

Macular protection with IOLs

Per Söderberg^{*abNF}, Stefan Löfgren^{aNF}, Marcelo Ayala^{acNF}, Xiuqin Dong^{aNF}, Manoj Kakar^{aNF},
Vino Mody^{aNF}, Linda Meyer^{aNF}, Carl-Gustaf Laurell^{aNF}

^aSt. Erik's Eye Hospital, Karolinska Institutet

^bDepartment of Biomedical Engineering, University of Miami

^cÖrebro University Hospital, Örebro University

ABSTRACT

The clinical outcome within one month after phacoemulsification cataract extraction with implantation of the blue-blocking SN60AT IOL was examined prospectively and compared to a retrospectively examined material of implantations of the equivalent SA30AL without blue-blocker. There was no difference in best corrected visual acuity gain between the two lenses. In addition, the subjective color perception was examined for with a questionnaire after the first implantation of blue-blocking IOL and after the second implantation of blue-blocking IOL. Only one patient noted a changed color perception. There are thus strong theoretical reasons to block blue light in IOLs and no short term clinical inconvenience. But, it remains to be proven in long term follow up studies that the blue-blocking IOL protects against macular degeneration.

Keywords: blue light, macular degeneration, yellow IOL, blue blocker

1. INTRODUCTION

The prevalence of macular degeneration in the western world increases linearly from less than 10 % at the age of 60 to 100 % at the age of 100 [1-6].

Experimental exposure of animals to blue light induces damage in the outer retina [7]. If the sun is gazed, solar retinopathy develops [8]. Clinical findings as in solar retinopathy have been observed in people living in ambient with a high intensity of solar radiation [9]. There is epidemiological evidence that exchange of the crystalline lens for a plastic IOL induces a quicker development of age related macular degeneration [10-12]. Further, in pre-existing macular degeneration and uneventful postoperative course in the first eye, there is a substantial increased risk for development of wet AMD after cataract operation in the second eye [13].

The spectral sensitivity of the retina to visible radiation peaks in the blue [14].

The attenuation of blue light in the ocular lens increases with increasing age [15, 16].

Originally Hoya (JAPAN) and recently ALCON (USA) have launched blue light filtering IOLs on the market. The original HOYA lens (UVC-1P) was a rigid lens but the recent HOYA (AF-1(UY)) and ALCON (SN60AT) are both foldable hydrophobic acrylic lenses (Figure 1).

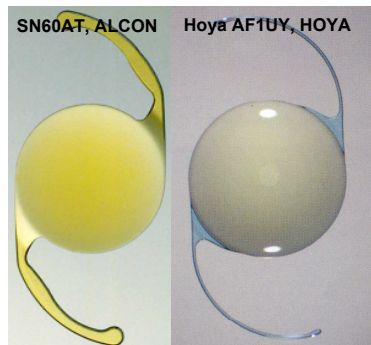


Figure 1 Blue blocking IOLs.

The transmittance characteristics of the two lenses are very similar (Figure 2).

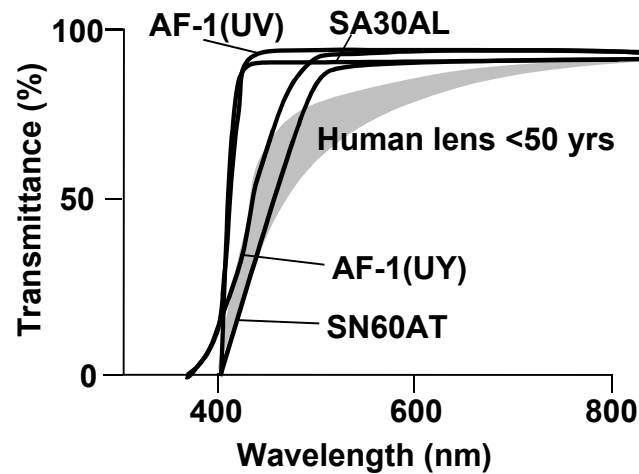


Figure 2 Spectral transmittance of blue-blocking IOLs as given by the manufacturers.

Both lenses attenuate blue light approximately as an average 50 yrs old human lens but the HOYA lens generally transmits a little bit more.

The current study intended to evaluate the short term clinical outcome of the first Swedish implantations of the SN60AT.

1 METHODS

It was intended to implant both eyes of 20 patients with SN60AT (ALCON, USA). The subjects were consecutive patients in the cataract ward at St. Erik's Eye Hospital, Stockholm, Sweden, that pre-operatively were judged to benefit from bilateral cataract operation with IOL implantation.

All patients underwent standard phacoemulsification surgery and lens implantation was done with the ALCON MONARCH® injector.

The outcome was planned to be compared to the outcome of a retrospective analysis of 200 consecutive implantations of the equivalent ALCON IOL without the blue light blocker (SA30AL).

For this evaluation, gain in best spectacle corrected visual acuity (BSCVA) was compared for the two lens types. Further, each patient implanted with the blue-blocking SN60AT was asked "Do you recognize any change of color perception after the operation?" after the implantation of the first lens and after the implantation of the second lens, and were allowed to answer yes or no.

2 RESULTS

There was no difference in gain of BSCVA between the two lens types (Figure 3)

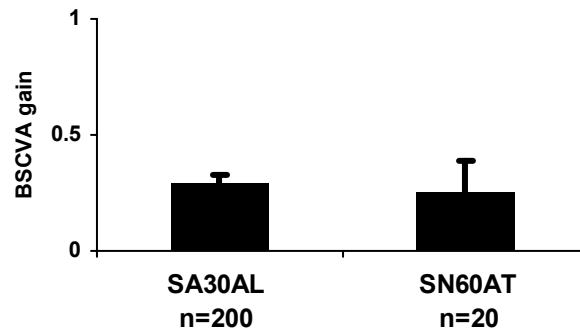


Figure 3 Gain of best spectacle corrected visual acuity on right eye. Bars are 95 % confidence intervals for mean gain.

as tested with Mann-Whitney's test with normal approximation (test statistic = 0.50, $Z_{0.05(2)} = 1.96$)

With regard to the question on subjective change of color perception after the IOL implantation, 1/20 responded yes after the first implantation and none of the patients yes after the second implantation.

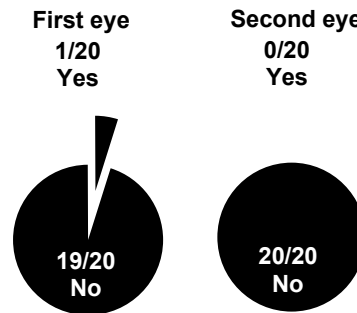


Figure 4 Subjective change of color perception

3 DISCUSSION

The fact that the spectral sensitivity of the retina to visible radiation peaks in the blue part of the spectrum [14] and that the normal non-cataractous human lens attenuates a lot of the blue light [15, 16] raises the question if replacement of a cataractous lens with a transparent IOL, leads to toxic exposure of the retina to blue light and thereby increase of macular degeneration [12]. This has led to the development of blue-blocking IOLs. The purpose of the present investigation was to preliminary examine the short term clinical outcome of implantations of the blue-blocking IOL SN60AT.

The finding that there was no difference in short term BSCVA between the non blue-blocking SA30AL and the blue-blocking SN60AT indicates that there is no short term difference in postoperative resolution of the eye (Figure 3).

The finding that only one patient noted a subjective color perception change after the operation of the first eye and that non of the patients noted any color perception change after the second operation (Figure 4) indicates that altered color perception is a small clinical problem.

In order to demonstrate a protective effect of the blue-blocking pigment in IOLs for prevention of macular degeneration, extended postoperative clinical follow up is required. However, the theoretical foundation for using a blue-blocking IOL

is strong. Further, current short term clinical outcome has not demonstrated any shortcomings with the blue-blocking IOLs. The current argument for using blue-blocking IOLs is therefore strong. It remains to be proven in long term follow up studies that the blue-blocking IOL protects against macular degeneration.

REFERENCES

- 1 Bressler. N. M, Bressler. S. B, West. S. K, Fine. S. L and Taylor. H. R The grading and prevalence of macular degeneration. *Arch Ophthalmol* 107, 847-852, 1989.
- 2 Klein. R, Klein. B. E and Linton. K. L Prevalence of age-related maculopathy. *Ophthalmology* 99, 933-943, 1992.
- 3 Klein. R, Rowland. M. L and Harris. M. I Racial/ethnic differences in age-related maculopathy. Third National Health and Nutrition Examination Survey. *Ophthalmology* 102, 371-381, 1995.
- 4 Laatikainen. L and Hirvelä. H Prevalence and visual consequences of macular changes in a population aged 70 years and older. *Acta Ophthalmol (Copenh)* 73, 105-110, 1995.
- 5 Vingerling. J. R, Dielmans. I, Hofman. A, Hijmering. M, Kramer. C. F. L and De Jong. P. T Prevalence of age-related maculopathy among elderly people; the Rotterdam Study. *Ned Tijdschr Geneesk* 139, 2252-2255, 1995.
- 6 Schachat. A. P, Hyman. L, Leske. M. C, Connell. A. M and Wu. S. Y Features of age-related macular degeneration in a black population. The Barbados Eye Study Group. *Arch Ophthalmol* 113, 728-735, 1995.
- 7 Wu. J, Chen. E and Söderberg. P. G Failure of ascorbate to protect against broadband blue light-induced retinal damage in rat. *Graefes Arch Clin Exp Ophthalmol* 237, 855-860, 1999.
- 8 Sadun. A. C, Sadun. A. A and Sadun. L. A Solar retinopathy. *Arch Ophthalmol* 102, 1510-1512, 1984.
- 9 Young. R. W Foveomacular retinitis in military personnel. *US Army Med Bull* 26, 250-251, 1969.
- 10 Pollac. A, Marcovich. A, Bukelman. A and Oliver. M Age-related macular degeneration after extracapsular cataract extraction with intraocular lens implantation. *Ophthalmology* 103, 1546-1554, 1995.
- 11 Klein. R, Klein. B. E, Jensen. S. C and Cruickshank. K. J The relationship of ocular factors to the incidence and progression of age-related maculopathy. *Arch Ophthalmol* 116, 506-513, 1998.
- 12 Wang. J. J, Klein. R, Smith. W, Klein. B, Tomany. S and Mitchell. P Cataract surgery and the 5-year incidence of late stage age-related maculopathy. *Ophthalmology* 110, 1960-1967, 2003.
- 13 Pollac. A, Bukelman. A, Zalish. M, Leiba. H and Oliver. M The course of age-related macular degeneration following bilateral cataract surgery. *Ophthalmic Surg Lasers* 29, 286-294, 1998.
- 14 Ham. W. T, Mueller. H. A and Sliney. D Retinal sensitivity to damage from short wavelength light. *Nature* 160, 153-155, 1976.
- 15 Boettner. E. A and Wolter. J. R Transmission of ocular media. *Invest Ophthalmol Vis Sci* 1, 776-783, 1962.
- 16 Lerman. S and Borkman. R Spectroscopic evaluation and classification of the normal aging and cataractous lens. *Ophthalmic Res* 8, 335-353, 1976.

