## Do blue light-blocking IOLs protect the posterior segment from conditions such as 1. age-related macular degeneration and 2. uveal malignant melanomas?

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23. Kongress der DGII
Munich, Germany
February 26-28, 2009

## Financial Disclosure

I have no financial interest in any of the products mentioned!

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## Introduction


Some examples of blue blocking IOLs

- Blue blocking IOLs were developed by Hoya (Tokyo, Japan) and Alcon Laboratories (Fort Worth, TX, USA) nearly simultaneously in 1991.
- One stated intent was and remains to protect the tissues of the posterior segment of the eye from purported deleterious effects of blue light.
- Since their inception the blue blocking IOLs have been advertised and marketed with great gusto by their manufacturers as well as some IOL users and some scientists.
- Recently, some authors have suggested that lack of a blue filter in the IOL optic may put the eye a risk for formation of uveal melanocytic growths or neoplasms .
- In sharp contrast there has been opposition to lenses with blue blocking filters by surgeons who have not found significant value to these, as well as scientists, who after years of study have not established their value and hence oppose their use.



## Purpose

To evaluate, in a prospective analysis of a large database of cadaver eyes with IOLs whether clear optic, non-blue blocking IOLs cause or exacerbate posterior segment conditions such as
1. age-related macular degeneration (ARMD) or
2. uveal nevi and malignant melanomas.

**In essence, are blue blockers necessary?**




## We have divided the study into two groups:

**Study 1 (ARMD):** We utilized data from our database of 4,000 cadaver eyes to test the hypothesis that blue light blocking IOLs may protect the posterior segment of the eye from conditions such as ARMD or that a lack of a blue blocking filter may be harmful to the eye.
*(None of the lenses in this database had blue blocking optics.)*

**Study 2 (Uveal Melanoma):** Furthermore we tested the recently reported hypothesis that blue light may be a causative factor in the pathogenesis of uveal melanocytic neoplasms and therefore that blue-blocking IOLs may help prevent the onset and growth of these lesions.



## Methods

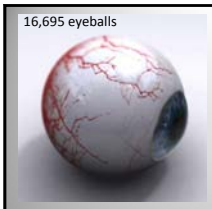
| Year | Amount |
|---|---|
| 1982 | 2 |
| 1983 | 87 |
| 1984 | 180 |
| 1985 | 497 |
| 1986 | 888 |
| 1987 | 1140 |
| 1988 | 1127 |
| 1989 | 1062 |
| 1990 | 1009 |
| 1991 | 1030 |
| 1992 | 984 |
| 1993 | 901 |
| 1994 | 920 |
| 1995 | 852 |
| 1996 | 771 |
| 1997 | 1532 |
| 1998 | 1575 |
| 1999 | 960 |
| 2000 | 666 |
| 2004-2008 | 512 |
| TOTAL | 16,695 |

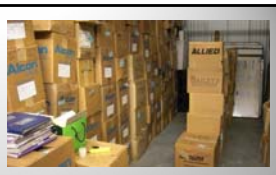
Tabulations of our database of accessioned cadaver eyes

This yellow box shows that we reached a total of more than 4,000 eyes in 1989.

The present study was terminated at that point although the anterior segment studies, as well as an informal analysis of posterior segment tissues, were continued to the present (n=16,695) and still counting.

16,695 eyeballs





We accessioned a total of **16,695 cadaver eyes** for study of ***anterior*** **segment lesions** and conditions.

From these we utilized the first **4,000 eyes** for the study of **posterior segment lesions.**

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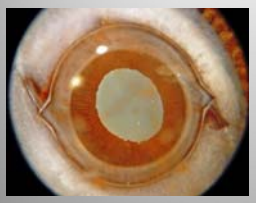
anterior



These figures are examples of the **anterior segment** utilizing the ***"Miyake-Apple Posterior Video - Photographic*** *Technique",*
*designed to evaluate*
*many conditions, including post surgical cellular proliferation and PCO rates.*
*(Left: Alcon IOL design, right: AMO IOL design)*

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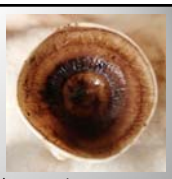
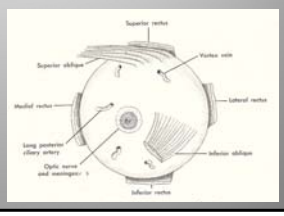
posterior



**Posterior aspect** of one of the 4.000 cadaver eyes from our study containing an IOL.

The best means of identifying the location of lesions in the posterior segment of the globe is by examination and orientation of structures seen on the exterior or epibulbar surface of the globe.



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**These are examples of the types of lesions one would expect to find if lack of a blue filter was a factor in their pathogenesis.**
**We did not find these!**

These figures show two control photomicrographs, cystoid diabetic retinopathy (left) and age-related macular degeneration (ARMD ) -right.
They were obtained in autopsy globes from cases in our laboratory collection unrelated to those analyzed in the 4,000 test eyes in the present study. They demonstrate that when present they can be readily recognized in post-mortem tissue.
Lesions such as these were searched for in the present study, **but rarely found!**

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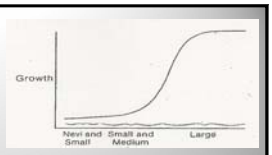
**D.J. Apple and F. Blodi** described the biphasic growth pattern of nevi/melanomas, as illustrated here. The curve illustrates the pattern of cell growth from a small to a large lesion.

**They found that many if not all uveal melanomas were often derived from preexisting nevi, unrelated to external factors such as solar radiation!**




This table shows the relationship of **factors** generally predisposing to orbital extension, distant metastasis, and increased mortality to the two major phases of tumor growth.

Solar irradiation (including blue light) has not been implicated as causative of intraocular uveal melanoma in several studies.
*(In sharp contrast to pigmented tumors of the skin)*

| Slow Growth Phase (Phase A) | % Mortality | Rapid Growth Phase (Phase B) | % Mortality |
|---|---|---|---|
| 1. Age <50 | 27% | Age >60 | 47% |
| 2. Location anterior border at posterior pole | 22% | Anterior border up to or anterior to equator | 33% |
| 3. Surface area <10 mm | 13% | Surface area >10 mm | 70% |
| 4. Height <2 mm | 7% | Height >2 mm | 39-40% |
| 5. Intact Bruch's membrane | 39% | Ruptured Bruch's membrane | 60% |
| 6. Predominant Spindle | | Predominant Epithelioid | |
| Spindle A | 6% | Mixed | 43% |
| Spindle B | 31% | Epithelioid | 64% |
| 7. Relatively amelanotic | 19% | More densely pigmented | 65% |
| 8. Confined to globe | 26% | Scleral infiltration | 57% |

* Modified from Shammas and Blodi,[9] *Arch Ophthalmol* 95:63, 1977.

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**Choroidal malignant melanomas** often begin to form after breakthrough and accelerated growth of a previously flat lesion or nevus that transitions to a more malignant phase, here exemplified by a rupture of Bruch's membrane.
This lesion clearly began as a flat benign nevus.

The **concept of growth and transformation** of a flat lesion (nevus) to a malignant melanoma.
This concept is well illustrated by noting the formation of a "mushroom" type of melanoma (so called *"collar button", "tourniquet" or "purse string" tumor).* Typically the growth progresses from a slow growth phase to a rapid growth phase!

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# Conclusions

## Study 1 - ARMD

After completion of our observations on the 4,000 test eyes *(obviously eyes without blue-blockers because they were implanted in the pre-blue blocker era),* **we found virtually no unexpected sensory retinal conditions that would otherwise be encountered in non-operated eyes!**

## Study 2 - Uveal Melanoma

The review of the same 4,000 test eyes **did not reveal any evidence of an increased incidence of uveal melanocytic proliferations/neoplasms.**

This is in agreement with previous studies of Apple and Blodi and others who **did not find a correlation** between solar radiation and uveal melanoma.
The authors also found that many if not all uveal melanomas were often derived from preexisting nevi, unrelated to external factors such as solar radiation!



# Conclusions

## In both Study 1 and Study 2,

**we did not uncover evidence that clear-optic, non-filtered IOLs (IOLs without blue blockers) caused or increased the incidence of these lesions (ARMD and/or uveal melanoma)**

**Therefore we believe that:**

**There is no support to the contention that blue light-blocking IOLs protect the posterior segment of the eye from these conditions!**



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