

Long-term visual outcomes in the Cataract-Free Zone Project in Brazil

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ABSTRACT.

Purpose: To determine the long-term visual outcomes and causes of poor vision in the cataract population in Brazil treated in the Cataract-Free Zone Project.

Methods: Project A subjects (62 patients) were recruited in Taquaritinga, SP, 26 months after surgery. Project B subjects (34 patients) were recruited in São João da Boa Vista, SP, 43 months after surgery. All patients underwent visual screening and eye examination (examination 1). They were classified according to visual acuity in the operated eye and the causes of poor vision were diagnosed and referred for treatment. The results of these interventions were collected (examination 2) and analysed by Chi-square test.

Results: At examination 1 in project A, 47 of 62 patients (75.6%) had visual acuity $\leq 20/100$. The main causes of poor vision were refractive error (31.9%) and posterior capsule opacification (17.0%), with or without refractive error. At examination 1 in project B, 22 of 34 patients (64.7%) had visual acuity $\leq 20/100$. The main causes of poor vision were again posterior capsule opacification (50.0%) and refractive error (9.0%). After posterior capsulotomy with Nd:YAG laser and prescription of new corrective eyeglasses, visual acuity = 20/80 was obtained in 64.5% of patients in project A (OR = 0.18, CI = 0.07–0.41) and 70.5% of patients in project B (OR = 0.19, CI = 0.06–0.60) at examination 2. The causes of blindness in the remaining patients were identified.

Conclusion: This type of project is effective in reducing blindness caused by cataracts in developing countries. However, long-term scheduled follow-up of operated patients is an effective means of avoiding consecutive blindness resulting from secondary cataracts and refractive changes.

Key words: blindness prevention – cataract surgery – developing countries – long-term follow-up

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Age-related cataracts are the primary cause of avoidable blindness in developing countries. Large-scale programmes in various regions of the world have applied a range of strategies aimed at reducing the incidence of such blindness (Ellwein & Kupfer 1995). More recently, some authors, in observing the long-term results of cataract surgeries in

these interventions, detected visual problems such as uncorrected refractive error, posterior capsule opacification and persistence of other non-treated diseases (Dandona et al. 1998; Pokharel et al. 1998; Zhao et al. 1998; He et al. 1999).

In Brazil, approximately 700 000 people are legally classified as blind be-

cause of cataracts. Only 150 000 cataract extractions are performed yearly (65% of which are carried out by the public health system) (Kara José & Arieta 2001).

Studies carried out at the National Eye Institute (NEI) in 1986 led to the establishment of the Cataract-Free Zone Project (CFZ), which aimed to evaluate and reduce the problem of blindness caused by age-related cataracts in Latin America. It was designed to:

- (1) break down the barriers between potential patients and the health care system;
- (2) identify appropriate cases in their own communities;
- (3) provide pre- and postoperative as well as surgical care;
- (4) make available state of the art surgical technology, based on local resources (Heldt 1987; Kara José et al. 1988; Kara José et al. 1990).

The first two projects were developed simultaneously in Campinas, São Paulo State, Brazil and Chimbote, Peru in 1989. Since 2000, CFZ projects have been successfully implemented countrywide in Brazil, based on the model described (Kara José et al. 1990).

The present study evaluates the long-term visual surgical results in two communities where the populations had no access to local, permanent, free eye care in the period between the intervention and the present evaluation (approximately 2 years in project A and 4 years in project B). The effectiveness of the process and complementary issues included in CFZ projects in order to provide consistent results were also assessed.

Patients and Methods

Cataract-Free Zone Project

Since 1986, CFZ procedure has followed the same several steps in each of its various locations in Brazil, as previously reported (Kara José et al. 1990). In summary, the protocol involves the dissemination of information to the population via local radio and TV stations and through distribution of printed material. The second phase involves visits by ophthalmologists, nurses and community volunteers to several areas in the community (rural and urban) to screen individuals of 50 years of age and older in order to identify those whose best corrected vision is $<20/100$ (World Health Organization categories 1–5). The third phase involves a full eye examination for eligible patients. When a patient decides to have surgery, he or she undergoes a preoperative evaluation (including clinical and laboratory examinations and biometry of the eyes). Surgery is performed up to 2 weeks later on an outpatient basis and transportation is provided when necessary. Follow-up visits are scheduled weekly after the first day, until medication is discontinued and eyeglasses are prescribed, which takes a mean period of 6 weeks. All work is carried out on a voluntary basis and surgery is performed in a public hospital.

Location

Two areas where CFZ projects were active at different times during the 1990s were selected for the long-term evaluation of visual outcome. The mean per capita income of the rural and urban attended populations is less than \$2000 in both areas. There is no public eye care service in either area.

Twenty-six months after implementation of CFZ project A (Taquaritinga, SP, Brazil) and 43 months after implementation of project B (São João da Boa Vista, SP, Brazil), patients who had undergone extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens (PCIOL) implantation were contacted individually by health agents to schedule an ophthalmic re-evaluation at a local health centre (examination 1).

Procedure

The ophthalmologic examinations were performed in the cities where the patients

resided and new glasses were prescribed and provided free of charge. The cases that required YAG laser capsulotomy were referred to the University Hospital at UNICAMP.

The first long-term evaluation of the postoperative eye, designated examination 1, included assessment of distance visual acuity (VA) with Snellen charts and near VA with Jagger cards, refraction, slit lamp examination, indirect ophthalmoscopy and tonometry. All evaluations in examination were carried out by two of the authors (FMBS and JAC). Information about the use of glasses was recorded during interviews with patients and relatives.

Patients who presented with visual acuity $\leq 20/100$ (WHO categories 1–5) underwent a second ophthalmological evaluation (examination 2) as described above, after optical correction and/or application of the YAG laser had been carried out.

Each patient's contralateral eye (untreated during the project) was also evaluated and referred for treatment when necessary, but these findings are not presented here.

Eye conditions which required subsidiary examinations, specialized evaluations, and surgical or laser treatment were referred to the Departments of Ophthalmology of tertiary hospitals in the area.

Comparisons of VA data before and after this intervention were performed using Chi-square analysis with paired data and odd ratios with confidence intervals (Statview Software, Abacus, Berkeley, California, USA).

Results

Patient data for CFZ project A

Surgery was performed on 81 eyes from 81 patients. At follow-up 26 months later, 62 patients were located (76.5%), eight had died (9.9%) and 11 (13.5%) either could not be located or refused to attend examination 1. The mean age of the patients was 73.7 years.

Information on preoperative VA, surgery description and the wearing of eyeglasses was not available for project A. Fifty-three patients (85%) had cataracts in the other eye, but none of the patients who attended examination 1 had undergone any ophthalmic evaluation or intervention between participation in the project and examination 1.

Patient data for CFZ project B

In project B, 63 patients were operated and 34 (53.9%) attended examination 1 after 43 months. The patients' mean age at examination 1 was 79.9 years. Twelve patients had died (19.1%), and 17 (27%) were not evaluated for various reasons (i.e. illness, absence, refusal).

Medical files indicated that VA in the operated eye before cataract surgery was $\leq 20/400$ in 25 subjects (75.5%), $\leq 20/200$ in four subjects (11.8%) and $\leq 20/100$ in five subjects (14.7%). Twenty-nine patients (85.3%) underwent extracapsular cataract extraction (ECCE) with IOL implantation under local anaesthesia. Intraocular lens implantation was contraindicated in one patient, intracapsular cataract extraction (ICCE) was indicated in another and in three cases (8.8%) IOLs were not implanted because of intraoperative complications. Twenty-eight patients (88.4%) had no intraoperative complications, two (5.9%) had posterior capsular rupture with vitreous loss and two (5.9%) had posterior capsular rupture but no vitreous loss. Following the planned ICCE, vitreous loss was recorded and an intraoperative hypermature cataractous lens luxation occurred in one patient, resulting in an option for ICCE in this case.

Nineteen patients (55.9%) in project B were wearing eyeglasses. In this group, eight patients (23.5%) had undergone cataract surgery in the other eye prior to participation in the project, and 10 (29.4%) had cataract surgery in the other eye following the CFZ project. Sixteen (47.1%) had no surgery in the other eye, despite a diagnosis of cataract.

Visual acuity status at examination 1

Examination 1 recorded the distance and near visual acuity of the operated eye of 62 subjects in project A, 26 months after surgery, and in 34 patients in project B, 43 months after surgery (Table 1).

Within the entire postoperative population (96 patients), examination 1 detected 26 cases (27%) of VA = 20/80, 40 cases (41.6%) of poor vision (20/100–20/200) and 29 cases (30.2%) of VA $\leq 20/400$. There was a similar distribution of VA with a trend towards lower vision in project A (Table 1).

Causes of poor visual acuity

The causes of visual acuity $\leq 20/100$ in the operated eye were identified in examination 1 in 47 patients (75.8%) in project

A and in 22 patients (64.7%) in project B. Posterior capsule opacification accounted for 19 cases (27.5%) and refractive error accounted for 17 cases (24.6%) of poor VA in the combined group.

Examination 1 showed that 46.8% (22/47) of subjects in project A and 27.2% (6/22) of subjects in project B had low vision or blindness caused by other eye diseases unrelated to cataracts or surgeries. In addition, a marked difference in the distribution of causes of poor vision in both projects was observed (Table 2).

With regard to low vision secondary to intraoperative surgical complications, the data from project B showed two cases of

posterior capsule rupture, three of vitreous loss and one non-programmed ICCE. Three of these complications resulted in no IOL implantation. In addition, postoperative, sight-threatening complications were identified in 4.2% (4/96) of patients in the combined group (two cases of endophthalmitis in project A, one case of phthisis bulbi and one of IOL decentration in project B). All those cases fell into WHO categories 2–5 (Table 2).

Management of cases involving poor vision

Patients with poor vision caused by pos-

terior capsule opacification (eight in project A and 11 in project B) underwent capsulotomy in the postoperative eye at the university referral centre responsible for the CFZ project. This procedure improved vision to better than 20/50 in all cases.

For the patients whose vision improved, eyeglasses were prescribed and provided free of charge by the university's optical unit. These two interventions (i.e. capsulotomy and/or new glasses) significantly increased the number of individuals with vision = 20/80 ($p < 0.05$, project A OR = 0.18 95% CI = 0.07–0.41, project B OR = 0.19 95% CI = 0.06–0.6) (Table 1).

Table 1. Measurement of visual acuity prior to and following refraction and capsulotomy in CFZ projects A and B.

Visual acuity	Project A				Project B			
	Before		After		Before		After	
	n	%	n	%	n	%	n	%
Distance VA								
20/20–20/30	1	1.6	11	17.7	5	14.7	14	41.2
20/40–20/80	14	22.6	29	46.8	6	17.7	10	29.4
20/100–20/200	28	45.1	12	19.4	12	35.3	4	11.8
< 20/400	19	30.6	10	16.1	10	29.4	5	14.7
Non-communicative	0	0	0	0	1	2.9	1	2.9
Total	62	100%	62	100%	34	100	34	100
Near VA								
J1-J3	17	27.4	42	67.7	9	26.5	24	70.6
J4-J6	14	22.6	3	4.8	9	26.5	2	5.9
> J7	31	50	17	27.4	15	44.1	7	20.6
Non-communicative	0	0	0	0	1	2.9	1	2.9
Total	62	100	62	100	34	100	34	100

Table 2. Causes of poor visual acuity (< 20/100) in the long-term evaluation of CFZ projects after 26 (project A) and 43 (project B) months.

	Project A		Project B	
	n	%	n	%
Disease processes				
Refractive error	15	31.9	2	9.0
Age-related macular degeneration	8	17.0	2	9.0
Diabetic retinopathy	4	8.5	2	9.0
Chorioretinal scar	3	6.4	1	4.6
Optic atrophy	2	4.3	0	0
Corneal opacity	2	4.3	0	0
Myopic degeneration	1	2.1	1	4.6
Glaucoma	1	2.1	0	0
Retinitis pigmentosa	1	2.1	0	0
Surgical complications				
Posterior capsule opacification	8	17.0	11	50.0
Endophthalmitis	2	4.3	0	0
Phthisis bulbi	0	0	1	4.6
Decentered IOL	0	0	1	4.6
Undetermined	0	0	1	4.6
Total	47	100	22	100

Discussion

Two groups of patients were evaluated by the CFZ project. All patients underwent cataract surgeries in the eye with poorer vision, while their better eyes had VA ≤ 20/100. After 26 and 43 months, respectively, re-evaluation showed that VA in 75.8% and 64.7% of subjects had regressed to its previous condition. A total of 46.8% of patients in project A and 27.2% of patients in project B suffered a decline in vision in their operated eyes caused by other conditions not directly related to cataracts or their surgery. The two major causes for the regression related to cataract surgery were capsular opacification and postoperative refractive error.

Posterior capsule opacification was the most common cause of visual impairment in both CFZ projects, accounting for one-third of cases, in concurrence with other reports (Ruit et al. 1991; Cook 1996; Shrestha et al. 2001). The solution in some developing countries is to perform ICCE in order to avoid posterior capsule opacification, reduce operating time, simplify technique, and reduce costs (Young & Schawb 1989; Reidy et al. 1991; South Asian Cataract Management Study Group 1995;). However, limitations to this approach include the adaptation of eyeglass prescriptions to aphakic conditions, the costs of aphakic correction and the difficulties in replacing the glasses (West & Quigley 1991; Hogeweg et al. 1992; Yorston 1998).

The problems initially reported with anterior chamber IOL (ACIOL) implantation (Apple et al. 1987a, 1987b) related to the quality and design of those lenses, indicating that our protocols should fo-

cus on providing cataract surgery by ECCE with PCIOL technique, in accordance with a worldwide trend (Kara José et al. 1990; Reidy et al. 1991; Ruit et al. 1991; Cook 1996; Gillies et al. 1998). However, two recent studies aimed at evaluating the safety of multiflex open-loop ACIOLs and ICCE have indicated reduced levels of complications and surgical time, suggesting that such approaches could provide alternatives to posterior capsule opacification and aphakic eyeglasses in CFZ projects (Henning et al. 1997; Snellingen et al. 2000).

In Brazil, the availability of local hospital facilities and the facility to relocate ophthalmic equipment to other areas means that ECCE with PCIOL implantation represents a reasonable technique and one that has, in fact, been performed throughout the CFZ projects. It is now the most widely performed technique for cataract treatment in this country. Efforts have been made to reduce costs and rationalize resources in order to provide cataract treatment on a larger scale, thus allowing the prevalent use of surgical microscopes, biometry calculation, IOL, viscoelastic solutions, and disposable materials (Christy 1990; Kara José et al. 1994; Gillies et al. 1998). Moreover, Nd:YAG laser devices are available in most tertiary referral centres.

Despite the use of biometry and IOL calculation, refractive error was the second most common cause of visual impairment. Although the reasons for this were not recorded, inaccuracy of the preoperative measurement of the ocular axis length and residual astigmatism are the probable causes. Other contributing factors are the short period of postoperative follow-up, resulting in a premature corrective prescription as demonstrated by previous works (Høvding et al. 1994; Storr-Paulsen et al. 1994, 1999), and the loss or breakage of glasses which were not replaced.

Other conditions not related to cataracts or their complications represented the third most common cause of impaired vision. In the group of people not eligible for cataract surgery because of satisfactory vision (second phase) and in the patients operated on, some of these conditions were progressive (e.g. glaucoma, diabetic retinopathy, etc.) and contributed to later visual impairment. In its present design, the CFZ is unable to provide treatment or prevention for these vision-threatening problems. Similar limitations have been identified in pro-

grammes carried out in Africa and India (Egbert & Buchanan 1991; Murthy et al. 1996; Dandona et al. 1998), suggesting that these conditions are underestimated by health-care providers and that long-term policies based on local epidemiological studies should be addressed (Dandona et al. 1998).

The rates of intra- and postoperative complications, despite being non-satisfactory compared to cataract surgeries regularly performed by experienced surgeons, were similar to those reported of projects carried out in similar conditions using ECCE (Egbert & Buchanan 1991; Ruit et al. 1991; Cook 1996).

Recent studies of the long-term outcomes of cataract surgery in Shunyi County, Nepal and Doumen, China have yielded results which fall below expectations. In these studies, VA outcomes correlated with visual function and quality of life scores. In both cases, posterior capsule opacification, refractive error and diseases not related to cataracts were causes of reduced VA, although surgical complications were the most frequent cause (Pokharel et al. 1998; Zhao et al. 1998; He et al. 1999). Although the quality of surgery is a key factor in the stability of visual acuity in CFZ projects, the long-term effects discussed above (posterior capsule opacification, refractive error and diseases not related to cataracts) represent the most frequent causes of vision reduction. This claim is confirmed by previous reports from CFZ projects in Brazil and Peru, showing that VA improved from $\leq 20/100$ to $\geq 20/70$ in 85% of patients during short-term follow-up (Kara José et al. 1990). In addition, a study of the long-term results of ECCE and IOL implantation in Ghana identified VA $\geq 20/100$ in 75% of re-evaluated eyes after a mean period of 16 months in a younger operated population (mean age 68.7 years) than that studied here (Egbert & Buchanan 1991).

We were unable to re-evaluate 23.5% and 46.0% of surgical patients in projects A and B, respectively. Even considering the risk of bias in our analysis, we obtained similar rates of patient recall to those of previous studies (Egbert & Buchanan 1991; Ruit et al. 1991). This may be explained by the high number of deaths, the prolonged period without patient/healthcare contact, numerous barriers between the healthcare system and many of the patients in developing countries, and the relatively expensive strategies required to bring patients to clinics in situ-

ations like temporary projects (Egbert & Buchanan 1991; Ellwein et al. 1991; Rabinu 2001). The difference between groups A and B in terms of impaired vision and distribution of causes may also be partly associated with the different postoperative times at which they were re-evaluated (26 and 47 months, respectively), since this could influence estimated rates of other ocular diseases and contribute to absence from re-examination.

As shown here, it was possible to improve the patient's vision more than two-fold using later and much less expensive interventions such as new refraction and Nd:YAG laser capsulotomy. We have also shown that the barriers between cataract patients and eye care services are not collapsed by a single intervention. Nevertheless, more than 80% of the patients who were re-examined evaluated the CFZ project positively and would agree to be operated under this scheme again. A recent evaluation in one district of India (Mysore, Karnataka) indicated that cataract surgery at mobile government camps generated higher levels of dissatisfied and postoperatively blind patients than surgery at non-governmental or medical college hospitals, notwithstanding the reduced costs of that option (Singh et al. 2000). The authors recommended permanent facilities and monitoring of cataract surgery outcomes to improve the cost-effectiveness of these programmes. The CFZ projects in Brazil comply in part with these recommendations, since all procedures and follow-ups are performed by experienced surgeons and in hospital-based operating rooms.

The lack of stability in the model of intervention provided by CFZ projects needs to be addressed. The absence of long-term postoperative follow-up and routine planned visits to an ophthalmologist appear to influence the patient's return to a state of visual impairment. In order to combat this problem in communities which are unable to provide permanent, free eye care, we suggest scheduled visits and a recall of operated patients every 2 years.

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