Pseudophakic Dysphotopsias

SAMUEL MASKET MD
CLINICAL PROFESSOR – UCLA
LOS ANGELES

RELEVANT DISCLOSURE – US PATENT IOL DESIGN
The Dysphotopsias

Subjective (Undesired) Optical Images Associated with Otherwise Uncomplicated Cataract/IOL Surgery – Photic Phenomena

- Positive (PD) – light streaks, arcs, flashes, star bursts
- Negative (ND) – temporal dark shadow
- Multifocal (Diffractive) – halos, rings
Incidence of Dysphotopsias

Chief Cause of Dissatisfaction Following “Routine” Cataract Surgery – Olson

- Tester, et al (JCRS 2000) 49% overall ND/PD
- Bournas (Ophthalmologica 2007) 19.5% POD 1
- Osher (JCRS 2008) 15.2% POD1 3.2% 1 YR ND
- Sharma (ESCRS) 9.6% POD 1 1.6% POD 42 ND

- 30,000 – 100,000 New Pts/Yr
Evaluating Dysphototopic Complaints

- There is NO objective test for clinical dysphotopsia
- Only subjective data available (PROs)
- Lab – Ray tracing analysis and Reflectometry of IOL
- Distinguished from Purkinje images, Maddox Rod Effect, and disabling glare
Zemax Non-sequential Ray-Tracing Used to Analyze Edge Glare
Ray Tracing Analysis of Edge Types – Franchini
JCRS 2/2003
Edge Glare with Oblique Light
Edge Induced Dysphotopsia

Not reported until use of ovoid PC IOLs

Masket, et al JCRS 1993
Nishis’ work established Square Edge design inducing non-continuous capsule bending as the most important IOL factor in retarding PCO, irrespective of IOL material.
What Causes Positive Dysphotopsia?

Erie et al (JCRS 2001, 2003) demonstrated that internal reflections of nearly axial light by the posterior aspect of the front surface of the IOL cause positive dysphotopsia. The flatter the lens radius of curvature and the higher the index of refraction of the material, the worse the condition.
Industry Response to PD

- Modify square edge – reduce thickness, anterior edge round
- Leave IOL edge unpolished or frosted
- Move more optical power to anterior IOL surface, less to posterior surface
- Opt for materials with lower I/R
- Reduce surface reflectivity? (albedo)
Negative Dysphotopsia

- Less Understood
- Temporal Dark Arc
- Etiology Unclear
  - Holladay – “Enigmatic Penumbra” – IOL Edge
  - Masket & Fram – Relationship of IOL to capsule bag
Pseudophakic negative dysphotopsia: Surgical management and new theory of etiology

Samuel Masket, MD, Nicole R. Fram, MD

PURPOSE: To evaluate the benefit of various surgical methods to address pseudophakic negative dysphotopsia.

SETTING: Private practice, Los Angeles, California, USA.

DESIGN: Interventional case series.

METHODS: The following 4 surgical methods were used to address pseudophakic negative dysphotopsia: piggyback intraocular lens (IOL) implantation, reverse optic iris suture fixation, ultrasound biomicroscopy (UBM) evaluation of the anterior chamber anatomy. The primary outcome was partial or complete resolution of symptoms 3 months postoperatively.

Ray-tracing optical modeling of negative dysphotopsia

Xin Hong
Yueai Liu
Mutlu Karakelle
Samuel Masket
Nicole R. Fram
Negative Dysphotopsia – Clinical Observations

- Associated with incision in ANY location and ANY in the bag IOL
- Stimulated by temporal light
- Only seen with “anatomically perfect surgery”
- Symptoms may be unilateral
- Symptoms abate with pupil dilation
- Not reported with sulcus placed PC IOLs or AC IOLs
- Posterior Chamber Depth Not a Factor
Negative Dysphotopsia: Surgical Experience – 34 Eyes

“Piggyback” Low IOL power alleviated symptoms – 8/10

“Reverse Optic Capture”
Primary –” prevented “ symptoms 8/8*
Secondary 12/12

IOL Exchange – Bag to sulcus 3/4

Overall benefit 31/34* eyes
Industry Response to ND
Anti-Dysphotopic IOL
Multifocal Dysphotopsia: Additive to Pseudophakic ND and PD

![Graph showing relative energy vs. pupil diameter with two curves for Distance Focus and Near Focus at 550 nm.](image)
Image Degradation by Astigmatism with Diffractive Multifocal IOLs

Cylinder 0 D

Cylinder 0.5D

Cylinder 1.0D
Visual Disturbances
120-180 Days Post-Operative

- Night Vision Problems
  - AcrySof® ReSTOR® IOL (N=457):
    - None/Mild: 9%, Severe: 4%
  - Monofocal Control (N=156):
    - None/Mild: 2%, Severe: 4%

- Glare
  - AcrySof® ReSTOR® IOL (N=457):
    - None/Mild: 21%, Severe: 5%
  - Monofocal Control (N=156):
    - None/Mild: 7%, Severe: 2%

- Halos
  - AcrySof® ReSTOR® IOL (N=457):
    - None/Mild: 19%, Severe: 5%
  - Monofocal Control (N=156):
    - None/Mild: 2%, Severe: 2%
Side Effects
Optical / Vision Symptoms

• Non-directed subject responses
  - “Are you having any difficulties with your eyes or vision”

• Halos most commonly reported
  - Most “mild” to “moderate”
  - Improved with time

Patient Satisfaction

Would you have the same intraocular lens implanted again?

% Subjects

Form 3 (N = 207)  Form 4 (N = 152)  Form 3A (N = 177)  Form 4A (N = 127)
If you had to undergo cataract surgery again, would you elect to have the same lens implanted?

*Higher than monofocal control

Dissatisfaction After Multifocal IOLs


- Retrospective chart review – 76 eyes
- Photic phenomena – 38.2%
- Blurred VA – 94.7%
- Chief causes – ametropia, PCO, pupil
- Amenable to therapy – 84.2%
- IOL Exchange – 4.0%
Summary

- Pseudophakic dysphotopsias (PD and ND) represent a meaningful burden.
- Diffractive multifocal IOLs have additional photic side effects.