Contralateral comparison of visual outcome of AcrySof IQ and SA60AT intraocular lenses

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ABSTRACT • RÉSUMÉ

Objective: To compare the visual performance of aspherical AcrySof IQ (SN60WF) and SA60AT spherical intraocular lenses after cataract surgery.

Design: Prospective comparative study.

Participants: Seventy eyes of 35 patients who underwent phacoemulsification for cataract surgery.

Methods: The IQ lens was implanted in one eye and the SA60AT lens in the other eye of every patient. Refraction, uncorrected visual acuity (UCVA), and best spectacle-corrected visual acuity (BSCVA) were measured 1 and 3 months after surgery. At 3 months' follow-up, the quality of vision, in terms of contrast sensitivity (CS) with and without glare and higher-order aberrations (HOA), was also determined.

Results: At 3 months postoperative, the mean UCVA in the IQ and SA60AT groups was 0.25 (SD 0.26) and 0.30 (SD 0.27), respectively, and BSCVA was 0.10 (SD 0.16) in both groups. Spherical refractive error was −0.56 (SD 1.03) D and −0.47 (SD 0.64) D in the IQ and SA groups, respectively. In photopic conditions without glare, IQ eyes had statistically significant better CS at 12 cycles per degree (cpd) and better function at 3 and 18 cpd, and in mesopic conditions without glare, IQ eyes also had better results at 3, 12, and 18 cpd. In mesopic conditions with glare, IQ eyes also had better CS in 6 and 18 cpd. In terms of aberrations, the IQ group had significantly ($p < 0.05$) lower spherical aberrations, root mean-square, and coma X and Y values with 6 mm pupil size than the SA group.

Conclusions: In terms of refraction, no significant difference was found between these 2 types, but there was a difference in the quality of vision in photopic and mesopic conditions and also HOA. Those with reactive and dilated pupils, such as younger patients and night drivers, may be more satisfied with IQ aspherical lenses.

Objet : Comparaison entre la performance visuelle des lentilles intraoculaires asphériques AcrySof IQ (SN60WF) et celle des lentilles sphériques SA60AT après la chirurgie de la cataracte.

Nature : Étude prospective comparative.

Participants : Soixante-dix yeux de 35 patients qui ont subi une phacoémulsification pour la chirurgie de la cataracte.

Méthodes : La lentille IQ a été implantée dans un œil et la SA60AT dans l'autre œil de chaque patient. La réfraction, l'AVNC (acuité visuelle non corrigée) et la MAVC (meilleure acuité visuelle corrigée) ont été mesurées 1 et 3 mois après la chirurgie. Après 3 mois de suivi, la qualité de la vision, en termes de sensibilité au contraste (SC) avec et sans éblouissement, et d'aberrations d'ordre supérieur ont aussi été déterminées.

Résultats : Trois mois après l'opération, la moyenne d'AVNC de la QI et celle de la SA60AT étaient de 0,25 (ÉT 0,26) et 0,30 (ÉT 0,27), respectivement, et celle de la MAVC était de 0,10 (ÉT 0,16) dans les deux groupes. L'ES (erreur réfractive sphérique) était −0,56D (ÉT 1,03) et −0,47D (ÉT 0,64) des les groupes QI et SA respectivement. Dans les conditions photopiques sans éblouissement, les yeux QI avaient une SC (sensibilité au contraste) statistiquement significative supérieure à 12 cycles par degré (CPD) et fonctionnaient mieux à 3 et 18 CPD et, dans des conditions mésopiques sans éblouissement, IQ avait aussi de meilleurs résultats à 3, 12, et 18 CPD. Dans des conditions mésopiques avec éblouissement, les yeux QI avaient aussi une meilleure SC dans 6 et 18 CPD. Quant aux aberrations, le groupe QI avait significativement moins d'aberrations sphériques ($p < 0,05$), de RMS, de coma X et de valeurs Y avec des pupilles de 6 mm en relation au groupe SA.

Conclusions : En termes de réfraction, il n'y avait pas de différence importante entre les deux types, mais il y a une différence de qualité de la vision dans les conditions photopiques et mésopiques et aussi aberrations d'ordre supérieur. Somme toute, ceux qui avaient une pupille dilatée et réactive, comme les jeunes conducteurs et ceux de nuit, peuvent avoir plus de satisfaction avec les lentilles IQ asphériques.

Along with advances in intraocular lens (IOL) designs, techniques in cataract surgery have improved significantly. These advances have changed cataract surgery from the simple removal of lens opacity to a surgical procedure that provides patients with the best possible quantity and quality of vision.

Most improvements in recent years are indebted to developments in the assessment of the eye as an optical system and the application of objective tests such as measuring higher-order aberrations (HOA) and contrast sensitivity (CS), which focus on functional vision.

In younger people, the positive spherical aberration (SA) of the cornea (mean +0.27 μm for a 6.0 mm pupil, and +0.30 μm for a 5.0 mm pupil) is somewhat neutralized by the negative SA of the crystalline lens.[1,2] After the age of 40 years, although the cornea remains optically intact,

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the SA begins to increase.[3,4] Meanwhile, using a spherical IOL increases the positive SA, which can decrease CS and quality of vision.[5–7]

By designing lenses with one or both surfaces modified (contrary to conventional spherical lenses), the quality of vision can be improved by decreasing the SA. In an optical system, zero SA seems to induce the best quality of vision, but other studies in the optical system of the eye have reported that some degree of SA (Beiko,[8] +0.1 μm 0) may have better results.

Because the highest refraction occurs in the corneal periphery, aspherical lenses perform better than spherical lenses when the pupil is dilated. To the best of our knowledge, 3 aspherical monofocal lenses have received Food and Drug Administration approval to date. The properties of these lenses are summarized in Table 1. In all these lenses, the periphery of the lens is flatter than the centre, to neutralize the inherently positive SA of the cornea, especially in the periphery, and to improve CS in mesopic conditions. Of these lenses, AcrySof IQ (SN60WF, Alcon Inc, Fort Worth, Tex.), which has an aspherical posterior surface that may add 0.2 μm of negative SA for a 6 mm pupil, has been designed based on the analysis of the SA data of more than 700 corneas. This lens is similar to the SA60AT by the same manufacturer, except for its asphericity, refractive index, and the yellow tint that filters blue light.[6] Therefore, in this study, we compared the quality and quantity of vision with these 2 spherical and aspherical lenses by means of CS, wave-front aberration, and visual acuity measurement.

Methods

Prior to patient enrollment, the study proposal was reviewed and approved by the Review Board of the Noor Ophthalmology Research Center. Seventy eyes of 35 patients who had phacoemulsification for cataract surgery with SA60AT IOL implantation during the past 6 months, and who agreed to implantation of an AcrySof IQ (SN60WF) IOL in the fellow eye, were enrolled in this prospective comparative study. Patients with a history of other ocular surgery, corneal opacity, glaucoma, uveitis, vitreous opacities, diabetes mellitus, connective tissue disorders, or posterior capsule opacity were excluded.

Because of the setting of the study, patients were informed of the type of implanted lens, and informed written consent was obtained, but we tried to keep the observers blind so that objective tests (aberrometry) would be free of bias.

All patients had preoperative and postoperative examinations. Preoperative uncorrected visual acuity (UCVA) and best spectacle-corrected visual acuity (BSCVA) were measured with logarithmic vision charts at 6 m. Complete slit-lamp examination and a full dilated indirect ophthalmoscopy (Topcon Corp, Tokyo, Japan) were performed. Lens power calculation was performed using the IOLMaster (Zeiss Meditech, Germany) or B-Scan U/S Biometry (Nidek Co, Gama Gori, Japan).

All patients were operated on and visited by the same surgeon (Alirezah Habibollahi) using the same procedure as for the previous cataract surgery. After intravenous sedation and topical anaesthesia with tetracaine 0.5% eye drops, a 2.8 mm clear corneal incision was made in the steep axis. For pupil dilation and more anaesthesia, a cocktail consisting of 2 mL xylocaine 2%, 0.5 mL adrenaline 0.1%, and 2.5 mL balanced salt solution was injected into the anterior chamber. As a viscoelastic material to form the anterior chamber, 2.4% methylcellulose (Coatel, Bausch & Lomb, Dayton, Ohio) was used. Capsulorrhexis was carried out with forceps in a diameter of 5.5 to 6 mm. Hydrodissection was carried out by the aforementioned cocktail, and the nucleus was extracted by a Sovereign White Star (AMO Inc, Santa Ana, Calif.; Allergan Inc, Irvine, Calif.) phacomachine using the "stop and chop" technique. Finally, after forming the anterior chamber with viscoelastic material, the IOL was implanted inside the bag using the Royalle III injector (Asico, Westmont, Ill.). The viscoelastic material was removed from the eye and the anterior chamber was formed by balanced salt solution, and the wound was checked to ensure self sealing.

Postoperatively, chloramphenicol eye drops 0.5%, 4 times for 1 week, and betamethasone eye drops 0.1%, 6 times a day for 4 weeks, were prescribed and the patient returned for follow-up during the first week and during the first and third months. Patients who did not show up for the follow-up (especially the third month) were telephoned (at least twice) and if they still failed to show after 3 months, they were considered lost to follow-up. All follow-up was performed by the same surgeon (Alirezah Habibollahi). In the first week, the condition of the anterior chamber and IOL were examined and in the first month, UCVA, BSCVA, and refraction tests were performed.

At the third-month follow-up, besides UCVA, BSCVA, and refraction measurement, slit-lamp examination was performed to rule out any tilting, decentration of the IOL, or opacification of the posterior capsule. Whole-eye aberrometric measurement was performed by Zywave aberrometer (Bausch & Lomb, Rochester, N.Y.). This aberrometer uses the Hartmann Shack technique to analyze outgoing wave front and can measure up to the fifth order of Zernike aberrations. All measurements were

Table 1—Properties of 3 different aspherical monofocal lenses

Lens	Manufacturer	Material	Pieces	Asphericity	Modifications
Technis Z9000	AMO	Polysiloxane	3	−0.275 μm	Prolate anterior surface
AcrySof IQ (SN60WF)	Alcon	Hydrophobic acrylic	1	−0.20 μm	Prolate posterior surface
Sof port	Bausch & Lomb	Silicone	3	0	Prolate anterior and posterior surface