

Outcomes of Cataract Surgery in Urban Southern China: The Liwan Eye Study

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PURPOSE. The outcomes of cataract surgery have been well reported in rural China; however, the situation in the urban population remains unclear. This study assessed the outcomes of cataract surgery in urban southern China.

METHODS. Data were gathered from the Liwan Eye Study, a population-based, cross-sectional study conducted in people aged 50 years or more in the Liwan District of Guangzhou. Presenting and best corrected visual acuity and a detailed eye examination were performed. For all aphakic and pseudophakic participants identified, information on the date, setting, type, and complications of cataract surgery were recorded.

RESULTS. Of the 1405 participants, 62 people (90 eyes) had undergone cataract surgery. Of those, 54.4% underwent the phacoemulsification (Phaco) technique, 33.3% extracapsular cataract extraction (ECCE) with intraocular lens (IOL) implantation, and 11.1% ECCE without IOL; 1 patient had intracapsular cataract extraction (ICCE). Presenting visual acuity (PVA) was $>6/18$ in 56 (62.2%) eyes, $<6/18$ to $>6/60$ in 20 (22.2%) eyes, $<6/60$ to $>3/60$ in 3 (3.3%) eyes, and $<3/60$ in 11 (12.3%) eyes. Of the 34 eyes with PVA less than 6/18, the principal causes were 26.5% retinal abnormalities, 20.6% glaucoma, 35.3% uncorrected aphakia or refractive error, and 14.5% posterior capsule opacification (PCO).

CONCLUSIONS. ECCE or Phaco with IOL are the major surgical techniques used in urban southern China. More than half of the eyes with poor outcomes due to uncorrected aphakia, refractive error, or PCO are potentially treatable. This result suggests a pressing need for improved surgical training and postoperative care. (*Invest Ophthalmol Vis Sci.* 2011;52:16–20) DOI: 10.1167/iovs.10-5382

Cataract is the leading cause of blindness globally and is particularly common in developing countries,¹ including China.^{2–5} Cataract surgery is the only method of restoring

vision for those with vision impairment due to cataract. In recent years, the number of people who undergo cataract surgery has increased rapidly.^{6–9} However, the quality of surgery remains a problem that should be addressed.¹⁰

The World Health Organization recommends that poor (best corrected visual acuity [BCVA] $<6/60$) or borderline (BCVA $<6/18$) outcomes after cataract surgery should not be more than 10% to 20%.¹¹ Results from population-based studies suggest that the outcome of cataract surgery varies greatly from region to region.^{1–5,8–13}

In mainland China, most of the data on cataract surgery outcomes are derived from population-based studies in rural dwellers,^{2,3} where health care services accessibility, socioeconomic status, and the quality of eye care service providers may be quite different from that of the urban population.

The purpose of the present study was to assess the postoperative outcome of cataract surgery in a population-based study in southern China.

METHODS

The methodology used in the Liwan Eye study has been described in detail elsewhere.¹⁴ In brief, The Liwan District of Guangzhou city, 1 of 10 administrative districts in Guangzhou, was selected for the survey because of its relatively stable population and representative demographic and socioeconomic characteristics. The subjects were identified by cluster random sampling. Those aged 50 years and older who resided in the selected study clusters for more than 6 months were considered eligible. The eligible subjects were invited for a comprehensive eye examination in the research clinic set up near the communities.

Detailed study procedures have been reported elsewhere.¹⁴ The presenting visual acuity (PVA) was tested with the Early Treatment Diabetic Retinopathy Study (ETDRS) visual chart with subject's habitual refractive correction. The subjects with presenting VA $\leq 6/18$ underwent BCVA testing based on the autorefraction results. An examination of the eyelid, globe, lens, and fundus was performed with a slit lamp (SL-8Z; Topcon, Tokyo, Japan, with D1x digital image system; Nikon, Tokyo, Japan) and +78-D lens at $\times 16$ magnification by an experienced ophthalmologist (MH). During the examination, if the subject was found to have undergone cataract surgery, several additional items were added to the eye examination, including the date, setting, type, and complications of the surgery. The type of surgery was determined based on both the history of the subject and the findings in the ophthalmic examination. If presenting VA was $\leq 6/12$, a principal cause of impairment was assigned by using a 15-item checklist for diagnosis. When two or more disorders may have caused the visual impairment of the same eye, the one being most amenable to treatment or prevention was selected, according to WHO recommendations.

Ethics approval was obtained from the Zhongshan University Ethics Review Board. Approval was granted by the Research Governance Committee of Moorfields Eye Hospital, London. The study was conducted in accordance with the tenets of the World Medical Association.

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TABLE 1. Lens Status of Both Eyes in Subjects with Cataract Surgery by Presenting Visual Acuity

Vision Category	Aphakic Aphakic	Aphakic Cataract	Aphakic Other*	Pseudophakic Aphakic	Pseudophakic Cataract	Pseudophakic Other*	All (%)
NN	0	0	0	0	1	27	28 (45.2)
VI	0	1	0	0	2	12	15 (24.2)
UL	0	1	0	0	5	11	17 (27.4)
MB	0	0	0	0	0	1	1 (1.6)
SB	0	0	0	0	0	1	1 (1.6)
All	0	2	0	0	8	52	62 (100)

The column headings describe the status of the better and worse eyes. NN, normal/near normal; $\geq 6/18$ in both eyes; VI, vision impairment, $\geq 6/60$ better eye; $6/18$ to $\geq 6/60$ worse eye; UL, unilateral blindness, $\geq 6/60$ better eye; $< 6/60$ worse eye; MB, moderate bilateral blindness, $< 6/60$ to $\geq 3/60$ better eye, $< 6/60$ worse eye; SB, severe bilateral blindness, $< 3/60$ both eyes.

* Includes a normal lens.

tion's Declaration of Helsinki. Written informed consent was obtained from all subjects. The examinations were performed between September 2003 and February 2004.

RESULTS

A total of 1405 subjects aged ≥ 50 years (75.3% participation rate) were successfully examined in the Liwan Eye Study, and 62 people (90 eyes) had undergone cataract surgery in one (34 subjects, 54.8%) or both eyes (28 subjects, 45.2%). The prevalence rate of cataract surgery was 4.4% (95% CI, 3.4%–5.4%).

Of the 62 subjects who had undergone cataract operations, the postoperative VA distribution was shown in Table 1. The definition of visual outcome was arbitrarily chosen as follows, to be consistent with our previous study in rural southern China¹⁵: (1) normal/near normal (NN), $6/18$ or better in both eyes; (2) visual impairment (VI), $< 6/18$ to $\geq 6/60$ in the worse eye, $\geq 6/60$ in the better eye; (3) unilateral blindness (UL), $< 6/60$ in the worse eye, $\geq 6/60$ in the better eye; (4) moderate bilateral blindness (MB), $< 6/60$ in the worse eye, $< 6/60$ to $\geq 3/60$ in the better eye; and (5) severe bilateral blindness (SB), $< 3/60$ in both eyes. Among those subjects, 28 (45.2%) individuals had a VA on presentation of $6/18$ or better in both eyes. The prevalence of vision impairment, unilateral blindness, moderate bilateral blindness, and severe bilateral blindness were 24.2%, 27.4%, 1.6%, and 1.6%, respectively.

Table 2 shows the visual outcomes of each eye with cataract surgery. Among the 90 surgical eyes, 56 (62.2%) had a PVA of $6/18$ or better, 20 (22.2%) with PVA of $< 6/18$ to $6/60$, 3 (3.3%) with $< 6/60$ to $3/60$, and 11 (12.3%) with $< 3/60$. With the BCVA, these values were 68 (75.6%), 12 (13.3%), 2 (2.2%), and 8 (8.9%), respectively.

Table 3 summarizes the main causes of visual impairment (including blindness) after cataract surgery. In more than half of the eyes with poor postoperative vision, it was due to potentially treatable diseases, such as uncorrected aphakia,

uncorrected refractive error, and posterior capsular opacification. The reasons for poor outcome were similar in the ECCE and Phaco groups.

Table 4 illustrates the PVA postoperative outcome of the 90 surgical eyes with respect to the time interval between surgery and survey, the operation site, years of education, and type of surgery. The visual outcomes of the eyes operated on after 1994 tended to be better than that of those operated on during or before 1994, although the difference was only marginally significant ($< 6/18$; χ^2 test, $P = 0.052$).

Of 90 surgical eyes, sites for surgery were identified in 76 (84.4%). These included the one eye specialty hospital (53 eyes, 58.8%), other tertiary care hospitals (21 eyes, 23.3%), and other hospitals (2 eyes, 2.3%). The eyes undergoing surgery at the eye specialty hospital had better visual outcome in comparison with those operated on at other tertiary care hospitals or other secondary hospitals ($P = 0.041$).

In this study, better visual outcomes (PVA, $\geq 6/18$) were not significantly associated with the subjects' years of education ($P = 0.540$). ECCE (44.4%) and Phaco (54.4%) were the major types of surgery, particularly in the cases performed after 1986 (ECCE) and 1994 (Phaco). Among the 40 patients who underwent ECCE, 10 (25%) had no implantation of IOLs, and 6 of those had poor vision. The better VA outcomes with IOL implantation were much better than those without (Fisher's exact test, $P = 0.018$). The better VA outcomes between ECCE with IOL and Phaco with IOL were not statistically significant ($P = 0.123$). However, the VA outcomes became statistically significant when Phaco+IOL cases were compared with all ECCE cases, including cases with and without IOL implantation ($P = 0.023$).

DISCUSSION

The outcomes of cataract surgery in a population-based sample has been reported in rural areas of China.^{15,16} The data re-

TABLE 2. Improvement in Presenting Visual Acuity with Pinhole versus BCVA

Presenting VA	BCVA				Undetermined	Total
	$\geq 6/18$	$< 6/18$ to $\geq 6/60$	$< 6/60$ to $\geq 3/60$	$< 3/60$		
$\geq 6/18$	56					56
$< 6/18$ to $\geq 6/60$	11	9				20
$< 6/60$ to $\geq 3/60$	1	2	0			3
$< 3/60$		1	2	8		11
Total	68	12	2	8	0	90

Data are the number of eyes.

TABLE 3. Principal Cause of Impairment or Blindness by Surgical Procedure in Eyes with Cataract Surgery with Presenting Visual Acuity <6/18

Principal Cause	ICCE	ECCE	PHACO	Total	%
Retinal abnormalities	0	6	3	9	26.5
Uncorrected aphakia	1	6	0	7	20.6
Glaucoma	0	3	4	7	20.6
Refractive error	0	2	3	5	14.7
Posterior capsule opacification	0	2	3	5	14.7
Corneal scar/opacity	0	0	1	1	2.9
Total	1	19	14	34	100

Data are the number of eyes.

* One case of IOL degeneration, 2 years later; this IOL was replaced and VA was restored.

ported herein are the findings in a population-based sample located in the urban community in the Liwan district of Guangzhou city in southern China. Because of the population-based nature of the study, the data reported should be representative of cataract surgery outcomes in the past two decades in Guangzhou city and perhaps in urban southern China in general. Although the sample size estimate was primarily based on the prevalence of blindness, the 62 individuals with cataract surgery (90 surgical eyes) identified in the survey were sufficient for an investigation on both postoperative outcomes and the associated factors. However, as the study was conducted in an urban setting, we were able to achieve only a 75% response rate in the survey. It is possible that those with poor postoperative outcome after surgery tended to be included the study and therefore biased the results.

In our study, cataract surgery produced much better visual outcomes compared with those in rural China (both Shunyi and Doumen).^{15,16} The proportion of eyes with presenting VA of 6/18 or better was 62.2% in the present study. This rate was much higher than those in Doumen (36.2%) and Shunyi (42.1%). The proportion is similar to that found in urban Bangladesh (58.7%)⁹ and Hong Kong (59.6%)⁴ and is slightly better than that in urban India (48.4%).¹² In the recent Beijing Eye Study,⁵ the visual outcome was even better than that in our study (79.7%, 106/133 eyes, had a PVA of 6/18 or better). This result could in part be explained by differences in the study population and quality of eye care service.

ICCE is now a very unusual surgical technique for sight restoration and has been replaced by ECCE or Phaco with IOL implantation.⁶ In our study, VA in the Phaco group was significantly better than that in the ECCE group. Manual small-incision cataract surgery (MSICS) could be the most economic and effective surgical option in a developing country,¹⁷⁻¹⁹ but its efficacy unfortunately has been very difficult to discern based solely on slit lamp examination. There were still 10 ECCE cases without IOL implantation, although these surgeries were all performed in the mid-1990s. ICCE surgeries often had poor visual outcomes. The increasing proportion of surgeries with IOL implantation has been demonstrated in several other studies. The proportions of pseudophakia are 87.8% in our study and 92.5% in Beijing, respectively, whereas these proportions are similar to other economically developed areas, such as Hong Kong (86.9%)⁴ and Los Angeles (73.7%).¹³ In contrast, these proportions are much lower in some developing countries and regions, such as Bangladesh, Rajasthan, and Nepal.⁸⁻¹⁰

Of 90 surgical eyes, 53 (58.9%) of the total cataract surgeries and 95% of the Phaco surgeries were performed in the eye

specialty hospital, the largest eye service provider in Guangzhou, China. The outcomes were significant better than those in other health care settings, such as secondary and tertiary care hospitals. A single hospital was the site of surgery in more than half of all cataract cases and in 95% of Phaco surgeries in Guangzhou City, which has a population of approximately 9 million. This distribution of surgeries suggests the advanced technology and trained surgeons are too concentrated in one major tertiary hospital. Patients tend to choose the hospital with the best reputation for their surgeries. The evidence suggests that the health authority should consider decentralizing the resources and distributing doctors to other hospitals, in that 57 government hospitals provide eye services in Guangzhou.²⁰

The main causes of vision impairment and blindness are retinal abnormalities, including diabetic retinopathy, high myopia retinopathy, and retina pigmentosa, similar to the findings in Hong Kong, Singapore, and Los Angeles.^{4,13,21} These could be eye diseases that develop over a long period after cataract surgery, particularly when the subjects are mostly elderly people.

Uncorrected aphakia and uncorrected refractive error accounted for 35.3% of visual impairment and blindness in our study. This problem was consistently reported in other developed regions, such as Hong Kong, Singapore, and Los Angeles,^{4,13,21} and even more so in developing countries.^{1-3,9,10,12} To avoid this problem, more precise IOL power estimation before operation and better postoperative care with optometry and spectacle provision should be ensured to maximize surgical benefits.

Visual outcomes and complications from cataract surgery in population-based subjects in studies conducted in China, Bangladesh, India, and Los Angeles are summarized in Table 5.

The principal strength of our study is that it is one of the very few population-based reports of the outcome of cataract

TABLE 4. PVA Outcome in Eyes with Cataract Surgery by Year of Surgery, Surgical Setting, and Surgical Procedure

	≥6/18	<6/18 to ≥6/60	<6/60 to ≥3/60	<3/60	Total
Age at survey, y					
50-59	1	1	1	2	5
60-69	15	2	0	1	18
70+	40	17	2	8	67
Sex					
Male	22	12	0	3	37
Female	34	8	3	8	53
Year					
<1994	6	3	1	5	15
>1995	50	17	2	6	75
Surgical setting					
Eye specialty hospital	39	11	1	2	53
Other tertiary hospitals	9	4	1	7	21
Other hospitals	1	1	0	0	2
Unknown	7	4	1	2	14
Education, y					
>5 years	15	5	0	1	21
1-5 years	14	7	0	1	22
None	27	8	3	9	47
Procedure					
ICCE	0	1	0	0	1
ECCE	3	7	0	0	10
ECCE/IOL	17	2	3	8	30
Phaco/IOL	36	10	0	3	49
All	56	20	3	11	90

Data are the number of eyes.

TABLE 5. Comparison of Cataract Surgery Outcomes in China with Those in Population Studies and Studies in India and the United States

	Liwan	Hong Kong ⁴	Doumen ³	Shunyi ²	Bangladesh ⁹	Rajasthan ¹²	Singapore (Malays) ²³	The Los Angeles Latino Eye Study ¹³
Location	Southern China Urban	Hong Kong Suburban	Southern China Rural	Northern China Rural	Bangladesh (80.6%) Mostly rural	India Mostly rural	Singapore Urban	United States Urban
Year of survey	2003	1998	1997	1996	1999–2000	1999	2004–2006	2000–2003
N	1,405	3,441	5,342	5,052	11,624	4,284	3,280	6,357
Age	≥50	≥60	≥50	≥50	≥50	≥50	40–80	≥40
Eyes/surgical patients, n	90/62	473/310	152/109	116/87	226/162	723/549	438/284	422/265
Presenting visual acuity ≥6/18 in surgical eyes, %	62.2	59.6	23.7	25.0	43.8	31.5	73.2	74.6
BCVA ≥6/18 in surgical eyes, %	76.7	72.1 (pinhole vision)	42.1	61.5	Urban, 58.7 Rural, 38.0	Urban, 48.4 Rural, 26.9	89.2	81.3
Pseudophakia, %	87.8	86.9	5.9	39.7	10.2	5.5	97.1	73.7
Causes of visual impairment	Uncorrected aphakia; refractive error; retinal abnormality	Refractive error; Macular degeneration; glaucoma	Uncorrected aphakia; uncorrected refractive error; retinal abnormality	Uncorrected aphakia; refractive error	Operative complications; macular degeneration; optic atrophy	Refractive error/ uncorrected aphakia; surgical complications; age-related macular degeneration	Uncorrected refractive error; diabetic retinopathy; glaucoma; age-related macular degeneration; PCO	Uncorrected refractive error; age-related macular degeneration; diabetic retinopathy

surgery in urban settings in China. The weakness is that the data were collected several years ago. Up-to-date information would have been even more helpful in understanding the current situation. However, because there has been, in fact, very little change in urban China in terms of both the eye care system and the insurance system, the information we collected is still valid for the current situation, particularly when the data derived from urban China are extremely limited.

In summary, we estimated the postoperative outcomes of cataract surgery in a population-based cohort. The visual outcome in our sample is comparable that found in economically developed areas (such as Hong Kong and Los Angeles) and is better than that in rural areas in China, Bangladesh, and India. The study suggests an urban and rural difference in cataract surgical outcomes and highlights the need for further improvement in the quality of service in China.

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