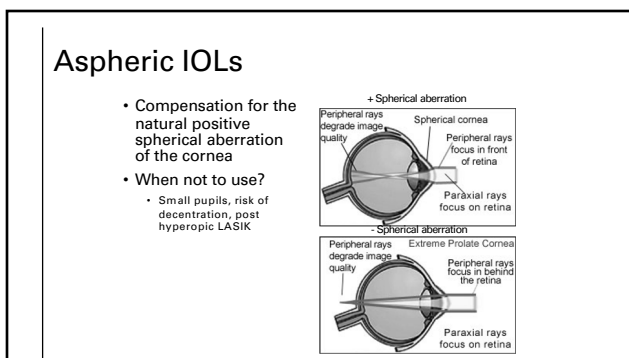
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Other IOL Features

- Haptic material and vault- single piece, PMMA, prolene
- Optic diameter
- Total diameter
- Edge design – rounded, square, frosted
- Inflammatory Adherence
- Hydrophobic / Hydrophilic
- PCO formation
- Suitability for sulcus
- Suitability for retinal procedures / silicone oil
- Resistance to capsular contraction
- Dysphotopsias
- Reflectivity in eye
- Insertion ease, control

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Refractive Target - Monofocals

Emmetropia
(Distance)

Intermediate

Near

Monovision

Mini-monovision

Other rare goals
(usually for
anisometropia):

- High myopia
- Hyperopia

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“CAN I SEE BOTH FAR AND NEAR, LIKE I DID WHEN I WAS 20?”

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Options for depth of focus and presbyopia

Monovision

Mini-monovision

Accommodating IOL

Spherical IOL

Extended Depth of Focus IOL (EDOF, Symfony)

Multifocal IOL

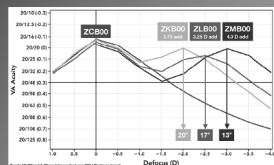
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Refractive Target – “Premium” Lenses

- Bifocal Multifocal IOL
 - Distance + a specific near point where things are clearest with a little bit of a range
- Trifocal IOL
 - “I ask my patients to choose between two sentences” (-Uday Devgan)
 1. I want the very best quality of vision, the best night vision, the best contrast, and I will wear reading glasses
 2. I don't want to wear reading glasses and, to achieve that, I'll happily sacrifice some quality of vision, especially at night when I'll see some glare and halos.
- Diffractive Extended Depth of Focus IOL
 - “function like a low-add bifocal diffractive IOL with reasonable intermediate and far vision, but not quite enough near vision without spectacles” (-Uday Devgan)

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Multifocal IOLs

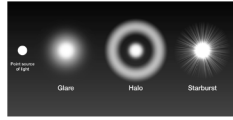


- Newer Designs
 - Trifocal MF IOLs
 - Toric MF IOLs
 - Low add MF IOLs (reduce halos)

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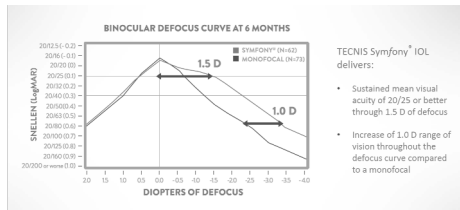
Multifocal IOLs

- Original bifocal IOL – center near, outer distance since pupil constrict with near reflex
- Difficulties: contrast sensitivity, “vaseline vision”, glare, halos, “chair time”, need to hit emmetropia (minimal cyl)

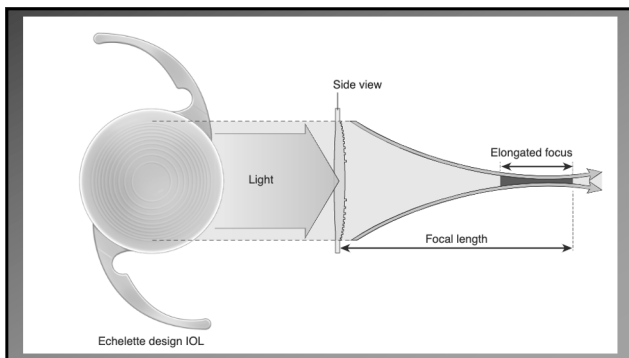


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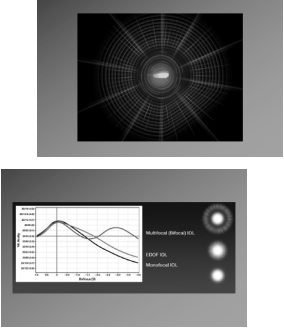
Extended Depth of Focus IOL



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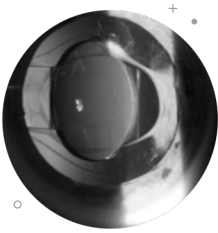
Extended Depth of Focus IOL

- Benefits
 - Improved chromatic aberration
 - Improved contrast sensitivity
 - Tolerant to decentration
- Disadvantages
 - Distance/intermediate dominant, still need readers
 - Starbursts/spiderweb

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Accommodative IOLs

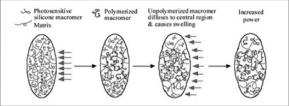
- Crystalens
 - Avoids optical problems of multifocals
 - Does it work? How does it work?
 - Z-syndrome, refractive stability
- Need to go in an intact capsular bag



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LIGHT ADJUSTABLE LENS (RXSIGHT)

FDA Approved November 2017



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LI-IOL

- Made of a unique material that reacts to UV light
- Delivered by the Light Delivery Device 17-21 days after surgery
- Must wear special eyeglasses for UV protection from the time of the cataract surgery to the end of the light treatments to protect the new lens from UV light in the environment.

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"CAN YOU CORRECT MY ASTIGMATISM?"

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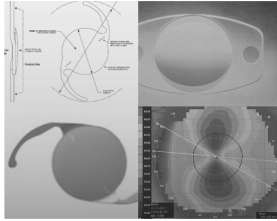
Refractive Target - Astigmatism

A corneal relaxing incision can correct small amounts of astigmatism

For 1.0 diopter (D) or more of preoperative corneal astigmatism, toric IOL implantation should be considered.

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Toric IOLs



- Most previously discussed models available as toric
- Corrects regular corneal astigmatism
 - Pre-op refractive cylinder is not a reliable predictor of corneal astigmatism
 - Anterior corneal astigmatism tends to drift toward against-the-rule with increasing age.
 - IOL Rotational stability is important
- Intraoperative wavefront aberrometry may assist in accurate IOL selection

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"I DON'T HAVE A CATARACT, BUT MY CORNEA IS TOO THIN FOR LASIK. CAN I HAVE A CONTACT LENS PUT INSIDE MY EYE?"

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Phakic IOLs

- Adjustable, reversible
- High myopia
- High hyperopia
- Toric models
- Location
 - Sulcus
 - Iris clip (AC)

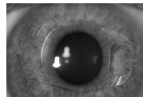
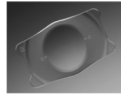
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“CAN A PHAKIC IOL CAUSE DAMAGE TO MY EYE OVER TIME?”

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Phakic IOLs and their possible complications

- Posterior chamber – decentration, pupillary block glaucoma, cataract
- Iris clip – iritis, endothelial cell loss, decentration
- Anterior chamber – ovalization of pupil, iritis



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“MY FRIEND HAD CATARACT SURGERY AND HAD 2 LENSES PUT IN HER EYE. CAN YOU TELL ME WHY?”

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Piggyback IOLs

- One IOL in bag, another in sulcus
- Indications:
 - Primary: no IOL power high enough
 - Secondary: correction of residual refractive error
- Complications: interlenticular opacification (with acrylic IOLs both in bag), pigment dispersion

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"I HATE THIS LENS, CAN WE SWITCH IT OUT?"

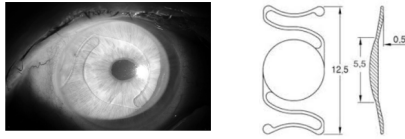
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IOL Repositioning / IOL removal

- Earlier re-operation = more likely repositioned vs removed
- Dysphotopsia symptoms are common in the early postoperative period
- Approximately 3% of patients report symptoms at 1 year postoperatively.
- Repositioning of the optic anterior to the capsulorrhexis by reverse optic capture through the capsulorrhexis or sulcus fixation of an appropriate PCIOL is successful.

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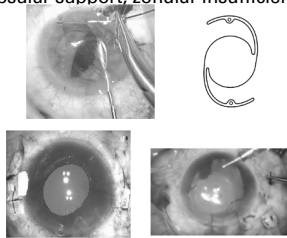
ACIOLs



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Iris or Scleral fixated IOLs

- Indication: Lack of capsular support, zonular insufficiency, secondary IOL



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