

Blue Light Filtering Intraocular Lenses in Phacoemulsification Cataract Surgery

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ABSTRACT

Blue light can damage retina and cause age related macular degeneration. After cataract surgery and lens removal retina stays unprotected. Blue light filtering intraocular lenses (IOL) increase protection of the retina. In our prospective study we investigated clinical results after bilateral implantation of Acrysof Natural IOL to 30 patients (N=60 eyes). In a control group (N=60 eyes, 30 patients), standard acrysof IOL was implanted bilaterally. Uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA) and Nd YAG laser capsulotomy rate were measured and compared with control group. Subjective patient's satisfaction and subjective colour perception were also investigated. There was no significant difference in UCVA, BCVA and Nd YAG laser capsulotomy rate between the two groups. High patient's satisfaction was noticed (96,7% of patients would implant Acrysof Natural IOL again). Acrysof Natural IOL enables good visual acuity VA, low rate of Nd YAG laser capsulotomy and high patient's satisfaction without colour perception disturbances.

Key words: light, lenses, intraocular, phacoemulsification, pseudophakia, macular degeneration

Introduction

The blue light region in the visible light spectrum is between 400–500 nm. It has the highest amount of energy in this spectrum and potentially can cause the largest damage on the retina¹⁻². Blue light is a component of sunlight and some artificial light sources such as office light, computers etc. Naturally human eye has its own protection against blue light in cornea, lens and macula (which contents yellow pigment). Those are natural blue light filters and lens is a major one. As we age, retina loses ability to produce yellow pigment and stays unprotected. But at the same time lens becomes more and more yellow and compensate loss of the macular pigment³. The problem exists when we do the cataract surgery or clear lens extraction and remove the only protection that has left in the eye (namely, cornea has only symbolic role in blue light filtering)⁴. After cataract removal blue light can freely reach retina. In the aging eye, retina becomes built up of the lipofuscin. A major constituent of lipofuscin is the fluorescent pigment A2E⁵. It accumulates in retinal pigment epithelium cells⁶. Excited by the

blue light A2E creates free radicals and causes RPE cells death that leads to age related macular degeneration (AMD)⁷. There are experiments that showed that blue light illumination of the RPE cell culture models accumulated with lipofuscin fluorophore A2E causes RPE cells apoptosis⁷. This is a link between blue light, cataract surgery and AMD. Cataract surgery significantly increases the risk for AMD⁴. Standard intraocular lenses protects only against UV light. Blue light filtering intraocular lens (Acrysof Natural IOL) contains covalently bounded chromophore that filters blue light and increases protection of the retina. It also absorbs UV light. Blue light filtering intraocular lens (Acrysof Natural IOL) transmits blue light similar to a fifty-three years old crystalline lens⁸. Studies have shown there are no detrimental effects on colour vision, contrast sensitivity and visual acuity after Acrysof Natural IOL implantation⁹⁻¹⁰. In our study we investigated clinical effects of Acrysof Natural implantation.

Patients and methods

This was a prospective, randomized comparative study. Patients were divided in two groups. First one included 30 patients (60 eyes) where blue light filtering intraocular lens (Acrysof Natural IOL) was bilaterally implanted. Control group included 30 patients, (60 eyes) with conventional AcrySof MA60BM IOL implantation. There were no significant differences between the two investigated groups regarding age, gender and ocular pathology. Mean age in »Natural group« was 68±4.5 years and 67±4.2 years in control group. In both groups we had 21 females and 9 males. Patients with glaucoma, retinal, or any other severe ocular pathology were excluded from the study. Cataract extraction was performed by PHACO surgery in the Eye Clinic »Svjetlost« (Infiniti, Alcon Laboratories Inc.) and University Department of Ophthalmology of General Hospital »Sveti Duh« (Legacy, Alcon Laboratories Inc.) in Zagreb, Croatia by two surgeons. There were no intraoperative or postoperative complications. Follow up was 6 months. Uncorrected visual acuity, best corrected visual acuity and Nd YAG laser capsulotomy rate were measured and compared in both groups. Patients were asked about their subjective satisfaction and subjective colour perception under photopic and mesopic conditions. In six patients AcrySof Natural IOL was implanted in one eye and AcrySof MA60BM IOL in other eye. We compared patient's satisfaction and subjective color perception under photopic and mesopic conditions between the two eyes. SPSS 11.0 for Windows was used for statistical analysis. Since there were two investigated groups with dichotomous variables, statistical significance was determined by Chi-Square test at level of 5%.

Results

Patients achieved similar uncorrected visual acuity (UCVA) in both groups. UCVA better than 0.8 (20/25) was achieved in 86.7% patients in »Natural group« and in 85.0% of those in control group) (Figure 1). There was no statistically significant difference between groups (Chi-square=0.69; df=1; p=0.793) (Figure 2). All patients regardless of the type of implanted IOL, achieved BCVA better than 0.8 (20/25) (Figure 3). Nd YAG laser capsulotomy rate was low (Figure 4) and there was no statistically significant difference between two groups

(Chi-square=0.152; df=1; p=0.5), (Figure 5). High patient's satisfaction was noticed since 96, 66 % of patients would implant AcrySof Natural IOL again (Figure 6). Only one patient would not implant this lens again due to the fact that other people can see yellow »shine« in his eye. None of the patients reported any colour perception disturbances in photopic or mesopic conditions. Out of 6 patients having AcrySof Natural IOL in one and standard AcrySof IOL in other eye, 3 patients were more satisfied with AcrySof Natural IOL, 2 of them didn't notice any difference and one of them was more satisfied with AcrySof MA60BM IOL. There was no difference in color perception under photopic and mesopic conditions between the two eyes.

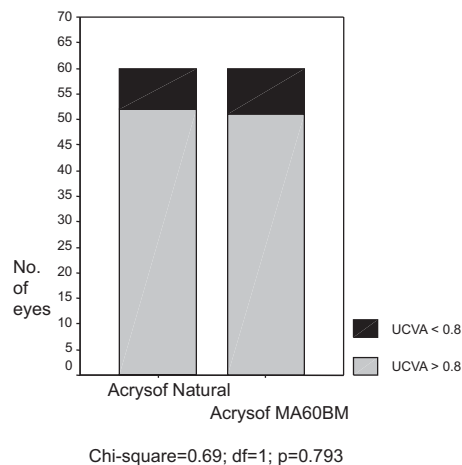


Fig. 2. Statistical analysis of difference between uncorrected visual acuity (UCVA) in Acrysof Natural IOL and Acrysof MA60BM group.

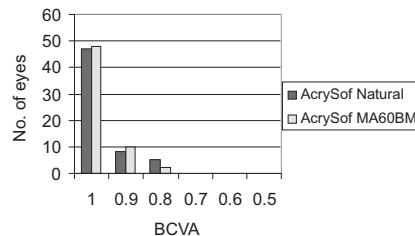


Fig. 3. Best corrected visual acuity (BCVA) at six postoperative month on patients implanted with blue light filtering lens (Acrysof Natural IOL) and standard acrylic lens (Acrysof MA60BM).

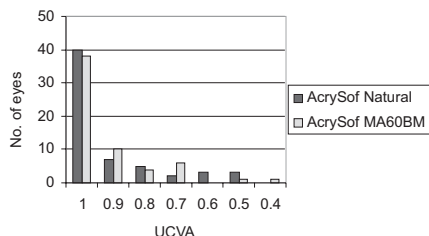


Fig. 1. Uncorrected visual acuity (UCVA) at six postoperative months on patients implanted with blue light filtering lens (Acrysof Natural IOL) and standard acrylic lens (Acrysof MA60BM).

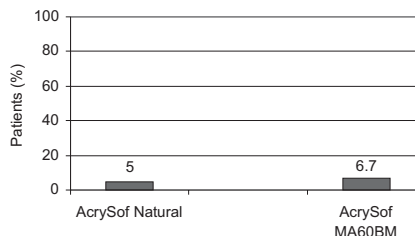
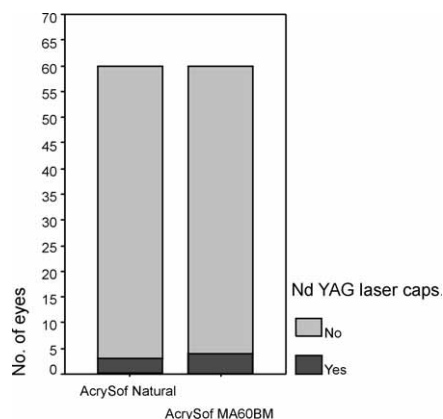


Fig. 4. Nd YAG laser capsulotomy rate in eyes implanted with blue light filtering lens (Acrysof Natural IOL) and standard acrylic lens (Acrysof MA60BM) at six postoperative months.



Chi-square=0.152; df=1; p=0.5

Fig. 5. Statistical analysis of difference between Nd YAG laser capsulotomy rate after AcrySof Natural IOL and AcrySof MA60BM IOL implantation.

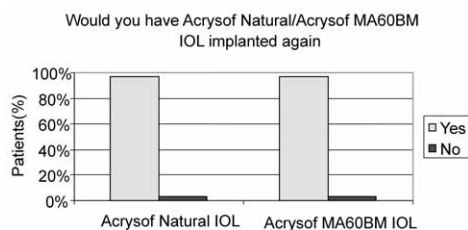


Fig. 6. Patient's subjective satisfaction after AcrySof Natural IOL and AcrySof MA60BM IOL implantation.

Discussion

According to our data, AcrySof Natural IOL enables good visual acuity which is comparable to results with standard acrysof lenses. The rate of Nd YAG laser capsulotomy is low in both investigated groups. Patients had to fill the questioner about colour perception disturbances in conditions of bright and low light. There were

some critics of this lens stating that blue light filtering reduces ability to discriminate between dark blue and black colours, especially in low light conditions¹¹. Our study have shown that there are no subjective colour perception disturbances. The study conducted by Robert J. Cionni also showed there is no difference in colour perception between patients with Acrysof Natural IOL and those with Acrysof SA60AT IOL and phakic patients¹². In the group where Acrysof Natural IOL was implanted in one eye and standard Acrysof IOL in the fellow eye few patients state that they prefer one type of the lens over other. However, they could not give us some specific reasons why they prefer one or the other lens. We can assume they would not report any difference if they had not been specifically asked for that. Patients were informed that different lenses were implanted. None of them had noticed any difference in colour perception between the two eyes. The aim of this study was not to investigate whether Acrysof Natural IOL prevent or reduce risk of age related macular degeneration since follow up was much too short for such conclusions. Our goal was to check clinical effects after its implantation and to investigate eventual detrimental effects on visual acuity and subjective colour perception. Evidences suggest that blue light can damage macula in patients who underwent cataract surgery or clear lens extraction^{6,13}. Also it is shown that RPE cells accumulated with lipofuscin and exposed to blue light undergo apoptosis. However, when we put Acrysof Natural IOL between blue light source and RPE cell culture model, cells stay viable¹⁴. AMD is a leading cause of central vision loss among people over 50 years of age in developed world. Some believe that AMD is related to genetics, while others thinks that environmental factors such as smoking, light and diet cause AMD. Since we are not satisfied with AMD treatments, we should try to prevent the disease. Blue light is surely not the only risk factor for AMD, but we can assume that blue light filtering IOLs may reduce risk of this disease. However, for such conclusion a longer follow up of patients implanted with Acrysof Natural IOL is needed.

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INTRAOKULARNE LEĆE S FILTEROM PLAVOG SVJETLA U ULTRAZVUČNOJ OPERACIJI KATARAKTE

S A Ž E T A K

Plavo svjetlo može oštetiti mrežnicu i uzrokovati senilnu degeneraciju makule. Nakon operacije mrežnice i odstranjenja leće mrežnica ostaje nezaštićena. Intraokularne leće (IOL) s filterom plavog svjetla povećavaju zaštitu mrežnice. U našoj prospektivnoj studiji ispitivali smo kliničke rezultate nakon obostrane ugradnje Acrysof Natural IOL kod 30 bolesnika (N=60 očiju). U kontrolnoj skupini (30 bolesnika, N=60 očiju) ugradili smo obostrano standardnu, akriličnu IOL. Mjerali smo nekorigiranu vidnu oštrinu (UCVA), najbolje korigiranu vidnu oštrinu (BCVA) i učestalost Nd YAG laser kapsulotomije i usporedili s kontrolnom skupinom. Ispitivali smo i subjektivno zadovoljstvo i osjet boja bolesnika. Nije nađena značajna razlika u UCVA, BCVA i učestalosti Nd YAG kapsulotomije između dvije skupine. Bolesnici su bili izrazito zadovoljni (96,7% bolesnika bi ponovno ugradili Acrysof Natural IOL). Acrysof Natural IOL omogućava dobru vidnu oštrinu, nisku učestalost Nd YAG laser kapsulotomije i visoko zadovoljstvo bolesnika bez smetnji osjeta boja.