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Original Research Article

Long-term visual outcome among adults availing free cataract surgery in Southern India

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ABSTRACT

Background: Cataract surgery aims to restore vision and independence, yet long-term follow-up in low-resource settings remains low. This study evaluates the sustainability of visual outcomes in patients who received free cataract surgery in South India.

Methods: A multicenter, observational study was conducted among adults who underwent cataract surgery at six tertiary care hospitals in Tamil Nadu and Karnataka. Two cohorts were assessed: individuals operated 2 years prior (n=319) and 4 years prior (n=361). Participants were selected using random-proportional sampling followed by convenience sampling. Data collection included home-based interviews and visual acuity assessment using a Snellen tumbling E chart. Baseline visual acuity obtained from medical records was compared with follow-up measurements. Both uncorrected and pinhole-corrected visual acuity were analyzed in LogMAR units. Paired t-tests and ANOVA were used to assess differences.

Results: In the 2-year cohort, mean uncorrected VA remained stable from baseline (0.34±0.37 LogMAR) to follow-up (0.35±0.30; p=0.08). Pinhole-corrected VA also showed no significant change (0.34±0.36 to 0.25±0.29; p=0.05). In the 4-year cohort, a significant decline in visual acuity was observed. Uncorrected VA worsened from 0.23±0.20 at baseline to 0.31±0.31 at 4 years (p=0.03). Similarly, pinhole-corrected VA declined from 0.17±0.22 to 0.21±0.28 (p=0.01).

Conclusions: While visual outcomes remained stable at 2 years post-surgery, a significant decline was evident at the 4-year follow-up among South Indian patients who underwent free cataract surgery. This underscores the necessity for structured, long-term postoperative care and monitoring systems in resource-limited settings to sustain the initial benefits of cataract intervention and address late complications.

Keywords: Cataract surgery, Visual acuity, Long-term follow-up, Low-resource settings, India, Postoperative outcomes

INTRODUCTION

Cataract surgery is at present one of the most frequently performed surgical procedures throughout the world.[1,2] Cataract surgery is regarded as economically successful because improvement of visual acuity may allow the person to continue his or her work and also it enables the elderly to be able to manage their daily life activities without other persons' regular help. Several studies on the visual outcome and complications following intra-capsular and extra-capsular cataract extraction with or without implantation of an intraocular lens have been published in various centres.[1-18]

In many developing countries, post-operative follow-up rates are as low as 20-30% because of poor transportation infrastructure, costs to patients, and failure to communicate the benefits of returning, which can include the distribution of corrective glasses.[19,20] Low rates of post-operative follow-up and uncertainty about whether returning patients are representative of the operated cohort make assessment of performance against objective standards difficult. WHO recommends that 80% of patients should have uncorrected (without refraction) visual acuity of 6/18 or better in the operated eye but does not stipulate a specific time after surgery for assessment.[21] Recent surveys in India, and elsewhere, have demonstrated that cataract blindness continues as the leading cause of blindness in developing countries.[1,3,13-18]

Accordingly, blindness control programmes in India have focused primarily on cataracts.[22] Although such programmes have improved the coverage of cataract surgery, they have not always resulted in good postoperative vision outcomes.[16-18] Reports from population-based studies in Nepal, China, and recently from three in India underscore the unmet need to fully realise the sight-restoring potential of cataract surgery.[16,18,23-26] A study by Panchpakesan J et al explains the 5-year visual acuity changes in the older population of Blue Mountains, Sydney, Australia. Cataract surgery significantly improved visual acuity in eyes with any baseline cataract change of 3.75±1.34 letters for right eyes and 6.7±0.99 letters for left eyes. Cataract surgery significantly improved vision in eyes with no substantial lens opacity at baseline (mean±SD), change of 3.78±1.85 letters for right eyes and 2.68±1.33 letters for left eyes). [13]

METHODS

In the years November 2018 to February 2022, free cataract surgeries were undertaken in six tertiary care hospitals in Southern India. During this period, an impact assessment was conducted on this cohort with the help of home-based visits and interviews. The current paper is the outcome of this assessment. Very little is known about the long-term implications and prognosis of a successful cataract surgical intervention. Long-term follow-up is, therefore, essential to completely understand the late complications of surgery and the overall success of this surgical intervention. The current study is designed to estimate the long-term outcome following successful cataract surgery in the two southern states of India – Tamil Nadu and Karnataka. This study is a multicenter, observational and retrospective cohort design. The study followed the guidelines provided in the Declaration of Helsinki and the local Ethics Committee provided the necessary approvals to conduct this study. A random-proportional sampling technique followed by convenience sampling technique to recruit participants fulfilling the criteria of age being 18 years and older, who had a successful cataract surgery done in at least one eye at two years and four years before the start of data collection, understanding at least one of the following languages – Tamil or Kannada and, had been operated for the first eye at the time of initial surgery were sampled and included in the study.

From the list of selected patients, convenient sampling was conducted based on access, and availability. A list of selected patients was compiled – one for those patients who had the cataract surgery done two years ago (cohort 1) and four years (cohort 2), from the date of data collection. The process of data collection for this study happened in two phases – Medical record extraction at the hospital and face-to-face interviews including the uncorrected visual acuity assessment with and without the pinhole of the respondents at their respective homes.

The study instrument was developed through a literature review on visual outcomes following cataract surgery among adult patients. Pilot testing was done to refine the data collection format and approach. A written informed consent was taken from the participants following which the study instrument was administered. The interview took around 30 minutes to complete and the uncorrected visual acuity readings with and without pinhole of the patients were recorded immediately using Snellen's tumbling E chart. The Snellen's notation was converted into LogMAR notation. All measurements were taken in full daylight with available correction. The visual acuity obtained was analysed as improved, remained the same, or deteriorated as compared to the baseline postoperative visual acuity details already recorded. If it had improved or remained unchanged, then the recording was appropriately done, and the interview was ended.

If a decrease was noted compared to the baseline reading, a referral card was handed over to the patient and were strongly advised to visit the hospital as soon as possible. The data were analysed using SPSS software (version 20.0, IBM SPSS, Inc.).

The descriptive statistics of Mean, standard deviation (SD), and standard error were provided for continuous variables of 2 years and 4 years cohorts. The paired t-test was analysed to compare the means of the visual acuity obtained from the two cohorts with their baseline. One-way ANOVA was performed to compare the visual acuity means of both cohorts with each other.

RESULTS

2-year cohort

Out of a total of 319 participants, there were 138 men and 181 females. Out of total number of individuals, 4 participants died. The mean age of individuals was 67.2±11.79 years, with mean age of males being 67.2±11.82 years and mean age of females being 67.2± 11.79 years.

4-year cohort

This consisted of 361 participants, with 108 being male and 253 being female. The average age of the individuals was 63.5 years.

Table 1: The sociodemographic and clinical characteristics of 2-year and 4-year cohorts.

Attributes	Variables	2 years cohort N (%)	4 years cohort N (%)
Eye operated	Right eye	167 (52.35)	179 (49.58)
	Left eye	152 (47.65)	182 (50.42)
Currently using spectacles	Yes	107 (33.54)	87 (24.1)
	No	212 (66.46)	274 (75.9)
Education level	Illiterate	169 (52.98)	234 (64.82)
	Nursery to class 5	84 (26.33)	66 (18.28)
	Class 6 to 12	63 (19.75)	60 (16.62)
	Graduate	3 (0.94)	1 (0.28)
Religion	Hindu	283 (88.71)	332 (91.97)
	Muslim	13 (4.08)	13 (3.6)
	Christian	19 (5.96)	16 (4.43)
	Other	4 (1.25)	0 (0)
Marital status	Never married	10 (3.13)	4 (1.11)
	Currently married	194 (60.82)	185 (51.25)
	Divorced/separated	6 (1.88)	4 (1.11)
	Widowed	103 (32.29)	168 (46.54)
	Refused to answer	6 (1.88)	0 (0)
Current occupation	Works in own farm	65 (20.38)	49 (13.57)
	Work in other's farm	81 (25.39)	72 (19.94)
	Labourer	6 (1.88)	2 (0.55)
	Private job	27 (8.46)	7 (1.94)
	Business	34 (10.66)	18 (4.99)
	Unemployed	106 (33.23)	207 (57.34)
	Others	0 (0)	6 (1.66)
Living with	Living with children and spouse	132 (41.38)	93 (25.76)
	Living with children without a spouse	74 (23.20)	127 (35.18)
	Living with spouse only	55 (17.24)	58 (16.07)
	Alone	45 (14.11)	71 (19.67)
	Living with relatives	13 (4.08)	12 (3.32)
Current eye discomfort	None	264 (82.76)	300 (83.1)
	Mild	45 (14.11)	53 (14.68)
	Moderate	1 (0.31)	5 (1.39)
	Severe	7 (2.19)	3 (0.83)
	Extreme	2 (0.63)	0 (0)
How would you rate your eyesight using both eyes currently?	Very good	112 (35.11)	201 (55.68)
	Good	157 (49.22)	104 (28.81)
	Moderate	42 (13.17)	50 (13.85)
	Bad	5 (1.57)	4 (1.11)
	Very bad	3 (0.94)	2 (0.55)
Have you experienced any decrease in the vision in the operated eye?	Yes	39 (12.23)	58 (16.07)
	No	268 (84.01)	293 (81.16)
	Cannot say	12 (3.76)	10 (2.77)

Table 2: The visual acuity changes in 2 and 4-year cohorts based on log mar vision chart lines.

			Visual acuity difference by 2 lines	Visual acuity difference by 3 lines	Visual acuity difference by 4 lines	Visual acuity difference by 5 lines	Visual acuity difference by 6 lines	Visual acuity difference by 7 lines	Visual acuity difference by 8 lines	Visual acuity difference by 10 lines	Visual acuity difference more than 10 lines
Increased	Without pinhole 2 years operated eye	Total count	29	26	2	5	4	2	2	2	8
		Gender	M=15, F = 14	M = 14, F = 12	M=0, F=2	M=1, F=4	M=2, F=2	M=1, F=1	M=1, F=1	M=1, F=1	M=1, F=7
		Age range	28 - 75	29 - 73	55 - 67	35 - 68	52 - 73	62 - 72	57 - 72	62 - 74	44 - 72
	With pinhole 2 years operated eye	Total count	22	37	7	11	8	0	4	2	11
		Gender	M=6, F =16	M=19, F=18	M=3, F=4	M=5, F=6	M=6, F=2	0	M=1, F=3	M=2, F=0	M=3, F=8
		Age range	45 - 72	45 - 75	47 - 75	29 - 67	52 - 73	0	45 - 62	61 -76	72 - 77
Decreased	Without pinhole 2 years operated eye	Total count	22	31	2	6	5	1	6	2	5
		Gender	M=7, F=15	M=13, F=18	M=0, F=2	M=4, F=2	M=3, F=2	M=0, F=1	M=2, F=4	M=2, F=0	M=4, F=1
		Age range	45 - 72	45 - 75	55 - 67	52 - 63	37 - 67	50	57 - 65	62 - 74	55 - 80
	With pinhole 2 years operated eye	Total count	48	15	2	7	4	0	5	2	6
		Gender	M = 22, F = 26	M=04, F=11	M=1, F=1	M=3, F=4	M=2, F=2	0	M=3, F=2	M=2, F=0	M=5, F=1
		Age range	28 – 73	45 – 76	67	59 – 69	62 – 67	0	55 – 72	62 -74	38 – 80
Increased	Without pinhole 4 years operated eye	Total count	31	32	3	7	5	0	0	0	1
		Gender	M = 8, F = 23	M=8, F=24	M=2, F=1	M=4, F=3	M=0, F=5	0	0	0	M=1, F=0
		Age range	28 - 69	45 - 76	22 - 64	37 - 73	35 - 62	0	0	0	63
	With pinhole 4 years operated eye	Total count	45	27	2	9	3	1	0	0	3
		Gender	M = 9, F = 36	M=8, F=19	M=0, F=2	M=1, F=8	M=2, F=1	M=0, F=1	0	0	M=1, F=2
		Age range	28 - 76	33 - 78	71 - 76	35 - 69	59 - 87	55	0	0	63 - 70
Decreased	Without pinhole 4 years operated eye	Total count	39	55	8	27	12	0	6	0	9
		Gender	M = 10, F = 29	M=21, F=34	M=3, F=5	M=6, F=21	M=1, F=11	0	M=0, F=6	0	M=2, F=7
		Age range	55 - 82	40-80	43 - 69	29 - 76	45 - 88	0	66 - 73	0	31 - 80
	With pinhole 4 years operated eye	Total count	61	44	3	16	6	1	0	0	8
		Gender	M= 15, F=46	M=15, F=29	M=3, F=0	M=1, F=15	M=1, F=5	M=0, F=1	0	0	M=2, F=6
		Age range	40 - 87	35 - 77	59 - 65	45 - 73	55 - 78	71	0	0	31 - 80

Table 1 shows the distribution of operated eyes was similar across both groups, with nearly equal proportions undergoing surgery on the right and left eyes. Spectacle usage was notably higher among the 2-year cohort, where one-third of participants reported regular use, compared to only one-fourth in the 4-year cohort. Educational attainment was low overall, with illiteracy prevailing in both groups—affecting nearly two-thirds of the 4-year cohort and just over half of the 2-year cohort. The majority of participants in both groups were Hindu, accounting for 88% of the sample. Looking at marital status, we found that 46% of participants in the 4-year cohort were widowed, compared to 32% in the 2-year cohort. Unemployment was high in both groups but more common in the 4-year cohort, where 57% were without work, compared to 33% in the 2-year cohort. Living arrangements also differed—more people in the 4-year cohort were living alone (20%) or raising children without a spouse (35%). On a positive note, the majority in both groups reported no current eye discomfort—83% in each cohort—suggesting that most were comfortable with their surgical outcome. When asked to rate their eyesight, 56% of the 4-year cohort described their vision as very good, compared to 35% in the 2-year cohort. However, a slightly higher percentage of the 4-year cohort (16%) felt their vision had decreased in the operated eye, compared to 12% in the 2-year cohort, indicating that this group may benefit from continued follow-up and care. Table 2 shows the Visual Acuity Difference by 2 Lines category, without using a pinhole at the 2-year mark, 29 patients experienced an increase in visual acuity, while 22 saw a decrease. When using a pinhole, 22 patients had improved visual acuity, and 48 experienced a decrease. At the 4-year mark, 31 patients improved and 39 decreased without a pinhole. With the pinhole, 45 patients improved, while 61 experienced a decline. In the Visual Acuity Difference by 3 Lines category, at the 2-year mark, 26 patients saw an increase and 31 a decrease without a pinhole. When using a pinhole, 37 improved while 15 declined. At the 4-year mark, without a pinhole, 32 patients had improved acuity, and 55 saw a decrease.

With a pinhole, 27 patients improved, while 44 declined. In the 4 Lines category, without a pinhole at 2 years, 2 patients improved while 2 declined; with a pinhole, 7 patients improved and 2 declined. At 4 years, 3 patients improved without a pinhole, while 8 saw a decline; with a pinhole, 2 improved and 3 declined. For 5 Lines, 5 patients improved and 6 declined without a pinhole at 2 years; with a pinhole, 11 improved and 7 declined. At 4 years, 7 patients improved without a pinhole, and 27 declined; with a pinhole, 9 patients improved, and 16 saw a decline. In the 6 Lines category, 4 patients improved, and 5 declined without a pinhole at 2 years; with a pinhole, 8 improved and 4 declined. At 4 years, 5 patients improved without a pinhole, and 12 declined; with a pinhole, 3 improved and 6 declined.

Table 3: The descriptive statistics and paired t-test values of the visual acuity of 2 years and 4 years cohorts.

	Without pinhole baseline	Without pinhole 2 years	With pinhole baseline	With pinhole 2 years	Without pinhole baseline	Without pinhole 4 years	With pinhole baseline	With pinhole 4 years
Mean	0.34	0.35	0.34	0.25	0.23	0.31	0.17	0.21
Standard deviation	0.37	0.30	0.36	0.29	0.20	0.30	0.22	0.26
P value	0.08		0.05		0.03		0.01	

In the 7 Lines category, at 2 years, 2 patients improved without a pinhole, and one declined. With a pinhole, 1 patient improved, and none declined. At 4 years, no patients improved or declined without and with a pinhole; with a pinhole, 1 improvement was seen, and 1 patient declined. For 8 Lines, at 2 years, 2 patients improved and 6 declined without a pinhole; with a pinhole, 4 improved and 5 declined whereas, none patients improved and 6 declined without a pinhole at 4 years. For visual acuity changes exceeding 10 lines, at 2 years, 8 patients improved, and 5 declined without a pinhole. With a pinhole, 11 patients improved, and 6 declined. At 4 years, 1 patient improved without a pinhole, while 9 declined; with a pinhole, 3 patients improved, and 8 declined.

Without pinhole correction, the average number of patients experiencing an increase in visual acuity was 8.89 at 2 years and 8.78 at 4 years, indicating a mean difference of -0.11. Conversely, the average number of patients experiencing a decline in visual acuity was 8.89 at 2 years and 17.33 at 4 years, indicating a mean difference of 8.44. With pinhole correction, the average number of patients experiencing an increase in visual acuity was 11.33 mean individuals at 2 years and 10 at 4 years, indicating a mean difference of -1.33. Conversely, the average number of patients experiencing a decline in visual acuity was 9.89 at 2 years and 15.33 at 4 years, indicating a mean difference of 5.44.

Table 3 shows the data was normally distributed, and we used paired t-tests to determine the statistical difference between the means of the cohorts as indicated by the p-value. For the 2-year cohort, the average visual acuity without a pinhole at baseline was 0.34±0.37, while after 2 years it was 0.35±0.30 (p=0.08). The p-value indicates no significant difference between the visual acuity from baseline to 2 years without the pinhole. The average visual acuity with a pinhole at baseline was 0.34±0.36, while after 2 years it was 0.25±0.29 (p=0.05). The p value

indicates a significant difference between baseline to 2 years with pinhole visual acuity.

For the 4-year cohort, the average visual acuity without the use of a pinhole at baseline was 0.23±0.20. After 4 years, the average visual acuity was 0.31±0.30 (p=0.03). The p-value indicates a significant difference between the visual acuity from baseline to 4 years. The mean visual acuity with the pinhole at baseline was 0.17±0.22, and after 4 years it was 0.21±0.29 (p=0.01). This indicates a significant change between the visual acuity at baseline to 4 years with pinhole.

A one-way ANOVA test was conducted to analyse the difference in visual acuity between the means of three groups (baseline, 2 years cohort and 4 years cohorts) with and without a pinhole. It was found that without a pinhole there was no significant difference (p=0.19) in visual acuity whereas, with a pinhole, there was a significant difference in visual acuity (p=0.03).

DISCUSSION

In the 2-year cohort, the patients 60+ years old were 61%, while in the 4-year cohort the 60+ age was 76%. The prevalence of unoperated cataracts in people aged 60 and above was 58% in North India and 53% in South India. The prevalence of cataracts was similar in both regions [2,14,15] In the current study majority of the patients belonged to the age group of 60 - 69 years which is also similar to previous studies 14-15. Whereas, 6.30% falls in the age group of >70 years. This is similar to the study conducted by Vashisht et al in 2011.[17] In terms of the eye operated, the right eye was more commonly operated on in 2-year cohorts, whereas, in the 4-year cohort, the left eye was more commonly operated.

In the 2-year cohort, a majority 52.98% were illiterate followed by education up to class 5, then class 12. A similar trend was observed in the 4-year cohort where a higher percentage of individuals were illiterate 64.82% followed by education up to the 5th grade (18.28%) and the percentage of education up to class 12 was 16.62%. Education level is associated with changes in visual acuity and improvement in visual function after cataract surgery, especially in women. Higher education levels were correlated with better outcomes in terms of visual acuity and visual function post-surgery.[14-16] The study conducted in Andhra Pradesh, India, found that there were differences in visual acuity outcomes post-cataract surgery based on education level, with those who had no education having poorer outcomes.[15,16] Religious affiliation remained relatively stable between the two cohorts, with Hinduism being the most common religion in both groups. However, there was a slight increase in the proportion of Hindus (from 88.71% to 91.97%) and a decrease in the proportion of Christians in the 4-year cohort. Marital status saw a majority in the percentage of married individuals, 60.82% in the 2-year cohort and 51.25% in the 4-year cohort. Occupational status revealed a diverse range of employment situations. In the 2-year cohort, worked in other's farm 25.39% and 33.23% were unemployed while in the 4-year cohort, the unemployed were 57.34% and self-employed individuals were 5%. In a study population majorly practiced Hinduism and consisted mostly of married couples. Most of the sample population revealed to be illiterate majority of them were female and most of the men had main schooling.[16]

Living arrangements showed that the majority lived with children and a spouse in 2-year cohorts (40.13%) while in 4-year cohort, majority lived with children without the spouse (35.18%). Eye discomfort showed the percentage of patients reporting no discomfort were majority in both the cohorts, 82.76% and 83.10% respectively. The individuals suffering severe discomfort were 2.19% and extreme discomfort were 0.63% in 2- year cohort. While in 4- year cohort, the individuals suffering severe discomfort were 0.83% and none suffered extreme discomfort. The number of patients reporting a decrease in vision post-surgery in 2 and 4-year cohort were 12.23% and 16.07% respectively. This correlates with the p-values obtained through paired t-tests. The discomfort can be due to the type of cataract surgery, pre-operative conditions, sociodemographic factors and gender.[16]

The data suggests that till 2 years, there is no significant change in the visual acuity while after 2 years till 4 years there is a significant change in the visual acuity. As seen in table 2, the trend of the p-value is moving towards a significant difference from 2 years to 4 years. Also, there is no significant difference between the means of the two cohorts. In the current study, while many patients experience improvements in their vision, a significant number experience declines over time. Without pinhole, the mean difference of -0.11 individuals experienced an increase in visual acuity from 2 to 4 years, while the mean difference of 8.44 individuals experienced a decline in visual acuity. With pinhole, the mean difference of -1.33 individuals experienced an increase in visual acuity from 2 to 4 years, while the mean difference of 5.44 individuals experienced a decline in visual acuity. These declines can be attributed to factors such as age, posterior capsule opacification, age-related macular degeneration and type of cataract.[11,12] This tendency emphasizes the significance of continuous patient care and individualized follow-up to handle the various outcomes reported after surgery. Research in the Journal of Cataract and Refractive Surgery indicates that significant visual improvements typically occur within the first two years post-surgery, with stabilization or gradual decline in visual acuity beyond this period.[9] A systematic review and meta-analysis in Ophthalmology corroborate these findings, noting that while short-term gains are substantial, long-term changes are less pronounced.[10]

The major limitation of this study is the non-availability of clinical data to correlate the reason behind the decline in visual acuity. Additionally, a review published in the British Journal of Ophthalmology emphasizes the

relationship between visual acuity improvements and quality of life in older adults, reinforcing that long-term outcomes are influenced by factors like patient adherence and management of other conditions.[11] A population-based study in the Indian Journal of Ophthalmology specifically examines long-term outcomes in India, noting similar patterns of initial gains followed by stabilization.[12] Finally, a longitudinal study reported in the Journal of Cataract and Refractive Surgery details the gradual changes in visual acuity over several years, highlighting the need for ongoing assessment and care.[13]

CONCLUSION

The comparative analysis of two patient cohorts, observed over 2- and 4-years post-cataract surgery, highlights significant demographic, educational, and clinical trends. The data suggests that up to 2 years, there is no significant decline in visual acuity; however, between 2 and 4 years, a significant decline occurs. Despite certain limitations, this study underscores the necessity of early surgical intervention and ongoing postoperative monitoring to preserve visual function and enhance the quality of life in the ageing population.

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