European Journal of Ophthalmology / Vol. 15 no. 4, 2005 / pp. 458-461

Contrast and glare sensitivity after implantation of AcrySof® and Human Optics 1CU® intraocular lenses

B.A. KAMPPETER, G. SAUDER, J.B. JONAS

Department of Ophthalmology, Faculty for Clinical Medicine Mannheim, Ruprecht-Karls-University, Heidelberg - Germany

PURPOSE. To evaluate contrast and glare sensitivity of a newly developed, potentially accommodative intraocular lens.
METHODS. The clinical interventional prospective randomized study included 20 patients (23 eyes) undergoing standard phacoemulsification with clear cornea incision in topical anesthesia. In the study group (10 eyes), the 1CU Human Optics intraocular lens (optics diameter 5.5 mm) was implanted. The control group (13 eyes) received the monofocal AcrySof intraocular lens (optics diameter: 6.0 mm). Using a newly developed contrast measuring device, contrast and glare sensitivity were tested 4 weeks after surgery.
RESULTS. The study group and control group did not vary significantly in contrast (p=0.38) or glare sensitivity (p=0.52).
CONCLUSIONS. The results suggest that the newly developed 1CU Human Optics intraocular lens and the standard AcrySof intraocular lens do not vary significantly in glare and contrast sensitivity. (Eur J Ophthalmol 2005; 15: 458-61)

KEY WORDS. Glare sensitivity, Contrast sensitivity, Intraocular lens, 1CU, AcrySof

Accepted: March 29, 2005

INTRODUCTION

Cataract surgery is able to restore almost all physiologic functions of the crystalline lens, such as transparency, refraction, absorption of ultraviolet light, and compartmentalization of the eye into a smaller anterior segment and a larger posterior segment (1). Recently, efforts have been intensified to develop intraocular lenses that may re-establish accommodation as one of the few remaining functions of the physiologic crystalline lens not yet restored by cataract surgery (2-11).

Because quality of vision does not depend on central visual acuity alone (12) but also on parameters such as contrast and glare sensitivity, and because newly designed intraocular lenses should be tested before being generally recommended for intraocular implantation, it was the purpose of the present study to evaluate contrast and glare sensitivity in relation to central visual acuity in patients who received a newly developed intraocular lens (Human Optics 1CU; Human Optics AG, Erlangen, Germany) compared with patients who received a standard intraocular lens (Alcon AcrySof® MA50BM; Alcon, Fort Worth, TX).

PATIENTS AND METHODS

The clinical interventional prospective randomized study included 23 eyes of 20 patients (11 women). The study group consisting of 10 eyes (44%; 9 pa-

1120-6721/458-04$15.00/0

tients) received the 1CU intraocular lens (optics diameter 5.5 mm). Thirteen (56%) eyes (11 patients) forming the control group received the monofocal AcrySof® intraocular lens (optics diameter: 6.0 mm).

Patients with postoperative visual acuity lower than 0.7 4 weeks after surgery were excluded to minimize visual acuity influence on contrast and glare sensitivity measurements. Other exclusion criteria were posterior lens capsule opacification upon slit lamp examination at 4 weeks after surgery, marked macular drusen, or other retinal diseases such as diabetic retinopathy. All patients signed an informed consent. The ethics committee of the university approved the study following the tenets of the Declaration of Helsinki. The study was performed at a university hospital. The control group receiving the AcrySof® intraocular lens and the study group receiving the Human Optics 1CU® intraocular lens did not differ significantly in age (65.9 ± 17.7 years versus 66.5 ± 10.5 years; p=0.93), intraocular pressure (16.2 ± 1.6 mmHg versus 16.2 ± 1.9 mmHg; p=0.95), or refractive error (+0.35 ± 0.75 diopters versus +0.17 ± 0.50 diopters; p=0.51). Surgery performed by the same surgeon with an experience of more than 3000 cataract surgeries at start of the study included a standard phacoemulsification through a 3 mm clear corneal incision, capsular rhexis with a diameter of approximately 5 mm (12), and implantation of the intraocular lens into the capsular bag. Intraoperative and postoperative complications such as lens capsule rupture, vitreous prolapse, subluxation of the intraocular lens, or postoperative wound dehiscence were not encountered.

At 4 weeks after surgery, the patients were re-examined including refractometry, measurement of visual acuity, slit lamp biomicroscopy of the anterior segment, and fundus examination in medical mydriasis. Contrast and glare sensitivity were measured photometrically using the Kontrastometer BA4 (BKG Medizintechnik, Bayreuth, Germany; Fig. 1). It projects a black optotype (Landolt ring, visual acuity level 0.1, presentable in eight directions) on a background of variable brightness. The latter is increased linearly and continuously during the course of the examination, starting from black background (no contrast, no optotype visible). Luminance and back light brightness are strictly defined. The scale ranges from 0 (for “no luminance,” minimal contrast) to 500 (for “full contrast,” luminance 0.40 cd/m^2).

Fig. 1 - Kontrastometer BA4, table mounted look-in device with operator’s external control.

After mesopic adaptation for 4 minutes, examinations were conducted under best-corrected visual acuity conditions with non-dilated pupils. Contrast was increased until the black optotype could be detected by the patient. The tests were repeated three times, and the mean contrast sensitivity was calculated. Glare sensitivity was measured using the same set-up with exception of a turned-on white glare light which is built into the device (diameter: 20’; angle: 3°, corneal illuminance 0.35 lux). Contrast was increased until the patient identified the optotype. The test was repeated three times, and the mean value was calculated. Results were given in arbitrary units ranging from 0 to 500, with lower figures indicating better contrast and glare sensitivity.

For statistical analysis, means and standard deviations as well as medians and ranges are presented. For the comparison of the study group and control group, statistical tests for unpaired samples were applied. The level of significance was 0.05 (two-sided) in all statistical tests. The statistical analysis was performed using the statistical software package SPSS-WIN, release 11.5.

RESULTS

Contrast sensitivity did not vary significantly between the control group receiving the AcrySof MA50BM intraocular lens and the study group receiving the 1CU intraocular lens (74.6 ± 38.0 units versus 63.3 ± 21.3

units; p=0.38) (Fig. 2). In a parallel manner, glare sensitivity did not differ significantly between the Acrysof-MA50BM control group and the 1CU intraocular lens study group (135.8 ± 47.0 units versus 149.8 ± 54.6 units; p=0.52) (Fig. 3).

Although no significant difference was found between the groups, the large spread of the patients receiving the AcrySof MA50BM intraocular lens was noted. The reason was found to be a single person who showed a significant lower contrast sensitivity (160 units) compared to the rest of the group (mean: 65.1 units), for which no apparent reason could be found. If this case is excluded, contrast sensitivity values and range of both groups converge (65.1 ± 27.7.0 units versus 63.3 ± 21.3 units; p=0.86). None of the statements in this article is affected by this case.

Glare sensitivity was significantly correlated with visual acuity (correlation coefficient r=-0.52; p=0.01). Correspondingly, visual acuity was significantly correlated with contrast sensitivity (r=-0.39; p=0.06). Contrast sensitivity and glare sensitivity were highly significantly correlated with each other (r=0.64; p=0.001). No correlation was found between age and contrast (r=0.10; p=0.64) or glare sensitivity (r=0.26; p=0.23).

Due to the selection of patients with an exclusion criterion of a postoperative visual acuity of lower than 0.7 at the postoperative examination 4 weeks after surgery, visual acuity 4 weeks post surgery was 0.90 ± 0.12 (AcrySof) and 0.99 ± 0.17 (1CU) with no significant difference between the two study groups (p=0.80).

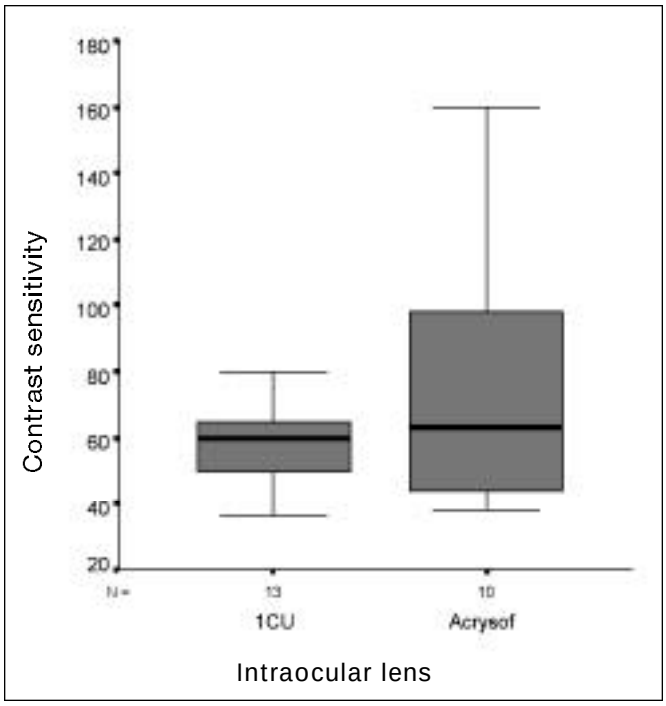

Fig. 2 - Contrast sensitivity in patients receiving the 1CU intraocular lens and patients receiving the AcrySof MA50BM intraocular lens.

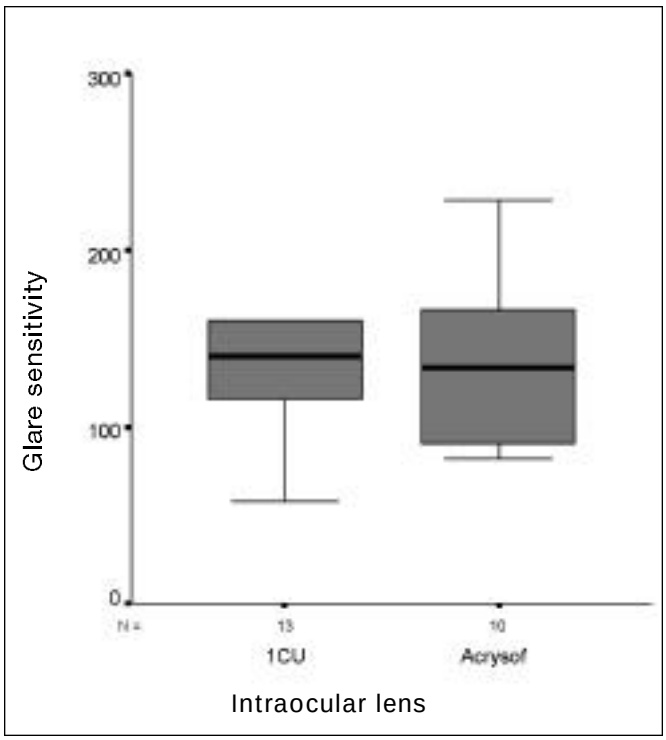

Fig. 3 - Glare sensitivity in patients receiving the 1CU intraocular lens and patients receiving the AcrySof MA50BM intraocular lens.

DISCUSSION

Quality of vision is influenced by several parameters such as central and paracentral visual acuity, central and peripheral visual field, color vision, dark adaptation, and contrast and glare sensitivity. The success of cataract surgery in terms of visual rehabilitation is usually given as increase in central visual acuity. From a psychophysical point of view, however, one may take into account that central visual acuity is only one out of several factors for the gain in quality of vision by cataract surgery. Contrast and glare sensitivity are important additional parameters for the comfort of vision (13-16). The results of the present study suggest that the new, potentially accommodating, intraocular lens

1CU does not differ in glare and contrast sensitivity from a standard non-accommodating intraocular lens. They may also suggest that the potential accommodating mechanism of the intraocular lens 1CU, if present or not, may not interfere with glare and contrast sensitivity. In summary, both intraocular lenses examined in the present study showed a similar performance with respect to contrast and glare sensitivity. The potentially accommodative design of the HumanOptics 1CU intraocular lens does not seem to significantly influence contrast and glare sensitivity.

Reprint requests to:
B. Kamppeter, MD
Universitäts-Augenklinik
Theodor-Kutzer-Ufer 1-3
68167 Mannheim, Germany
Bernd.Kamppeter@augen.ma.uni-heidelberg.de

REFERENCES

1. Olson RJ, Mamalis N, Werner L, Apple DJ. Cataract treatment in the beginning of the 21st century. Am J Ophthalmol 2003; 136: 146-54.
2. Leyland MD, Langan L, Goolfee F, et al. Prospective randomised double-masked trial of bilateral multifocal, bifocal or monofocal intraocular lenses. Eye 2002; 16: 481-90.
3. Jacobi PC, Dietlein TS, Luke C, Jacobi FK. Multifocal intraocular lens implantation in prepresbyopic patients with unilateral cataract. Ophthalmology 2002; 109: 680-6.
4. Kuchle M, Nguyen NX, Langenbucher A, et al. Two years experience with the new accommodative 1 CU intraocular lens. Ophthalmologe 2002; 99: 820-4.
5. Kuchle M, Nguyen NX, Langenbucher A, et al. Implantation of a new accommodative posterior chamber intraocular lens. J Refract Surg 2002; 18: 208-16.
6. Auffarth GU, Martin M, Fuchs HA, et al. Validity of anterior chamber depth measurements for the evaluation of accommodation after implantation of an accommodative Humanoptics 1CU intraocular lens. Ophthalmologe 2002; 99: 815-9.
7. Mastropasqua L, Toto L, Nubile M, et al. Clinical study of the 1CU accommodating intraocular lens. J Cataract Refract Surg 2003; 29: 1307-12.
8. Leyland M, Zinicola E. Multifocal versus monofocal intraocular lenses in cataract surgery: a systematic review. Ophthalmology 2003; 110: 1789-98.
9. Montes-Mico R, Espana E, Bueno I, et al. Visual performance with multifocal intraocular lenses: mesopic contrast sensitivity under distance and near conditions. Ophthalmology 2004; 111: 85-96.
10. Doane JF. Accommodating intraocular lenses. Curr Opin Ophthalmol 2004; 15: 16-21.
11. Kuchle M, Seitz B, Langenbucher A, et al. Comparison of 6-month results of implantation of the 1CU accommodative intraocular lens with conventional intraocular lenses. Ophthalmology 2004; 111: 318-24.
12. McGwin G Jr, Scilley K, Brown J, Owsley C. Impact of cataract surgery on self-reported visual difficulties: comparison with a no-surgery reference group. J Cataract Refract Surg 2003; 29: 941-8.
13. Kora Y, Marumori M, Kizaki H, et al. Experimental study of small intraocular lenses using an eye model. J Cataract Refract Surg 1993; 19: 772-5.
14. Superstein R, Boyaner D, Overbury O, Collin C. Glare disability and contrast sensitivity before and after cataract surgery. J Cataract Refract Surg 1997; 23: 248-53.
15. Erie JC, Bandhauer MH. Intraocular lens surfaces and their relationship to postoperative glare. J Cataract Refract Surg 2003; 29: 336-41.
16. Kershner RM. Retinal image contrast and functional visual performance with aspheric, silicone, and acrylic intraocular lenses. Prospective evaluation. J Cataract Refract Surg 2003; 29: 1684-94.