Evaluation of the Biocompatibility of Intraocular Lens Power Adjustment Using a Femtosecond Laser

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John A. Moran Eye Center
University of Utah

Nick Mamalis, MD
Liliana Werner, MD, PhD
Jason Nguyen, MD
Joah Aliancy, MD
Jason Ludlow, MD
Sean Enright, BS
Ray Alley, BSEE
Ruth Sahler, BA, MA


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Purpose

- The use of a femtosecond laser to alter the hydrophilicity of targeted areas within an intraocular lens (IOL) creates the ability to build a refractive index shaping lens within an existing IOL.

- Phase-Wrapped Structure
  - Contains entire curvature of traditional convex or concave lens in **one layer**
  - Creates significant refractive change in limited area
    - Refractive index change of 0.01 in a conventional lens = 0.4 D change
    - Refractive index change of 0.01 in a phase-wrapped lens = 3.3 D
Purpose

• The object of this study was to evaluate the biocompatibility (uveal and capsular) of an IOL following power adjustment by a femtosecond laser

• The postoperative IOL power adjustment following treatment with the femtosecond laser was evaluated
Methods

• 6 rabbits underwent phacoemulsification with implantation of a commercially available, hydrophobic acrylic IOL in both eyes

• Postoperative power adjustment was performed using the femtosecond laser 2 weeks following implantation in one eye
Methods

• Alignment and docking of the eye was performed under the control of a camera and OCT system of the laser

• An interface was specially designed for use in the study based on previous studies regarding the size and geometry of the rabbit eye

• The treatment was designed to adjust the spherical power by 3.6 diopters and the duration was 23 seconds
Methods

- The animals were followed clinically with slit lamp examinations for an additional 4 weeks to assess for signs of any postoperative inflammation or toxicity.

- The rabbits were humanely euthanized and the globes enucleated.
Methods

• The globes were bisected coronally and gross examination and photographs from the posterior aspect (Miyake-Apple view) were performed to assess anterior capsular opacification and fibrosis as well as posterior capsular opacification

• The IOLs were explanted for measurement of the achieved power change

• The globes were then sectioned and processed for standard light microscopy with hematoxylin-eosin staining
Results

• Slit lamp examination performed after laser treatment showed the formation of small glass bubbles behind the lens which disappeared within a couple of hours.
Results

• No postoperative inflammation or toxicity was observed in the treated eyes on slit lamp examination and on Miyake-Apple view of the globes when compared to non treated eyes.

• Histopathologic evaluation revealed no signs of postoperative inflammation or toxicity when comparing the study eyes to the non treated control eyes.
Results

• After explantation evaluation of the lenses confirmed that the change in power obtained was consistent and within 0.1 diopter
Conclusions

• Consistent and precise power changes can be induced in the optic of commercially available hydrophobic acrylic lenses in vivo by using a femtosecond laser

• Results show that the laser treatment of the IOLs was biocompatible in the rabbit model