Distribution and visual impact of postoperative refractive error after cataract surgery in rural China

Study of Cataract Outcomes and Up-Take of Services report 4

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PURPOSE: To model the possible impact of using average-power intraocular lenses (IOLs) and evaluate the postoperative refractive error in patients having cataract surgery in rural China.

SETTING: Rural Guangdong, China.

METHODS: Patients having cataract surgery by local surgeons were examined and visual function was assessed 10 to 14 months after surgery. Subjective refraction at near and distance was performed bilaterally by an ophthalmologist. Patients had a target refraction of −0.50 diopter (D) based on ocular biometry.

RESULTS: Of the 313 eligible patients, 242 (77%) could be contacted and 176 (74% of contacted patients, 56% overall) were examined. Examined patients had a mean age of 69.4 ± 10.5 years. Of the 211 operated eyes, 73.2% were within ±1.0 D of the target refraction after surgery. The best presenting distance vision was in patients within ±1.0 D of plano and the best presenting near vision, in those with mild myopia (<−1.0 D to ≥2.0 D) (*P*= .005). However, patients with hyperopia (>+1.0 D) reported significantly better adjusted visual function than those with emmetropia or myopia (<−1.0 D). When the predicted use of an average-power IOL (median +21.5 D) was modeled, predicted visual acuity was significantly reduced (*P*= .001); however, predicted visual function was not significantly altered (*P*>.3).

CONCLUSIONS: Accurate selection of postoperative refractive error was achieved by local surgeons in this rural area. Based on visual function results, aiming for mild postoperative myopia may not be suitable in this setting. Implanting average-power IOLs significantly reduced postoperative presenting vision, but not visual function.

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In principal, modern cataract surgery allows the physician and patient to choose the desired postoperative refraction through appropriate selection of intraocular lens (IOL) power and placement of the surgical wound. In fact, several studies in the developed world report high accuracy[1] in the prediction of postoperative refraction, with 72% to 83%[2–7] of patients within ±1.00 diopter (D) of emmetropia or the target refraction. Many formulas to attain acceptably accurate predictions of postoperative refraction have been developed.[8–10] New technologies using partial coherence interferometry to measure axial length may provide more accurate prediction of postoperative refraction.[6,11,12] Risk factors for deviation from desired emmetropia include older age,[2] clear corneal (as opposed to limbal) incisions,[2] and use of anterior chamber IOLs.[13]

Some studies in the developing world[14,15] report acceptable accuracy in the prediction of postoperative refraction, even using average-power IOLs,[14,15] with 45% to 54% of patients having a postoperative refraction within ±1.00 D.[14] However, postoperative

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refractive error has been implicated as one of the most significant risk factors for poor visual and functional outcomes after cataract surgery in many reports from rural Asia, including those from Bangladesh,[16] Pakistan,[17] China,[18] and India.[19–22]

Few studies from rural Asia have reported in detail the distribution of refractive error after cataract surgery. The impact of different amounts of refractive error on visual acuity and function is also little studied in this setting. It is not known, for example, whether the practice of aiming for a modest degree of postoperative myopia, common in the developed world,[2] is suited to the visual needs of persons having cataract surgery in rural Asia.

The Study of Cataract Outcomes and Up-Take of Services (SCOUTS) is an intensive evaluation of outcomes and service uptake in a clinical series of approximately 300 persons having sutureless manual cataract extraction by local surgeons in rural China. The report presented here examines (1) the predicted impact on visual outcomes of using average-power IOLs; (2) the distribution of IOL powers and postoperative refraction relative to the predicted value, given IOLs selected by biometric measurement; and (3) the impact of postoperative refractive error on visual acuity and visual function (observed and predicted for average-power IOLs).

PATIENTS AND METHODS

The protocol for SCOUTS has been described in detail.[23] All patients having cataract surgery in at least 1 eye through the Project Vision/Caring Is Hip program at the Sanrao Hospital in Guangdong, China, by 1 of 2 recently trained local surgeons between August 8 (when surgeons first began to operate independently) and December 31, 2005, were eligible to participate. No other inclusion or exclusion criteria were used. All eligible persons were invited by telephone to have a comprehensive eye examination at Sanrao Hospital between October 16 and 21, 2006, an average of 12 months after surgery. The examination included refraction and the administration of a visual function questionnaire.[24] Written informed consent was obtained from all study participants, all study procedures were approved by the Institutional Review Board at the Joint Shantou International Eye Center (parent hospital for Sanrao), and the tenets of the Declaration of Helsinki were followed. Sanrao Hospital is a government-run, village-level facility in rural Guangdong Province, China, serving a largely rural population.

Selection of Intraocular Lens Power and Surgical Protocol

All participants were determined to have visually significant cataract on examination by 1 of the 2 surgeons and had surgery in at least 1 eye between August 8 and December 31, 2005. If the participant subsequently had surgery in the other eye at Sanrao Hospital during or after the study period, the second eye was included in the analysis; however, eyes operated on by other surgeons at Sanrao, at other facilities, or by the 2 study surgeons before they become fully independent on August 8, 2005, were not included.

An IOL (model KC60BN, Alcon Laboratories) was chosen for each participant for a target refraction of −0.50 D based on axial length (SW-2000S Ultrasound A-scan machine, Tianjin Suowei), keratometry (Topcon KR-8800, Topcon Hong Kong Ltd.), and the SRK/T formula.[25] The A-constant used was that provided by the manufacturer. Modifications for the refractive error in the fellow eye were not made as most patients had visually significant cataract in both eyes.[23,26]

Sutureless large-incision manual cataract extraction is a modification of previous manual sutureless cataract extraction techniques.[23] Manual sutureless cataract surgery was developed for use in areas in which resources are scarce, where the startup costs and recurring expenses of phacoemulsification may be problematic. Manual sutureless surgery can provide the rapid visual rehabilitation associated with a sutureless wound and thus offers advantages over extracapsular cataract extraction. As the wound is larger than in other manual sutureless methods, the technique used in this study allows easier expression of large, hard lenses; thus, it is less traumatic to intraocular tissue and potentially easier to learn.

Surgery was performed under retrobulbar anesthesia after the eye had been prepared and draped in the usual sterile fashion. A temporal peritomy was created and a temporal corneoscleral tunnel fashioned at half scleral depth. The tunnel was 8.0 mm wide and measured 4.0 mm anteroposteriorly; it was centered on the limbus. A continuous-tear capsulorhexis was created after staining with trypan blue. The lens nucleus was mobilized by gentle rotation under an ophthalmic viscosurgical device and then removed intact through the tunnel incision with the aid of an anterior chamber maintainer and lens vectis. Cortical cleanup was done using a modified Simcoe cannula, and the IOL was placed in the capsular bag.

Examination

The presenting and best corrected visual acuities after refraction (Topcon KR-8800 autorefractor, Topcon Hong Kong

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Ltd.), followed by subjective refinement by an ophthalmologist at distance and near, were measured separately in each eye of all patients. Distance vision was measured using an illuminated tumbling-E Snellen chart at 6 m, and near vision was measured with a handheld tumbling-E chart at 33 cm. Keratometry (Topcon KR-8800) and noncontact tonometry (Leica AT550, Leica Hong Kong Ltd.) were performed bilaterally. A comprehensive examination was performed by the same examiner (N.G.C.). After the anterior chamber and gonioscopy examinations, patients thought to have a closed angle for 180 degrees or more had a neodymium:YAG iridotomy and both eyes of all patients were dilated. The disc, macula, and peripheral fundus were then examined.

Visual Function Questionnaire

The visual function questionnaire was a Chinese translation of one developed by Fletcher et al.[24] for use in rural Asia. All questions were administered in the local dialects (Chaoshanhua and Kejiahua) by 1 of 3 native speakers after a period of training and standardization. These instruments have been validated for use in Chinese patients[18,27] and have been described in detail.[24] The scores on the visual function instrument range from 100 (best possible) to 0 (worst).

Statistical Analysis

The following formula was used to calculate the expected postoperative refractive error in surgical eyes if an average-power IOL of +21.5 D was used: Current postoperative refraction in the eye at distance + [(21.5 D – IOL power)/1.25].[28]

The minimum angle of resolution, the decimal equivalent of the Snellen fraction, was used in all calculations of vision. The distribution was considered sufficiently normal not to require log transformation to logMAR values.

The postoperative refractive error was categorized into 5 groups based on the spherical equivalent (SE) refractive error in the operated eye: plano (≤ +1.0 D and ≥ −1.0 D), mild myopia (< −1.0 D and ≥ −2.0 D), moderate myopia (< −2.0 D), mild hyperopia (> +1.0 D and ≤ +2.0 D), and moderate hyperopia (> +2.00 D). Univariate associations between categorized postoperative refractive error and potential predictors were analyzed using a 1-way analysis of variance, chi-square test, or Fisher exact test, as appropriate.

Multiple linear regression modeling was used to examine the potential predictors of visual function. Generalized estimation equation (GEE) models were used to assess the association between postoperative presenting near and distance acuities and postoperative refractive error adjusting for age, sex, and vision in the fellow eye. The GEE models accounted for the intracorrelated data of patients with bilateral surgery. When the patient had surgery in both eyes, the refractive categorization of the first eye was used. More complex models allowing for the possibility of a patient having different refractive errors in the 2 eyes were also examined; the results were identical, presumably due to the rarity of such persons and that the model for the first operated eye was used.

The PROC GENMOD (release 9.1, SAS Institute) was used to fit GEE models. All statistical tests were 2-sided; a P value less than 0.05 was considered statistically significant.

RESULTS

Of the 313 persons operated on within the study period, 242 (77%) could be contacted by telephone. Of these, 176 (74% of contacted patients, 56% overall) had examinations and/or interviews, 60 (25%) had telephone interviews without examination, and 3 (1%) refused examination or interview. The mean age of the examined patients was 69.4 years ±10.5 (SD); 116 (67%) were women, 149 (86%) had been blind (presenting vision 6/60 or worse) in the operated eye before surgery, and 35 (19.9%) had bilateral cataract surgery. Examined and interviewed patients did not differ significantly from those who could not be contacted in age, sex, or preoperative presenting or 1-day postoperative acuity in the surgical eye (data not shown).

Two hundred eleven cataract surgeries were performed in the 176 examined patients. Postoperative refractive error data were available for 209 (99.1%) of the 211 operated eyes. The median SE refractive error was −0.25 D (interquartile range −0.65 to +0.50 D), and the mean was −0.15 D ± 1.30 (SD) (Figure 1). The mean absolute value of refractive error was 0.81 ± 1.02 D. The median power of implanted IOLs was +21.5 D (interquartile range 19.5 to 23.0 D), and the mean was 21.0 ± 2.9 D (Figure 2). The postoperative refractive error was within ±1.0 D of the target (−0.5 D) in 73.2% of eyes (Figure 2). Of the operated eyes, 16 (7.7%) had an SE refractive error less than −1.5 D and 40 eyes (19.1%), more than +0.5 D.

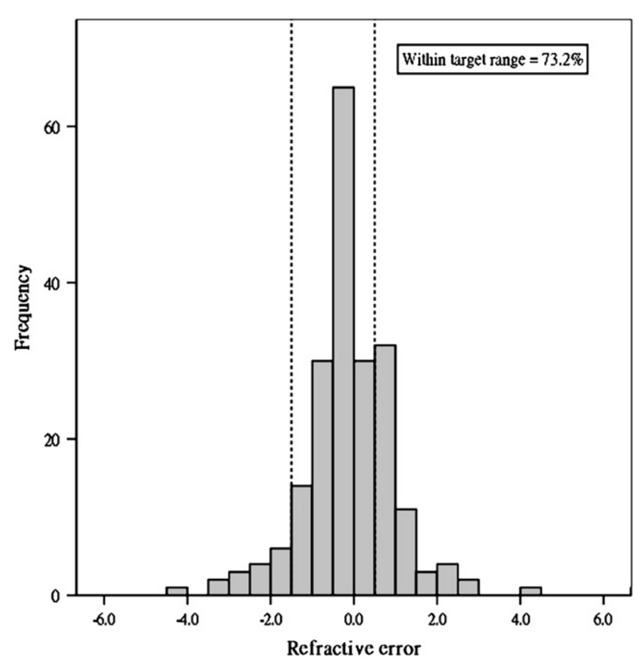

Figure 1. Distribution of SE refractive error in 211 eyes having cataract surgery in rural China. The dotted lines represent patients with an SE refractive error within ±1.0 D of the target refraction of −0.5 D.

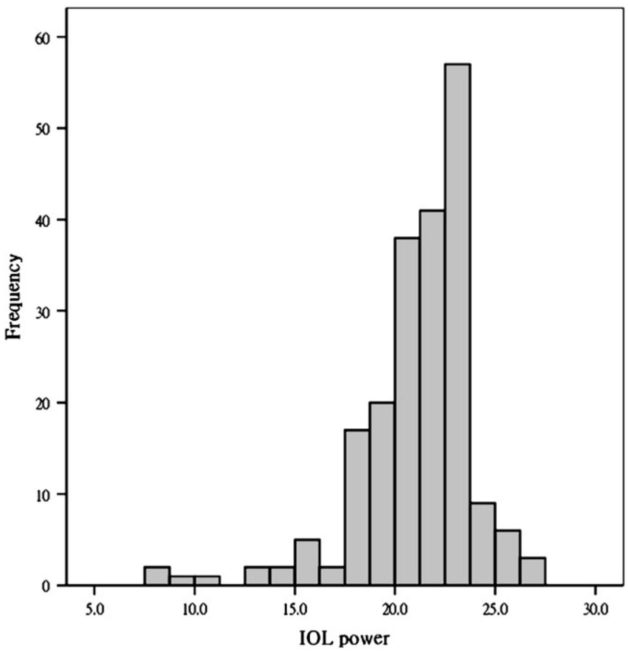

Figure 2. Distribution of IOL powers in 205 eyes having cataract surgery in rural China (information missing for 6 eyes).

After adjusting for age and sex in multivariate linear regression models, presenting distance visual acuity was significantly worse in eyes with an SE refractive error >+1.00 D or <−1.00 D than in eyes within ±1.00 D of plano (Table 1, *A*). After adjusting for age and sex, the presenting near acuity was significantly better in eyes with mild myopia than in those within ±1.00 D of plano; those with mild or moderate postoperative hyperopia had significantly worse near vision. The near vision in eyes with moderate myopia was not significantly different from that in eyes within ±1.00 D of plano (Table 1, *B*).

Table 2 shows the refractive error in the operated eye (first eye in bilateral surgery cases) as a predictor of visual function, adjusting for age, sex, surgeon, bilateral surgery, preoperative vision, intraoperative complications, and postoperative presenting acuity (minimum angle of refraction). Patients with a hyperopic postoperative refractive error (SE in operated eye >+1.00 D; n = 18) reported significantly better postoperative visual function than those with myopic (<−1.00 D; n = 26) or emmetropic (≥−1.00 D and ≤+1.00 D; n = 131) refraction (*P* = .005) (Table 2). The unadjusted mean visual acuity in hyperopic patients (92.6 ± 7.9) was better in emmetropic patients (88.7 ± 10.3), and the difference reached borderline significance (*P* = .06); the difference in the mean between myopic patients (88.8 ± 8.7) and emmetropic patients was not statistically significantly different (*P* >.4).

Univariate analyses of potential predictors of SE refractive error indicated that age, sex, date of surgery (as an indicator of surgeon learning effect), IOL power, refractive error in the fellow eye, and surgeon identity were not significantly associated with the postoperative SE refractive error (Table 3).

Use of an average-power +21.5 D IOL (mean value in this cohort) in all patients would have resulted in a reduction in the percentage of eyes falling within the target refractive from 73.2% to 41.2%. The number of eyes with >+1.00 D of hyperopia would have increased from 18 to 58 (222% increase) and with <−1.00 D myopia, from 26 to 67 (158% increase) (Figure 3).

Figure 4, *A* and *B*, shows the actual distribution and predicted distribution, respectively, of the presenting distance visual acuity in the operated eye based on the model of distance vision (minimum angle of refraction) as a function of refractive error (Table 1, *A*). The predicted mean minimum angle of refraction using average-power IOLs (0.47 ± 0.21) was significantly lower than the actual observed mean (0.60 ± 0.27) (*P* = .001). However, when visual function was modeled using predicted presenting acuity and refractive

Table 1A. Association between presenting visual acuity (minimum angle of resolution) at distance and postoperative refractive error adjusting for age, sex, and acuity in the fellow eye (N = 211 operated eyes).*

Independent Variable	β Value (95% CI)	*P* Value
Age	−0.006 (−0.010, −0.002)	.001
Sex	0.058 (−0.009, 0.125)	.092
Refractive error in operated eye		
Moderate myopia versus plano (>−2.0 D vs ±1.0 D)	−0.363 (−0.445, −0.281)	<.001
Mild myopia versus plano (>−1.0 D to ≤−2.0 D vs ±1.0 D)	−0.186 (−0.259, −0.114)	<.001
Mild hyperopia vs plano (>+1.0 D to +2.0 D vs ±1.0 D)	−0.191 (−0.318, −0.064)	.004
Moderate hyperopia versus plano (>+2.0 D vs ±1.0 D)	−0.568 (−0.758, −0.378)	<.001

CI = confidence interval
*Estimates obtained using generalized estimation equation model with adjustment for intracorrelated data from patients with bilateral surgery

Table 1B. Association between presenting visual acuity (minimum angle of resolution) at near and postoperative refractive error adjusting for age, sex, and acuity in the fellow eye (N = 211 operated eyes).

Independent Variable	β Value (95% CI)	*P* Value
Age	−0.002 (−0.004, 0.000)	.048
Sex	0.012 (−0.027, 0.051)	.558
Visual acuity in fellow eye	0.027 (−0.136, 0.190)	.748
Refractive error in operated eye		
Moderate myopia versus plano (> −2.0 D vs ±1.0 D)	0.071 (−0.017, 0.159)	.113
Mild myopia versus plano (> −1.0 D to ≤ −2.0 D vs ±1.0 D)	0.120 (0.018, 0.222)	.021
Mild hyperopia vs plano (> +1.0 D to +2.0 D vs ±1.0 D)	−0.100 (−0.151, −0.049)	<.001
Moderate hyperopia versus plano (> +2.0 D vs ±1.0 D)	−0.177 (−0.267, −0.087)	<.001

CI = confidence interval
*Estimates obtained using generalized estimation equation model with adjustment for intracorrelated data from patients with bilateral surgery

error with average-power IOLs (model in Table 2), the predicted mean visual function (89.6 ± 3.6) did not differ from the actual observed mean (89.1 ± 9.6) (*P* > .3).

DISCUSSION

In nearly three quarters of the eyes operated on in this study, the final refraction was within ±1.00 D of the target refraction of −0.50 D. These results are well within the range of 72% to 83%[2–7] of eyes falling within ±1.00 D of the target refraction reported in studies from Europe and the United States. Few studies of postoperative refraction after cataract surgery in which the IOL was selected using biometry have been reported in the developing world. Yorston and Foster[14] report that the absolute value of the sphere was <1.00 D in 53.5% of 71 eyes having cataract surgery after biometry in Kenya. Postoperative refractive error, presumably resulting from inaccurate IOL selection and aphakia, has been reported as a leading risk factor for poor postoperative vision in several studies from rural Asia.[16–22]

The median value (+21.5 D) of the IOLs implanted in this study agrees surprisingly well with values in other areas of the world. A median IOL power of +21.6 D has been reported in Vietnam[29] and of +21.9 D in Kenya.[14] In Taiwan,[30] a lower value of +20.0 D was found in 3068 cases. The strong observed cohort effect, with lower powers being required for younger persons, suggests that recent reported increases in the prevalence of myopia[31] may have influenced the Taiwanese results. Although none of the studies was population based, the surprising uniformity of results between Africa and Asia suggests that except when an unusually high prevalence of refractive errors exists, an average IOL power of +21.5 D may be useful in a variety of contexts.

On initial review, our visual outcomes data offers support for the common clinical practice[2] of setting a target refraction after cataract surgery in the range of plano to mild myopia. Distance vision was significantly better in patients with a postoperative SE refraction within ±1.00 D of plano than in those with mild or moderate myopia or moderate hyperopia. Patients with mild myopia had the best near vision followed by patients with moderate myopia or plano refraction, in whom near vision was slightly worse. Those with mild or moderate hyperopia had the worst near vision. These results generally correspond with what might be predicted from simple optics.

From the perspective of cataract surgical program impact, however, self-reported visual function is at least as important as Snellen vision. We found that at a given level of distance vision, hyperopic patients reported significantly better visual function than

Table 2. Potential predictors of visual function in 176 patients completing interviews 10 to 14 months after cataract surgery in rural China.

Independent Variable	β Value (95% CI)	*P* Value
Male sex	0.597 (−2.604, 3.798)	.715
Age	0.021 (−0.132, 0.174)	.788
Surgeon	0.721 (−2.274, 3.716)	.638
Bilateral surgery	3.244 (0.261, 6.227)	.035
Preoperative visual acuity (>6/60 vs ≤6/60)	2.836 (−1.445, 7.117)	.196
Intraperative complications	−0.048 (−5.934, 5.838)	.987
Myopia (vs emmetropia)*	3.419 (−0.899, 7.737)	.123
Hyperopia (vs emmetropia)†	7.201 (2.217, 12.185)	.005
Postoperative presenting acuity (1st operated eye >6/60 versus ≤6/60)	11.694 (5.336, 18.052)	<.001
Reading (ever reads versus never reads)	−2.579 (−6.548, 1.390)	.205

hyperopia = spherical equivalent > +1.0 D; myopia = spherical equivalent < −1.0 D

Table 3. Univariate association between categorized postoperative refractive error and potential predictors in the first operated eye of 176 persons having cataract surgery in rural China.

	Postoperative Refractive Error (D), n (%)					
Independent Variable	< −2.0	−2.0 to < −1.0	−1.0 to 1.0	> 1.0 to 2.0	> 2.0	*P* Value*
Age	72.4 (7.7)	67.3 (11.8)	69.8 (10.0)	68.1 (12.0)	57.5 (19.6)	.449
Sex						.850
Female	7 (6.1)	11 (9.6)	86 (74.8)	8 (7.0)	3 (2.6)	
Male	2 (3.4)	6 (10.2)	48 (81.4)	2 (3.4)	1 (1.7)	
Date of surgery	90.1 (48.4)	100.0 (56.5)	111.1 (47.1)	96.5 (44.9)	111.8 (26.1)	.622
IOL power	20.0 (5.2)	19.8 (5.5)	21.2 (2.4)	21.8 (2.6)	19.5 (3.1)	.760
Refractive error (D) in fellow eye						.068
< −2.0	1 (5.6)	1 (5.6)	14 (77.8)	1 (5.6)	1 (5.6)	
−2.0 to < −1.0	0	3 (25.0)	9 (75.0)	0	0	
−1.0 to 1.0	3 (3.8)	6 (7.7)	65 (83.3)	2 (2.6)	2 (2.6)	
> 1.0 to 2.0	1 (9.1)	0	7 (63.6)	2 (18.2)	1 (9.1)	
> 2.0	2 (13.3)	0	10 (66.7)	3 (20.0)	0	
Surgeon						.708
A	6 (7.0)	7 (8.1)	67 (77.9)	5 (5.8)	1 (1.2)	
B	3 (3.6)	9 (10.8)	63 (75.9)	5 (6.0)	3 (3.6)	

*One-way analysis of variance, chi-square, or Fisher exact test, as appropriate

emmetropic or myopic patients. The unadjusted difference between the hyperopic group and the other 2 groups, roughly 3 points on a 100-point scale, was approximately the same magnitude as the advantage experienced by patients having second-eye surgery,

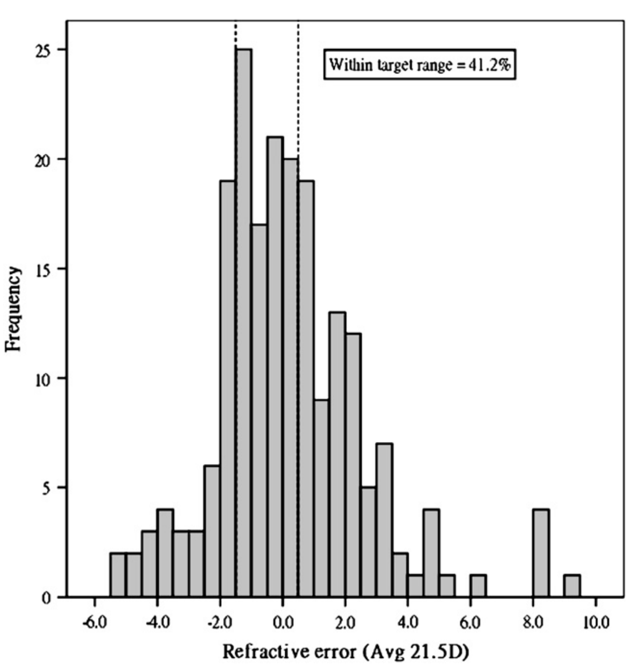

Figure 3. Predicted distribution of refractive error in 211 operated eyes having cataract surgery in rural China if an average-power IOL of +21.5 D had been used. The dotted lines represent patients with a predicted SE refractive error within ±1.00 D of the target refraction of −0.50 D.

while the adjusted difference was 7 points. This is twice the advantage associated with second-eye surgery and approximately 60% as large as the difference in self-reported visual function between persons with postoperative presenting vision ≤6/60 (blindness) and those with >6/60 in the first surgical eye. This was unexpected; postoperative myopia in the range of −0.5 to −1.0 D is usually recommended after cataract surgery.[3,32,33] It may be that near vision is of less importance to this population and, thus, mild to moderate myopia offered little perceived advantage. Only 10.7% of patients reported reading once a week or more, and 74.5% indicated they did not read at all (unpublished study). This does not explain what functional advantage might be conferred by hyperopia, particularly given that the mean Snellen vision was significantly lower in patients with mild to moderate hyperopia.

Little actual evidence exists that modest postoperative myopia is preferable to hyperopia in the pseudophakic state. The literature on refractive error and visual function relates mostly to young phakic patients and suggests that hyperopia may often be preferred to myopia.[34,35] However, these patients presumably adjust to induced hyperopia with accommodation.

Alternatively, that hyperopic patients report better visual function than myopic and emmetropic patients might relate to the optical advantages of hyperopia in compensating for higher-order spherical aberrations induced by IOL tilt or decentration. Although we did not observe large amounts of IOL decentration or tilt, measurable levels of spherical aberration can be induced with even modest degrees of tilt.[36] In addition,

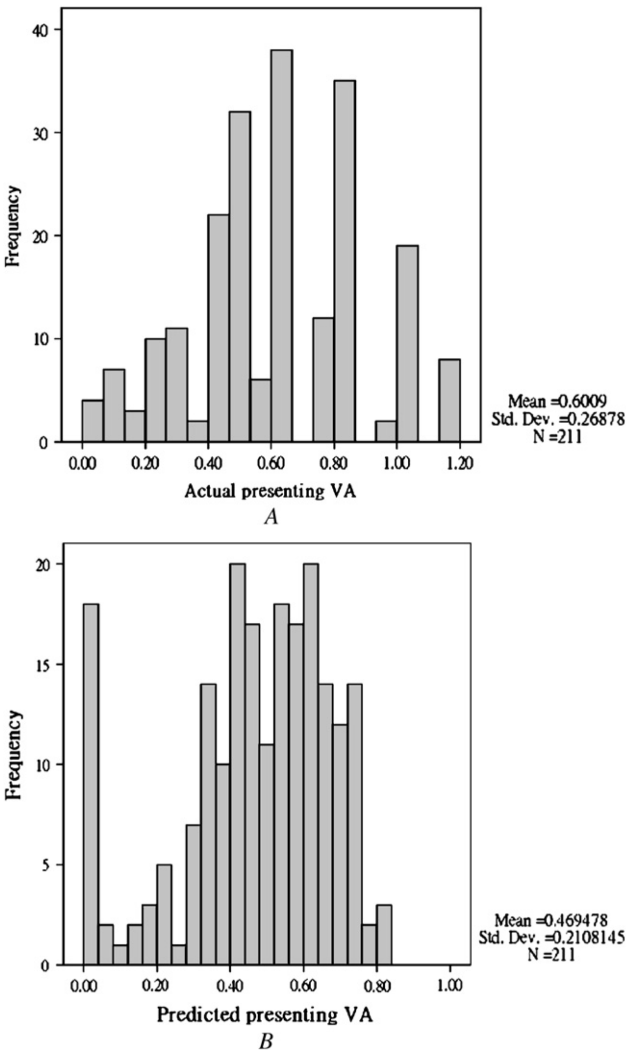

Figure 4. *A*: Actual presenting visual acuity (minimum angle of resolution) in 211 operated eyes of 176 patients having cataract surgery in rural China. *B*: Predicted visual acuity (minimum angle of resolution) (using model in Table 1) in 211 eyes having cataract surgery in rural China assuming an average-power 21.5 D IOL for all patients (VA = visual acuity).

some theoretical studies predict that certain combinations, such as counterclockwise tilt with decentration, may improve image quality in hyperopic eyes.[37]

More work is needed to elucidate the optimal postoperative refractive error in rural Asian populations, where many respondents indicate that reading is not of importance. Our finding that self-reported visual function was better in hyperopic cases is based on a small number of eyes (18) and requires further study. The lack of an observed beneficial effect on self-reported visual function in cases of mild to moderate postoperative myopia may be less counterintuitive and to some extent calls into question the suitability of a mild myopic target refraction in the rural Asian context.

Average-power IOLs are often used in cataract programs in the developing world and may provide good visual results.[14,15] Advantages include easier management of inventory and that there is no need to purchase and maintain an ultrasound unit. Few studies have directly compared the impact on vision[14] and visual function of biometrically selected and average-power IOLs, and true randomized designs may pose ethical dilemmas. Although our models suggest that presenting postoperative vision would have been significantly worse in this cohort with average-power IOLs, the predicted visual function was not affected. Given the potential savings with average-power IOLs, this area deserves further research.

This study had limitations. Not all eligible patients could be examined, and those that participated may not have been representative of patients operated on at Sanrao Hospital. However, examined and contacted patients were similar in several important demographic and clinical factors. The study was not population based; thus, the results cannot be broadly generalized to other parts of rural China. The surgical results reported are highly program or surgeon dependent; the available literature suggests they are not typical of outcomes in other rural areas of the country.[18,27] That internationally comparable refractive error results can be achieved by local surgeons in rural government facilities is itself important, however, given the problems that exist with outcome quality in many parts of China.

Finally, our conclusion that the use of average-power IOLs may be associated with significant reduction in postoperative presenting acuity, but not with a decrease in self-assessed visual function, is dependent on the accuracy of our statistical models as we did not perform a direct study of average-power IOLs. True comparative data are rare, however, and controlled trials may be difficult to perform.

Despite the study's limitations, its data regarding the impact of refractive outcomes on vision and visual function are not widely available in rural Asia. Thus, they may be useful for programs seeking to set appropriate refractive targets for cataract surgery in these large populations.

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