The History of Development of Microincisional Phaco and MICS IOL and their Importance in Modern Phacorefractive Surgery

IOL Technology & CO-MICS

D. Breyer, Düsseldorf

Kassel, 13.03.2010
Background - Science v. Art

“I’m the first to admit... the use of toric IOL is science....whereas corneal incisions are an inexact art...”

Robert H. Osher in CRST 2009
What Do We Need for Perfect Toric IOL Surgery?

Repeated, reliable videokeratography (Pentacam HR, Oculus and Wavelight)
Customized, individual, rotation stable toric MICS IOL of high optical quality
Online calculation program
Astigmatism neutral (sub 2.0mm incision) coaxial Microincision Phaco
Reliable, precise marking method (Gerten, Wehner, Osher and Zaldivar.....)
Precise intraoperative IOL orientation method (Breyer - screen Transparency, STACY)
Optional: slitlamp control in the OR
Best of all: live surgery videokeratoscopy

...all of this meeting high international standards of quality management
Is Carl Zeiss Meditec helping us meeting those high standards?

A perfect marriage:

Acri.Tec and CZM

Innovative MICS IOL and precise diagnostic and operation tools

Goal: high quality management standards and perfect workflow

To provide the highest quality and best standard to our patients
Historical Toric Evolution
or
Disadvantage of previous toric IOL (ESCRS 2005)

No MICS IOL (induction of astigmatism)
Big stiff haptics (danger of capsular rupture)
Silicone IOL (Silicone oil endotamponade)

Reduced image quality: monotoric principle

no correction of aberration
# Acri.Smart 646 TLC - Technical Specifications

<table>
<thead>
<tr>
<th>Material:</th>
<th>Acrylate with UV-blocking hydrophobe surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optics:</td>
<td>symmetric biconvex aspheric, bitoric</td>
</tr>
<tr>
<td>Optical diameter:</td>
<td>6,0 mm</td>
</tr>
<tr>
<td>Total diameter:</td>
<td>11,0 mm</td>
</tr>
<tr>
<td>Angle of haptics:</td>
<td>0°</td>
</tr>
<tr>
<td>Edge:</td>
<td>sharp edge</td>
</tr>
<tr>
<td>Delivery range:</td>
<td>sph + 0,0 D to +32,0 D</td>
</tr>
<tr>
<td></td>
<td>cyl +2,0 D to +12,0 D</td>
</tr>
</tbody>
</table>
The cylinder is symmetrically distributed on its anterior and posterior surface:

This results in the reduction of the radius distance between sphere and plus cylinders

Result: improved image quality even in high astigmatism

you name it, CZM produces it (no limits)
Just Pretending?

Another yellow IOL statement

How can we proof this statement with scientific methods?
Quality of Vision Can Be Measured
Measurement of Modular Transfer Function - MTF

OptiSpheric Anlage
Light of a cold light source is turned into monochromatic light by a filter.

Then directed through a pinhole onto a mirror and through an IOL of a model eye.

The resulting picture is captured by a CCD camera.
Every single IOL that is produced is going through that approval before being delivered to the surgeon!
Airy Disc – PSF - MTF

The distribution of brightness of the so called Airy disc is captured by the CCD camera and the point spread function (PSF) and the modulation transfer function (MTF) are calculated by the computer.
MTF of a monotoric IOL with different pinhole size

Monotoric IOL (+20.0 sphere +6.0 cylinder)

3 mm pinhole

5mm pinhole

Theo (green line) = theoretical optimal MTF
Sag and Tan = focus intersections of toric IOL
MTF of a bitoric IOL with different pinhole size

Bitoric IOL (+20.0 sphere +6.0 cylinder)

3 mm pinhole

5 mm pinhole

Theo (green line) = theoretical optimal MTF
Sag and Tan = focus intersections of toric IOL
MTF Monotoric v. Bitoric Design, Different Diopters, 3mm

646TLC - Monotorisches vs. Bitorisches Design
MTF Werte bei 100 Lp/mm und 3 mm Apertur

Modulation [%]

0 10 20 30 40 50 60 70 80

MTF Monotoric
MTF Bitoric

10+6 Dpt
20+6 Dpt
30+6 Dpt
10+6 Dpt
20+6 Dpt
30+6 Dpt
The advantage of the bitoric optic becomes more dominant at larger apertures.
Aspheric = Aberration corrected IOL

spheric optic

lens corrected optic

Distance from corneal center

refraction
Injection of the IOL with Cartridge and Injector
Optimized Position of the Bitoric IOL (DOC & ESCRS 2005)
Comparison Monitor Foil - Mendez Ring
STACY - Screen Transparency for Toric IOL

Emmel, Breyer  DOC 2006
Marking With Gerten Plumb Marker - ON 05/08

„...the plumb marker is a precise and reliable surgical tool...“

Original photographs courtesy to Dr. Gerten
Rejection of an Old Bias on Plate Haptic Design
Rotational stability proven

DOC 2005

Wehner – Nürnberg
„…absolute rotational stability of all IOL after one year…“

ESCRS 2006

Menapace - Vienna and Breyer - Düsseldorf
„….same results…“

!!! Do not make the mistake and compare this highly stable acrylate IOL with the historic Staar silicone toric IOL wich disappeared in the vitreous after YAG Capsulotomy !!!!
A High Quality Toric IOL Requires MICS Surgery

If we spend so much time and effort on evaluation of preoperative data and IOL production, these data should be one by one transferred into our OR

i.e.

We need atigmatism neutral incisions!
Monomanual CO-MICS or Bimanual Sleeveless MICS?

Bimanual MICS Problems

incision too wide: no sleeve phaco
- intraoperative leakage

incision too tight: irreversible stretching of collagen fibers
- postoperative leakage

Obvious solution: coaxial phaco with sleeve
- no leakage & quiet fluidics
Monomannual Coaxial Microincision Cataract Surgery

19G  20G  CO-MICS 1  CO-MICS 2

Graphics courtesy of Oertli
CO-MICS Tip Geometry Evolution

Graphics courtesy of Oertli
# Emulsification Power

<table>
<thead>
<tr>
<th>Phaco Tip</th>
<th>Design</th>
<th>Incision Size</th>
<th>Emulsification Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>19G</td>
<td>Traditional</td>
<td>2.8 mm</td>
<td>100%</td>
</tr>
<tr>
<td>20G</td>
<td>Traditional</td>
<td>2.2 mm</td>
<td>54%</td>
</tr>
<tr>
<td>CO-MICS</td>
<td>Traditional</td>
<td>1.6 mm</td>
<td>29%</td>
</tr>
<tr>
<td>CO-MICS 2</td>
<td>Smart</td>
<td>1.6 mm</td>
<td>146%</td>
</tr>
</tbody>
</table>

![Phaco Tip Images]
## Holdability

<table>
<thead>
<tr>
<th>Phaco tip</th>
<th>Design</th>
<th>Incision Size</th>
<th>Holdability</th>
</tr>
</thead>
<tbody>
<tr>
<td>19G</td>
<td>Traditional</td>
<td>2.8 mm</td>
<td>100%</td>
</tr>
<tr>
<td>20G</td>
<td>Traditional</td>
<td>2.2 mm</td>
<td>59%</td>
</tr>
<tr>
<td>CO-MICS</td>
<td>Traditional</td>
<td>1.6 mm</td>
<td>34%</td>
</tr>
<tr>
<td>CO-MICS 2</td>
<td>Smart</td>
<td>1.6 mm</td>
<td>106%</td>
</tr>
</tbody>
</table>

![Phaco Tip Images](image-url)
Results - Videokeratography

No surgically induced astigmatism with CO-MICS (see studies by R. Menapace)
Next Revolutionary Step: Toric MIOL

Encouraged by excellent results and happy patients with the toric and multifocal IOL of the CZM Smart Family the development of a toric MIOL was a logic consequence.
Background

Acri.LISA results: very promising:

best intermediate vision, very good contrast vision, less light scattering,
high patient satisfaction!

(Aggarwal, Alio, Author, Mester, Pietrini, Zaldivar)
Unique: The Queen of IOL: Acri.LISA TD: Toric MIOL

Front face toric
Back surface bifocal
Pupil independence
Light allocation 65:35
Light intensity refractive distant focus 65%,
Light intensity diffractive near focus 35%
Near addition: + 3,75 dpt
MICS-Technology:
an incisionwidth of only 1,5 mm allows an
astigmatism neutral operation
First Implantations - Toric MIOL

Wolff und Breyer December 2007

Wolff in ON: „...very precise, promising results...“

Breyer ASCRS 2008 CO-MICS and toric Acri.LISA first study results
Preop. Vs. Postop Refraction Sphere

Subjective Refraction Sphere

Sphere [D]
Preop. Vs. Postop. Cylinder

Subjective Refraction Cylinder

Cylinder [D]

preop  postop
Spherical Equivalent

Spherical Equivalent

SE [D]

preop  postop
Spherical Equivalent

-15
-10
-5
0
5
10
SE [D]

preop  postop
Visual Acuity, $n = 78$

**Distance Visual Acuity**

- **sc**
- **cc**

**Near Visual Acuity**

- **sc**
- **cc**

**Binocular Visual Acuity**

- **rear**
- **distance**

Legend:
- **SC**
- **CC**
Mean Subjektive Refraction, n = 78
Conclusion

The CO-MICS procedure avoids any surgically induced astigmatism.

The objective measurements and especially the subjective patient statements are very satisfying and promising.

By using the Acri.Lisa TD one can avoid a bioptic procedure in patients with higher astigmatism and the wish for bifocal IOL.

CO-MICS and the Acri.Lisa TD are a perfect match in phacorefractive surgery.

Standardized Quality management reliable online calculation methods and documentation (Z CALC) and live alignment methods (Z ALIGN) are developed and in clinical trial for even better refractive outcomes.
After The Pioneer Work:
Improvement of Workflow and Standardization (QM)

Improvement of workflow: Z CALC: online calculation program

Improvement of standardization: Z ALIGN: live video IOL orientation
Thank You....

Very much for your kind attention!

„All truths are easy to understand once they are discovered; the point is to discover them“
Galileo Galilei

„A discovery is said to be an accident meeting a prepared mind“
Albert Szent-Gyorgyi