REFRACTIVE LENS SURGERY: WHEN AND WHY?

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Refractive Lens Surgery

- Abbé Des Monceaux: The first person to propose clear-lens surgery in high myopia in 1776
- Vincenz Fukala (1847–1911): pioneer in systematically extracting the clear crystalline lens in young patients with high myopia (1890)

Clear lens extraction (CLE), also called refractive lens exchange (RLE), is the removal of a non-cataractous natural lens of the eye with or without intraocular lens placement as a refractive procedure.
Refractive Lens Surgery

Clear lens extraction for the correction of high refractive error
W. Andrew Lyle, M.D., George J.C. Jin, M.D.

EDITORIAL ARTICLE: S. OBSTBAUM

Clear lens extraction for high myopia and high hyperopia

We are entering the era of refractive surgery. What began as a concept for reducing myopia has burgeoned into techniques and technology that address all aspects of refractive conditions. Despite awaiting the results of ongoing studies to determine if they can predictably reduce high refractive errors. The data are not yet available and long-term consequences of treating these eyes are unknown.

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Refractive Lens Surgery

Why in the 90’s?

- Safer procedure compared to the past
- Foldable Intraocular lenses
- More precision in IOL power calculation in extreme long or short eyes
- Limitations of corneal laser surgery
Refractive Lens Surgery

Considerations...
• How “ethical” is to operate on a “healthy” eye
• Retinal Detachment and other complication rate
• Under- and Overcorrections
• Long-term outcome in these eyes

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<thead>
<tr>
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<th>Rate %</th>
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<tr>
<td>CME</td>
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<tr>
<td>RD</td>
<td>0.04</td>
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<td>RD in high myopia</td>
<td>0.0 – 7.3</td>
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<tr>
<td>Endophthalmitis</td>
<td>0.01</td>
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Refractive Lens Surgery

Currently....
- A safe refractive procedure
- Low Complication rate
- Stability of Long-term outcomes in these eyes
- A huge choice of IOLs to correct almost all refractive errors
- Few Under- and Over-corrections
- Presbyopic Correction!

Refractive Lens Surgery is the procedure with the best *permanent* outcomes in presbyopia correction.
Refractive Lens Surgery

Requirements:
• Careful Patient selection
• Significant chair time preoperatively
• Accurate preoperative measurements
• Careful Planning of Surgery
• State-of-the-Art Surgery
• Ability to manage the potential complications
• Close preoperative monitoring of the eye

Patient Selection for Lens Surgery

• Motivation
• Lifestyle
• Patient Expectations
• Personality
• Tolerance
• Informed Consent
Preoperative Chair Time

• Patient information and education
• Understanding his needs, motivation and expectations

Patients for Lens Surgery

**Myopes (with or without astigmatism):**

• Presbyopic or Near-presbyopic age
• Always include correction of *presbyopia* with monovision or multifocal IOLs
• Always correct *moderate and high astigmatism* with IOLs and *Low astigmatism* with Arcuate Incisions (LRIs or Femto AKs)
• Caution with low myopes!
• Accurate biometry!
• Check Macula and Peripheral Retina
Candidates for Lens Surgery

Hyperopes (with or without astigmatism):
• Presbyopic, Pre- or Near-presbyopic age
• Always include correction of presbyopia with monovision or multifocal IOLs
• Always correct moderate and high astigmatism with IOLs and Low astigmatism with Arcuate Incisions (LRIs or Femto AKs)
• Caution with very short eyes!
• Accurate biometry!
• Check Macula and Anterior Chamber Angle
• Most Satisfied Group!

Candidates for Lens Surgery

High Astigmatism
• Seldom, usually presbyopic age
• Always include correction of presbyopia with monovision or multifocal IOLs
• Many are amblyopic!
• Many have irregular astigmatism
• Accurate keratometry from different sources!
• Check Fundus and cornea!
Candidates for Lens Surgery

Presbyopes
- Monofocal, EDOF or Multifocal IOL, CL, Laser or No surgery?
- Always correct **moderate and high astigmatism** with IOLs and **Low astigmatism** with Arcuate Incisions (LRIs or Femto AKs)
- Accurate preoperative measurements
- Prepare for dysphotopic phenomena of EDOF and MF IOLs
- Check Macula!
- Check Pupil Size
- Treat Dry Eyes

Preoperative Measurements

- Refraction
- Tonometry
- Dilated Fundus examination
- Scheimpflug Tomography
- Corneal Topography
- Optical Biometry
- Endothelial Cell Count
- O.C.T. of macula (+ O.N.)
- U/S B-Scan
- Image Guided System
Planning of the Operation

- Calculation of IOL Power
- Selection of IOL Type (Monofocal, EDOF or Multifocal)
- Selection of Method for Correction of Astigmatism (LRI, FemtoAK)
- Final Planning of the operation with Imaging System
- Transfer of Data to the O.R.

IOL Power Calculation Formulas
IOL Power Calculation Formulas

Estimation of Effective Lens Position
• Axial Length
• Keratometric readings
• Anterior Chamber Depth
• White-to-White
• Lens Thickness
• Manifest Refraction
• Age

a0,a1,a2 for Haigis, C constant for Olsen
IOL Type Selection

- Monofocal
- Trifocal
- Enhanced Depth of Focus (EDOF or EDF)
  + Toric versions

B&L Envista
Alcon Clareon
Alcon Panoptix
Physiol Finevision
J&J Symfony
Sifi Mini Well
IOL Type Selection

- Accommodative IOLs

Multifocal IOL Contraindications

- Severe diabetic maculopathy
- Corneal Pathology
- Irregular Astigmatism
- Severe Dry Eyes
- Retinal Disease
- ARMD
- Uveitis
- Zonular Inefficiency
- Advanced Glaucoma
- Amblyopia
- Eccentric Pupil
- Aniridia
- Professional Drivers / pilots
- Very old Age
- Intraoperative Surgical Complications
Monovision

- Determination of Dominant eye
- Assessment of Individual Needs of the Candidate
- Trial with Contact Lenses and different near correction (+0.50 to +2.00)
- Superiority of EDOF IOLs?
  (Mini-monovision (+0.50 to +0.75 without previous CL trial)

Monovision

- Success rate of monovision: 76–92%
- Success in monovision correlates with three principles:
  1. Accuracy of distance correction in the dominant eye
  2. Stereoacuity reduction of less than 50' of arc
  3. Distance esophoric shift of less than 0.6 prism diopters.

<table>
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<tr>
<th>Age</th>
<th>Target Refraction</th>
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<tbody>
<tr>
<td>44 -</td>
<td>1.00 to -1.25</td>
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<tr>
<td>49 -</td>
<td>1.25 to -1.50</td>
</tr>
<tr>
<td>&gt;52</td>
<td>1.50 to -2.00*</td>
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*Ronald R. Krueger, MD, MSE

Customization according to the needs of the presbyope.
Femtolaser and Image Guided Systems have improved Refractive Lens Surgery with Premium IOL insertion adding precision and standardization to the surgical skills of the surgeon.
Femtolaser and Image Guided Systems have improved Refractive Lens Surgery with Premium IOL insertion adding precision and standardization to the surgical skills of the surgeon.

**State-of-the-Art Refractive Lens Surgery**

**Contribution of Femtosecond Laser in Refractive Lens Surgery:**
- Capsulotomy (Centration, size, circularity with 0.1mm precision)
- Management of low astigmatism
  - Intrastromal or Penetrating Corneal Incisions
- Lens Fragmentation
- Incisions (Main and Side Port)
State-of-the-Art Refractive Lens Surgery

Intrastromal Astigmatic Keratotomies

- Less discomfort
  - Less dry eye
  - Less inflammation
- Uncut: 50μ anteriorly and 20% posteriorly
- 8mm optical zone
- Verion Nomogram + 30% of arc length
- Aks Centered to the limbus
Intrastromal Astigmatic Keratotomies

- 196 eyes of 133 patients
- >0.70 D of astigmatism
- 8.0 mm zone
- TIA: 1.21 D ± 0.42 D
- SIA: 0.74 D ± 0.40 D
- DV: 0.74 D ± 0.38 D
- Mean Astigmatism Correction: 63%

Surgeon Position: Temporally

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<tr>
<th>WTR</th>
<th>ATR</th>
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<tr>
<td>0,25 - 0,5 D</td>
<td>FSAK</td>
</tr>
<tr>
<td>0,5 - 1,0 D</td>
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<tr>
<td>&gt; 1,0 D</td>
<td>TIOL</td>
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State-of-the-Art Refractive Lens Surgery

**Contribution of Image Guided Systems in RLE:**
- Avoidance of wrong eye mistakes through registration
- Centration of Capsulorhexis according to limbus or pupil
- Reduction of Surgically Induced Astigmatism
- Calculation of Cyclotorsion
- Markerless Toric IOL placement

Intraoperative Complications

- Posterior capsule tear – vitreous prolapse
  IOL in the sulcus with posterior optic capture after ant.vitr.

  "Finger of God" sign

  Implantation of a 3-piece IOL with less power in sulcus
- Any complication seen in cataract surgery
Postoperative Complications

- Posterior Capsule Opacification > YAG-laser required earlier
- Cystoid Macular Edema > Medical Therapy
- Retinal Detachment > VR Surgery
- Endophthalmitis > Medical Treatment or VR Surgery
- IOL Decentration > IOL repositioning or exchange
  The near images (newspaper characters) became difficult to distinguish at a decentration of 0.75 - 1.0mm
- Under- or Overcorrections > Refractive Corneal Surgery, IOL exchange or Add-on IOLs
- Dysphotopic Phenomena > Brimonidine Drops to reduce pupil size, Wait at least 3-6 months before removing MF IOL

Causes of Patient Dissatisfaction with Bi/Trifocal IOLs

- Unsatisfactory Visual Acuity
  - Residual Refractive Error
    - Spherical
    - Cylindrical (>0.75 D)
  - IOL decentration
  - Posterior Capsule Opacification
  - Large Pupil
  - Limited reading depth
  - Dry Eyes
  - IOL opacification/glistenings
Causes of Patient Dissatisfaction with Bi/Trifocal IOLs

- Dysphotopic Phenomena
- Wrong Personality Selection
- High Expectations
- Low motivation
- Unilateral implantation

Decision Making in Refractive Lens Surgery

- **Myopia**
  - **<40 yrs**
    - Low Myopia
      - Corneal Refractive Surgery, Phakic IOL or No Surgery
  - **>40 yrs**
    - Mod.-High Myopia
      - Monovision (1 eye)
        - Corneal Refractive Surgery or IOL (EDOF)
      - Monovision (2 eyes)
        - with EDOF or Trifocal

- **Hyperopia**
  - **<35-40 yrs**
    - Low Hyperopia
      - Corneal Refractive Surgery or No Surgery
    - Mod.-High Hyperopia
      - Trifocal or EDOF IOL
  - **>40 yrs**
    - Trifocal IOL
    - Trifocal IOL
Decision Making in Refractive Lens Surgery

Astigmatism

- Regular
  - Low
    - No Surgery or Corneal Refractive Surgery
  - High
    - CL, Phakic IOL, Toric EDOF IOL

- Irregular
  - <45 yrs
    - Monovision with Toric EDOF if no amblyopia exists
    - Or Toric EDOF and Reading Glasses
  - >45 yrs
    - Monovision (2 eyes) with Toric EDOF
    - Or Toric Trifocal

Presbyopia

- <50 yrs
  - Trifocal IOL or EDOF IOL
- >50 yrs
  - Monovision (1 eye) with Corneal Refractive Surgery
  - Or Intracorneal Implant (?)

Clinical Examples #1

- Female, 53 yrs, housewife
  - OD: +2.75 -1.50 x 175 add:+2.25 VA: 1.0
  - OS: +2.25 -0.50 x 180 VA: 1.0 (Dominant)
  - No corneal or retinal Pathology
  - Wants to be able to see far and read her tablet without glasses

1. OD: Trifocal Toric IOL
   OS: Trifocal IOL + FEMTO-assisted Aks
2. OD: EDOF Toric IOL – target refraction -0.50 or -0.75 sph
   OS: EDOF IOL + FEMTO-assisted Aks
3. Monovision with EDOF IOLs after CL trial – OD target -1.50 sph
Clinical Example #2

- Male, Taxi Driver, 45 yrs
  OD: +0.25 sph          VA: 1.0 (Dominant eye)
  OS: -0.50 cyl x 180    VA: 1.0           Near add: +1.25
Mild Diabetes, controlled with diet, normal fundus OU
He doesn’t want to wear glasses at all

1. No Refractive lens surgery (yet)
2. Contact lens in OS (+1,50)
3. OS Corneal Refractive Surgery – target: -1.50 D after CL trial

Clinical Example #3

- Male, 59 yrs, Accountant
  OD: -2.25              VA: 1.0 (Dominant Eye)
  OS: -2.75              VA: 1.0
No Ocular or Retinal Pathology except mild nuclear sclerosis OU
Wants to get rid of glasses but has very high expectations of his postop near, intermediate and far vision

1. Extended chair time to explain the expectations
2. Mini-monovision with EDOF (OD plano- OS: targ -0.5 to -1.00)
   if he agrees to wear near glasses for very small print
3. Trifocal IOLs OU if he has understood that he may see dysphotopic phenomena
Summary

**Refractive Lens Surgery:**
- A relatively safe intraocular procedure
- Low complication rate
- Requires careful patient selection and education
- Requires state-of-the-art surgery
- High patient motivation enhances the outcome
- Stability of refractive status of the eye over the years

شكرا على الاهتمام