Update on Accommodative IOL’s

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Future Challenges for the Cataract Surgeon
- It’s More Than Tough Cases -

- Patient Expectations

- Preventing Infection and Inflammation

- Modulating lens epithelial cells

- Socioeconomic Issues
I O L

- Familiarity = Security

- Usually used to 1 IOL
  - No customization

- IOL power alone is no customization
Patients’ New Expectations

Refractive Cataract Surgery

“Hype” associated with laser vision correction

Patients desire “Superman” vision
Achieving the Desired Optical Results

The Six “A”s

- Astigmatism Control
- Aspheric Optics
- Accurate Biometry
- Appropriate Formulas
- Adjusting the Outcome
- Accommodation
Presbyopia: Final Frontier?

- Sclera
- Cornea
  - Presbyopic LASIK
  - Corneal Inlays
- Lens
  - Multifocal IOL
    - Phakic / pseudophakic
  - Accommodative IOL
Presbyopic Surgery – Issues to Consider

Measuring accommodation

True versus Pseudo-Accommodation

Reading ease, speed

Accommodative reserve

Quality of vision - HOAs
True vs Pseudo-accommodation

**Pseudo-accommodation**
- First devices available
- IOLs
  - Refractive – ReZoom
  - Diffractive – ReSTOR

  Variable loss of CSF; may have optical side effects

**True Accommodation**
- Transient and rapidly reversible change in optical power of the eye
- Generally requires IOL change of shape or position

Not associated with loss of CSF
Present IOL - FDA

- Monofocal

- Pseudoaccommodative
  - Multifocal
    - ReSTOR
    - ReZoom

- Accommodative
  - Crystalens
Present IOL

- Monofocal
  - Years of experience
  - Excellent visual acuity
  - Best contrast sensitivity
  - Need for some glasses
  - Astigmatism control available
  - Monovision
Present IOL

- **Multifocals** *(ReStor / ReZoom)*
  - Good for some…
  - Few years experience
  - Excellent visual acuity
  - Decreased contrast sensitivity
  - Need for some glasses
  - Astigmatism control available in future
  - Cortical adaptation?
Present IOL

- **Accommodative**
  - Crystalens

- Excellent quality of vision
- Minimal contrast loss
- Very poor accommodation
  - 1-1.5D
- PCO
- Future ???
  - 26% spectacle free
Future accommodating IOL’s

- Based on accommodation theories
  - Exact method controversial

- Helmholtz’s theory

  Ciliary M. contraction  $\rightarrow$  Decreased zonular tension

  Thicker lens  $\leftarrow$  Bag more lax

  More PLUS power
Accommodative IOLs

- Future of refractive surgery
- FDA approved has limited accommodation
- Small incision IOL
- Truly accommodation will be available when:
  - Right IOL concept / design
  - Maintained long term flexibility of capsule
Models

- Lens “filling”
  - Deformable IOL

- Single optic

- Dual optic
Single optic IOL

- Hinged haptics
- Forward movement > effective power of IOL
- Poor accommodation
  - Need 1.5 mm axial move to achieve 2 D of accommodation
Dual optic IOL

- **Positive lens anterior / negative lens posterior**
- Lenses connected with spring like pieces
- Accommodation through CB contraction induced separation of lenses
- Large area required

*Figure 5. This concept for an accommodating IOL system uses dual optics in a truly telescopic design. During rest (left), the optics are close together, and the “springs” maintain potential energy. With accommodation (right), the springs exhibit kinetic energy, and the optics separate, thus increasing the optical power of the lens system.*
Dual optic IOL

- Advantage over single optic
  - More accommodation
  - Less IOL movement required
  - No glare or contrast issues

- Inter-lenticular opacities?

Accommodation
Single optic:

Crystalens

- Only FDA approved
Single optic:

1 CU (Human Optics)

- 4 flexible haptics for axial movement
Single optic:

**BioConfold 43 E (Morcher)**

- Ring haptics for optic movement
Single optic:
Opal (B&L)

Currently in clinical trials
Single optic:

**Tetraflex (Lenstec)**

- Depends on axial move
Single optic:

Fluid vision (Power Vision)

- Dynamic Optic with Fixed Haptics
- Up to 10 D accommodation
- Accommodation driven hydraulic lens shape change
Single optic:

**Flex optic (AMO)**

- Conforms the capsular bag
- Changes optic curvature
- No axial movement
“Single optic”:

**NuLens (Nulens)**

- Flexible polymer between 2 rigid plate, one with an opening
- Polymer bulges = more positive lens
- 30 - 50 D of accommodation
Dual optic: 

Synchrony (Visiogen)

- Dual optic (+ anterior & - posterior) / single piece
- “Spring like haptics”
- Up to 2.5 acc.
Bag filling:

Smart IOL (Medennium)

- Bag filling
- Ciliary muscle resumes lens shape change control - Pliable for accommodation
- Thin rod that > to desired shape with body temperature
Bag filling:
Accommodating Injectable Lens (AMO)
Liquilens (Vision Solutions)

- 2 fluids with different refractive indexes in center of lens in single optic
- Looking down mixes fluids creating a more positive lens
Magnetic IOL

- Magnetic capsular tension ring
- Opposing magnets under rectus muscles
Light adjustable IOL (Calhorn Vision)

- Residual refractive error post op laser “adjustment”

- Multifocal post op “adjustment” possible ??
Challenge: Accommodating IOLs and the Lens Capsule Bag

- PCO = PITA
- Perfect Sx and CCC required
- Fibrometaplastic postoperative changes of the LECs often lead to capsule fibrosis
- Dynamic IOLs require that the lens capsule remains flexible

Different eyes = different capsules

PITA = pain in the ass
Conclusions : Future

Acc. IOL’s should:
- Be the hope for the future
- Have a physiologic concept
- Have few optical side effect

Hope for:
- Aspheric optics
- Adjustability
- Toricity
- Control of lens epithelial cells
Conclusions: Now

- Glasses
- Monovision
- Crystalens
- Pseudo-accommodative IOL’s

- Keep it under 40
Conclusions: Now

- Start to familiarize with astigmatism control
- Familiarize with refractive lens surgery concept
  - *Not* to be confused with RLE
- Keep it under 40
Prediction: Near future

- Cataract prevention surgery (RLE) more popular
- Improved pseudo-accommodative IOL’s
- “Large” (3.0-3.5 mm) incisions WILL be around
- Truly full accommodation IOL in 5 years

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