IOL evolution and achievements of premium IOLs

for better performances but higher requirements

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Race for Progress!
What is new : to pay for progress ?

4 properties

- Asphericity (Q factor)
  - correlated to Spherical aberration
  - AS – or AS free / improve quality of vision
  - Integrated on optic by manufacturer (no extracost)

- Toricity : access to cylindrical correction > 1 D

- Presbyopia
  - Correction : accommodative (the ideal ...still awaited)
  - Compensation : Multifocaux ...EDOF
When Cataract surgery became a refractive surgery

Thanks to surgical progress
- Mini and micro-incision: no induced astigmatism + Sutureless
- Fast recovery + safety increase
- Emmetropia can be targeted
- LRI combinable on a femtocataract platform

Thanks to better understanding and control of optics
- Toric IOLs for spherocylindrical correction...as for long-lasting glasses and contact lenses
- Asphericity linked to spherical aberrations: vision quality
- Why not spectacles independence?: Multifocal...EDOF


Consensual conclusion of all papers on presbyopia correction: patient + information = key of success!
« True » Cataract
- BCVA < 0.6 ? Official but outdated criterion
- Loss of quality of vision to integrate (contrast, halos, glare)
- LOCS III
- New indices: OSI (OQAS) / DLI (i.Tracey) / densitometry (Pentacam, OCT)
- > 65 years old

« PRELEX »: Refractive Clear lens exchange
- Demand for spectacle independance
- « Prevent » cataract occurrence
- Increase retinal risk? < 56 years old + LA > 24 mm

High expectations: benefit / risk = > 55 years
When Presbylasik and monovision insufficient

Patient selection and information +++
Raise the level of ambition: create demand
IO solution = the winner of presbyopia correction
Poor candidate selection
- No respect of ocular and general contraindications
- No assessment of expectation and needs

Inadequate measurements:
- No refined evaluation of ocular structures (lens, retina...)
- No optical biometry
- No topography
- ...Neither aberrometry
- Binocular vision, Kappa angle

Insufficient patient Information
- Decision tree of available strategies not described
- Limits and benefits not listed
Intraoperative complications?
- Risk = those of a cataract surgery
- If capsular rupture ... no multifocal implantation (decentration, tilt)
- ... Then binocular balance?

Secondary cataract = PCO
- Not a complication ... but earlier visual penalization than monofocal
- YAG never < 6 months, wider ... respect the optic of IOL (careful focus)

Quid ... if an ocular disease occurs?
- RD : no surgical problem
- Glaucoma : neuropathy alters visual field whatever the correction
- Maculopathy : more delicate surgery
  = loss of the ability to use multifocality (as spectacles) but probably no exchange
Postoperative evaluation after Presbyopia Surgery

Objective measurements
- UDVA (4m) + UNVA (30 - 40 cm) + UIVA (60-70 cm)
- Refraction
- BDCVA + UNVA with BCVA (for distance)
- Defocus curve, amplitude of accommodation
- Capacity for near: reading speed
- Quality of vision
  - Contrast sensitivity +/- glare
  - MTF
  - Aberrometry (spherical aberrations) (no reliability of H. Shack WF)

Questionnaire of life +++ : satisfaction rate

Hogan JC, Kutryb MJ – Mo Med 2009 – Jan-Feb 106(1) : 78-82
Are Multifocal IOLs excellent?

- Incomparable / predecessors (halos, VP??)
- Thanks to optical refinements
  - Asphericity, toricity
  - Apodization, smoothing
- If patient informed....over 90% happy without glasses
  - Light-dependent visual performances
  - No restoration of the 20-year-old eye
  - Just compensate for the loss of accommodation

- Marques EF - JCRS 2015 Feb 41(2) 354-63
  Comparison of visual outcomes of 2 diffractive trifocal IOLs (indépendances lunettes 100%, comparables)
- Cochen B – JRS 2015
  Prospective clinical comparison of patient outcomes following implantation of trifocal or bifocal intraocular lenses

In general, multifocal IOLs are able to provide patients with excellent uncorrected distance and near visual acuity resulting in high levels of spectacle independence. Although superior from a theoretical point of view, currently available accommodating IOLs are unable to offer the same level of near visual acuity. Dissatisfaction following implantation of multifocal IOLs is rare and is often amenable to treatment. Some cases of dissatisfaction are due to the occurrence of phenomena inherent to the design of multifocal IOLs (such as glare and halos) and are therefore more difficult to treat. This demonstrates the importance of preoperative patient education, careful selection of cases, and individualized weighting of benefits and side-effects of multifocal IOLs. If these principles are respected, multifocal IOLs can lead to excellent results and can be of great value to present-day ophthalmology.
**Which multifocal ? = pseudophakic ... wide choice**

- **Refractive**
  - Better respect of vision quality
  - Often limited in near vision

- **Diffractive : bi or trifocal**
  - The favorites ... hydrophilic, hydrophobic
  - Optics in constant refinements

- **Refractive or diffractive toric : a true benefit**
  - ½ patient have an astigmatism > 1D
  - Used to represent THE cause for ReTt : PRK, LRI ...

- **Piggy back ? In expansion**
  - In front of a monofocal, in sulcus
  - Additive surgery ..... reversible !

- **Benefits**
  - Benefited of added asphericity
  - Trifocal : « smart concepts »
    - No more light loss / bi
    - Gain in intermediate vision
  - Toric : allowed access to emmetropia
  - Can be « tried » or 2ary implanted
Trifocal: favourites in Europe

No more loss of light (15%) / bifocal
But gain in intermediate vision

MicroF Fine Vision Physiol

• Hydrophlyic
• 2X C loop for toric Pod F

AT 839 – Zeiss

• Plate
• Toric version
• Hydrophlyic (PCO)
• 2 add: 1.66 + 3.33 D
• + smoothing

PanOptix - Alcon

• Quadrifocal (2 far)
• « enlighten »
• Hydrophobic, GF?

Evidence based: efficacy + safety
Target = emmetropia

VI 70 cm

VI 60 cm
Defocus curve
(blurring test +2 to -4 D)
New entity: Extended depth of focus IOLs

Various Principles for one Objective
- No light division on multiple focal points
- Better vision quality than multifocal
- Better sensitivity to contrasts
- Less photic phenomena

On the other hand
- VA by far well preserved
- Optimized intermediate AV
- Near vision less efficient

Current elective indications
- Elderly patients
- Patients with retinal risk
- Surgeon ...concerned about multifocality
3 current concepts

- Focal (diffractive) zones
  - Symfony®, AT Lara®
- Asphericity modulation
  - MiniWell®
- Pinhole
  - IC8®

Compromise
- Monofocal / MF
- Minimonovision
Micro-Monovision recommended: -0.5 to -0.75D

- On non-dominant eye
- Below: dependance of glasses for near
- Beyond: halos induced

Higher tolerance to remaining error

- Cylinder and/or sphere: up to -0.75 D
- Less demanding of emmetropia achievement than Multifocal

Quality of vision

- Comparative study with diffractive trifocal IOLs
- Comparable level of functional symptoms (6 to 10%)
First dare one....

Then let yourself be convinced of the results

Then refine your choice
  - According to his conviction: materials, drawing
  - According to the needs of the custom match patient
  - Combine them "mix match" (dominant: far / dominated: near?)

Watch for evolutions...full explosion
  - For increasing accuracy
  - ...IOL with "increased depth of field"?
  - including the integration of the femtocataract: what gain?

Toric:
- $\geq 0.75$ D MF
- $\geq 0.75$ D EDOF
A complete range:
- AT Lara +/- toric (2017)

One piece / 4 haptics design:
- Refractive / diffractive
- Concept LISA
  - L: Light distributed asymmetrically (between F and N: ↓halos and glare)
  - I: Independency from pupil size
  - S: SMP technology no right angles for reduced light scattering
  - A: Aberration correcting optimized aspheric optic
    (↑contrast sensitivity, depth of field and sharper vision)
A continuous track of INNOVATION

CT ASPHINA CT SPHERIS
First 1.8 mm MICS

AT TORBI
First bitoric MICS

AT LISA
First multifocal 1.8 mm MICS

AT LISA toric
First toric multifocal MICS

BLUEMIXS (2010)
Easy and save preloaded MICS injector

AT LISA tri
First trifocal preloaded MICS

AT LISA tri toric
First trifocal toric Preloaded MICS

AT LARA
Next generation EDoF

From Bi to trifocal

- **Bifocal**: Phase zones equal in all zones, which contributes to near vision.
- **Trifocal**: Phase zones different in even (near vision) and uneven (intermediate) zones.

**True living vision**: additional value of intermediate vision (fills the gap).

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5. German multicentric clinical data collection / n = 60; 1 month follow-up
6. Prospective case series, Peter Mojzis, MD, Ph. D, FEBO / n = 26; 6 month follow-up
30 peer reviews in favour of AT Tri
Contrast Sensitivity: no difference between AT LISA Bi and Tri

3 Detlev Breyer, Introducing trifocal AT LISA tri 839MP. Presentation given at APACRS symposium, Singapore, 2013 / n = 38 patients; 3 months follow-up

6 Prospective case series, Peter Mojzis, MD, Ph. D, FEBO (Havlíčkův Brod, Czech Republic) / 6 month follow-up
Mean EPCO score for the central 4.3mm zone of 0.26 ± 0.35 and a Nd:YAG laser capsulotomy rate of 2% at 1 year follow-up

Table 2. The EPCO grading scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Minimum wrinkling of capsule with a fine layer of LECs</td>
</tr>
<tr>
<td>2</td>
<td>Mild honeycomb PCD; thicker layer of LECs with dense fibrosis</td>
</tr>
<tr>
<td>3</td>
<td>Classic Ectatic pearls; very thick layer of LECs</td>
</tr>
<tr>
<td>4</td>
<td>Severe opacity with a darkening effect</td>
</tr>
</tbody>
</table>

LECs = lens epithelial cells; PCD = posterior capsule opacification

Prospective case series, Peter Mojzis, MD, Ph. D, FEBO / n = 50; 12 month follow-up

AT Lisa Bi: 90% < 7° rotation
AT Lisa tri: same encouraging outcome

Achieved change in CYL

Prospective case series, Patrick Versace, MD (Sydney, Australia)
AT LARA 829 (MP) : (cf Frank Goes)

for less side effect than multifocal, but no loss of BNV than Monovision

- 4 haptics
- Hydrophilic acrylic IOL (hydrophobic surface properties)
- Optical « light bridge » on ant surface (continuous extends the range of focus )

- Aberration neutral aspheric design optic
- Advanced chromatic aberrations correction (better contrast sensitivity)
- « Smooth microphase » (minimize light scattering)
Whereas for users who are convinced up to 40% of their IOLs

Probably

- Frightened by the unpopularity of their past
- Fear of their complications
  - Wrong patient selection
  - Non respect of the operating conditions (integrity bag, axis...)
- More refractive approach
- Requires an exploration platform
- Requires discussion, selection, information
- ....Pb of cost

ESCRS 2016 survey:
40% tri / 34% Bi / 18% EDOF

Education + Information of MD
If there’s no restoration ... Progress in Optics allow an efficient compensation of accommodation loss.

Multifocal IOLs of yesterday have no comparison with those of today... neither to those of tomorrow?!

EDOF IOLs: an interesting compromise that may extend the number of patients and surgeons?