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REFRACTIVE EFFICACY OF LIGHT ADJUSTABLE INTRAOCULAR LENSES

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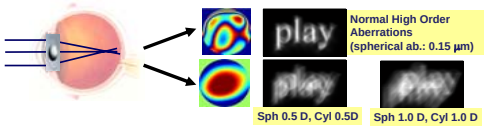
INTRODUCTION

- Many patients after cataract surgery have significant refractive errors:
  - →More than 50% of patients have a spherical equivalent superior to 0.5 D
  - →Most patients have astigmatism in the range 0.5 to 2.0 D
- The retinal image (& visual performance) is mainly degraded by refractive errors (see simulated retinal images below):

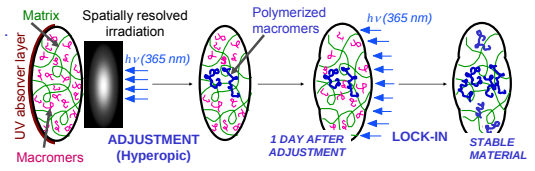


- There are two alternatives to Improve refractive accuracy in cataract surgery:
  - Better IOL power calculations (**see Cánovas et al., ARVO poster 1157**) & toric IOLs
  - ***Light adjustable IOLs (LALs)***

METHODS

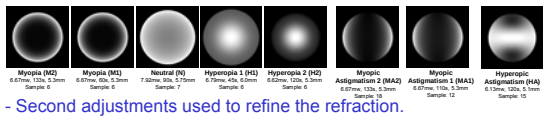
A group of 77 patients (corneal astigmatism ≤2D) were implanted with Light Adjustable IOLs (Calhoun Vision, Pasadena, USA) and evaluated with an objective **Wavefront**-guided approach for refraction control through the treatment process.

LALs [Schwartz DM. *Light-adjustable lens*. Trans Am Ophthalmol Soc. 2003;101:417-36] are similar to standard 3-piece lenses, but contain photosensitive silicone molecules that enable postoperative adjustment of the final refractive power using ultraviolet (UV) light (see figure below for an example of the lenses principle).



Light adjustment profiles

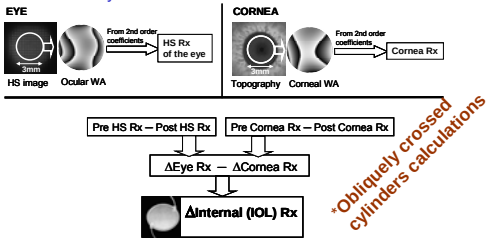
After implantation, patients wore spectacles to block UV radiation up to two weeks, when the lenses are irradiated using a digital light delivery (DLD) system. Eight different irradiance patterns used to correct refractive errors were tested:



- Second adjustments used to refine the refraction.
- Two irradiance lock-ins used to stabilize the IOL material.

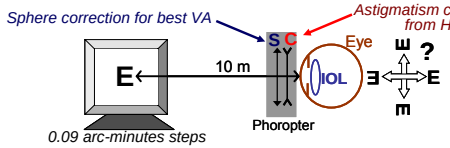
Objective control of refraction changes

- Objective eye refraction (defocus & astigmatism) was estimated from wavefront measurements obtained with a Hartmann-Shack sensor (HS).
- Control of refraction changes produced by the cornea (from corneal topography & ray-tracing calculations).
- Estimation of refraction changes in the LAL by direct subtraction* of corneal and eye data.



Visual Acuity and subjective refraction

Best corrected and uncorrected visual acuity (VA) expressed by decimal units (1/MAR) was measured in every patient and condition

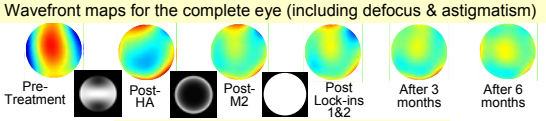


RESULTS

Example of refraction changes in a complete treatment

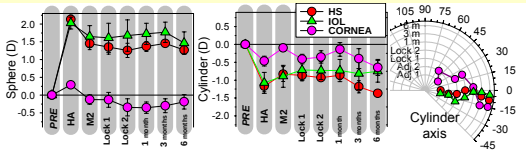
Patient treated with HA(1ST adjustment) & M2(2ND adjustment)

Wavefront maps for the complete eye (including defocus & astigmatism)

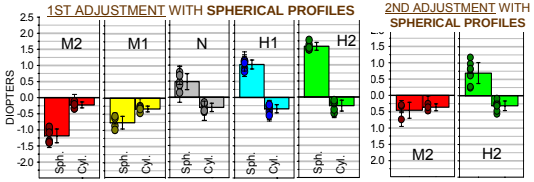


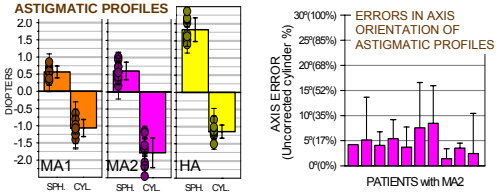
Induced wavefront changes by each treatment

Refraction changes induced by treatment in the **eye**, **cornea** & **LAL**



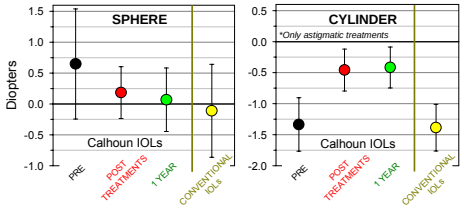
Average refraction changes in the eye by treatment

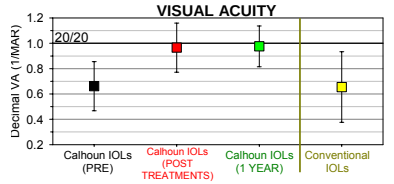




Subjective refraction and visual acuity

Comparison of average values of refraction and visual acuity in the patients implanted with LALs (before and after treatments) and a group of 16 patients implanted with conventional IOLs.





CONCLUSIONS

- LAL's offer an accurate alternative to conventional IOLs to provide patients with predictable and improved refractive errors.
- The refractive range that can be corrected is +2/–2D of defocus and 2.0 D of astigmatism with a precision around 0.5 D for each treatment.
- Visual acuity in the group of patients after light treatments was in average near 1.0 (20/20). These patients are in practice spectacle-free for distance vision.
- After lock-ins, LALs refraction was stable over time (>1 year follow up).
- This technology could also be used to modify higher order aberrations in pseudopakic eyes (See Alcón et al., ARVO presentation 1626, Monday).

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