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Clinical Outcomes of Surgery for Age-related Cataract with Intraocular Lens Implantation in Two Hospitals in North-Central Nigeria

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Aims: The study aimed to assess the post-operative presenting visual acuity (PVA) and best-corrected visual acuity (BCVA) from six weeks and above post-surgery, of patients operated for age-related cataract with biometry-calculated IOL power and available IOL power implantation, in two hospitals in Jos, Nigeria.
Study Design: Retrospective cross-sectional survey.
Place and Duration of Study: Eye units of two mission Hospitals in Jos namely; Bingham University Teaching Hospital and the Faith Alive foundation Hospital, between June and August 2021.
Methodology: Patients aged 40 years and above, who had undergone surgery for age-related cataract in the preceding 18 months in two hospitals in Jos and were six weeks or more post-surgery were consecutively enrolled into the study, after obtaining informed consent. Socio-demographic data and surgical history were obtained from patients and their surgical records. The

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PVA and BCVA were assessed and categorized based on World Health Organization guidelines.
Results: A total of 87 patients were examined within the study period. Post-operative PVA was good (≥6/18) in 32 (36.8%), borderline (<6/18-6/60) in 41 (47.1%) and poor (<6/60) in 14 (16.1%) participants. After refraction, the proportion of good outcomes increased to 78.2% with only 8.1% of outcomes remaining poor. Biometry-calculated IOL power and available IOL power use did not significantly influence visual outcome (*P*=.645 and *P*=.146 for PVA and BCVA respectively).
Conclusion: Majority of participants had post-operative PVA in the borderline category with residual uncorrected refractive error as the principal cause. Regardless of the IOL power implanted, surgery for age-related cataract enhanced patients' vision. This study has shown that the presence of biometry is a guarantee of refractive success. Hence, refractive outcome audits are essential.

Keywords: Age-related cataract; outcome; intra-ocular lens.

1. INTRODUCTION

The use of available intraocular lens (IOL) power in cataract surgery, often a single power of IOL for all patients is not uncommon. Especially in settings where biometry equipment is either unavailable or non-functional, and comprehensive IOL banks are not maintained. The negative impact of this practice is, however, unclear. Continuous monitoring of clinical outcomes of cataract surgery in these settings is essential for sustained improvement.

In Sub Saharan Africa, about 60% of cataract surgical facilities either do not have functioning biometry equipment's or they are non-functional and many lack comprehensive intraocular lens (IOL) banks [1]. Consequently, the use of standard or available IOL (A-IOL) power as against pre-surgery biometry-calculated IOL (BC-IOL) power has become common practice in this region [2-5].

Globally, audit of refractive outcomes of cataract surgery with accurately calculated IOL power have consistently demonstrated better visual outcomes and reduced post-operative spectacle dependence [6,7]. However, because the prevalence of refractive error (RE) has been reported to be low in Sub-Saharan Africa (SSA), it is not clear if the benefits of biometry are as large as in other populations with higher prevalence of RE [8,9]. The best published results in terms of post-operative presenting visual acuity (PVA) from a routine hospital cataract service in SSA that I am aware of utilized a standard 22 diopter lens for every patient [10]. Although the low prevalence of RE in SSA may be genetic in part with a substantial environmental component, the move to urbanization of the African population is expected to be accompanied by a rise in RE prevalence. Therefore, the absence of biometry equipment in some African cataract surgical services, is likely to become more important as time goes on. Good PVA results using A-IOL in past series cannot therefore, guarantee that similar stable refractive outcomes will be found in more urbanized African population in the future. Cataract remains the leading cause of blindness in SSA and world over [11,12]. As efforts are being made to increase the cataract surgical coverage and cataract surgical rate, it is important that equal attention be given to improving the quality of cataract surgery. In resource-limited settings, necessary attention may not be given to cataract surgical outcomes until substantial evidence of a need for improvement is generated. Reliable evidence from low- and middle-income countries identifying factors that cause clinical outcome of cataract surgery to be less than ideal and the specific steps that can be taken to address these factors are insufficient.

This study was undertaken to evaluate the impact of biometry on PVA in a setting were uptake of glasses following cataract surgery is low. If the use of biometry is found to produce significantly better PVA outcomes for patients, this would increase the incentive for resource constrained cataract service providers to invest in biometry equipment, its maintenance and the continued stocking of a full range of IOL powers.

2. MATERIALS AND METHODS

A retrospective cohort of all patients aged 40 years and older, who had undergone surgery for age-related cataract in two hospitals in Jos, north-central Nigeria between November 2019 and April 2021 was constructed.

2.1 Inclusion and Exclusion Criteria

Eligible participants were patients who had undergone first eye surgery with posterior

chamber intraocular lens implantation in the preceding 18-month, and who were six weeks or more post-surgery at the time of study. The data collection period was June to August 2021. Patients excluded from the study were those who did not give consent, were younger than 40 years, with pre-operative vision of no light perception, secondary or complicated cataract, bilateral cataract surgery, combined procedure (e.g., cataract surgery with filtration surgery) and those without posterior chamber intra ocular lens implantation. Those whose telephone contacts were not available in the surgical records and residing outside of Plateau state at the time of the study were also excluded. All participants were given a stipend to reduce travel cost incurred.

2.1.1 Data collection

The cataract surgical records of both hospitals in the preceding 18-month were reviewed by the investigator who is an ophthalmologist to determine eligibility. Eligible participants were invited for enrollment and examination at their respective hospitals by an ophthalmic nurse via telephone calls. Non-responders were eligible participants who declined participation, failed to show up or could not be reached via their telephone contacts.

Upon enrollment, participants were interviewed by the ophthalmologist to obtain their socio-demographic data and relevant cataract surgical history. History of pre-operative biometry and intra ocular lens power implanted were retrieved from patient's surgery notes. Thereafter, all patients underwent distant visual acuity (VA) assessment by an ophthalmic nurse with available correction at a distance of 6 meters using an illuminated Snellen's 'E' chart to obtain the Presenting Visual Acuity (PVA). Near vision was tested with available correction with the patient holding the reduced 'E' chart at a distance of 40cm. Automated refraction followed by subjective refraction was performed by an optometrist for all patients with PVA worse than 6/18 to obtain the Best-Corrected Visual Acuity (BCVA). In all cases, measurements were first made separately for each eye, beginning with the right eye. In the same manner, the left eye was tested before testing the two eyes together. To reduce measurement bias, visual acuity charts and assessment method were standardized and the same personnel performed PVA and BCVA assessment in each facility through the entire period of data collection.

Cause(s) of visual impairment (VI) not amenable to refractive correction were identified following anterior and posterior segment examination by the ophthalmologist. A lack of improvement in PVA by at least one line on the Snellen Chart was considered as VI from a cause other than refractive error (RE). Participants found to have uncorrected distant and or near RE were given spectacle prescription. Those with VI from causes other than RE were given appropriate treatment or referred for further management. Fig. 1 is a flow chart of study activities.

For the purpose of this study, the following operational definitions were used:

1. Post-operative PVA: Visual acuity in the operated eye using currently available refractive correction [13].
2. Post-operative BCVA: Visual acuity in the operated eye with best possible correction [13].
3. Clinical outcomes of cataract surgery include: post-operative PVA and BCVA.
4. Post-operative visual outcome was classified as good (≥ 6/18), borderline (6/18 – 6/60) and poor (< 6/60) based on World Health Organization recommended guidelines on outcome of cataract surgery at six weeks post-operatively [14].
5. Refractive error: PVA worse than 6/18 which improves by one or more lines on the Snellen's chart with refraction.

2.1.1.1 Statistical analysis

Data was entered into Microsoft excel spreadsheet and imported into STATA version 16.0 (Stata Corp, College Station, TX, USA) for analysis. Descriptive statistics was used for socio-demographic data and patients' surgical history. Categorical variables are represented as numbers and percentages and Fisher's exact test used to test association between categorical variables. A 2-sided *P value* =.05 was regarded as statistically significant for all variables of interest.

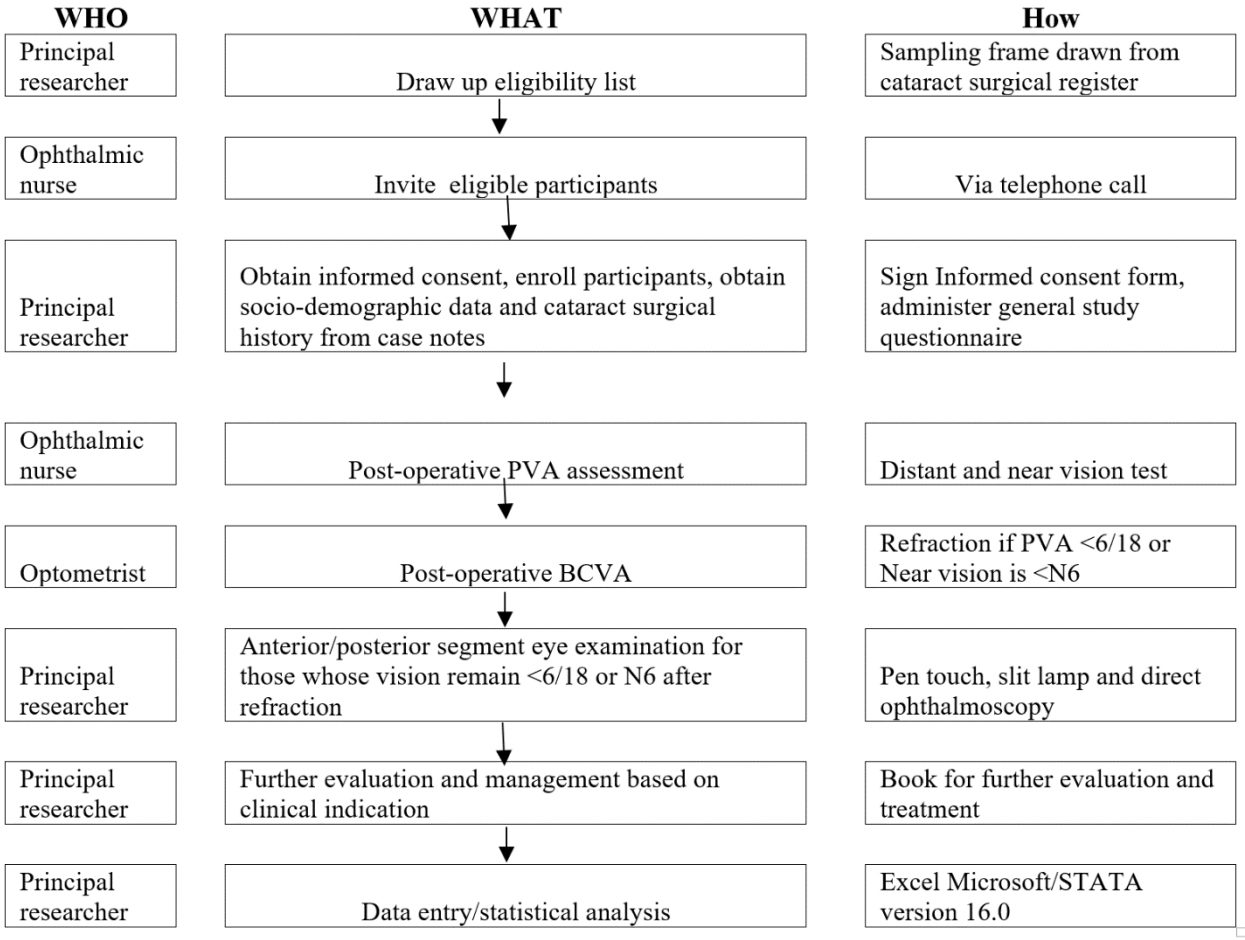

Fig. 1. Flow chart of study activities

3. RESULTS AND DISCUSSION

A total of 125 participants from the two hospitals met the eligibility criteria. Of these, 87 were enrolled into the study giving a response rate of 69.6%. Non-response in 38 (30.4%) subjects was due to declined consent (two), death (three) and failure to turn up after initial verbal accent (seven) while the remaining 26 (21%) subjects were not reachable using their hospital registered telephone contacts.

The age of the study participants ranged between 40-104 years (mean=67.2 SD± 12.0). Forty-six (52.9%) were males, with a male to female ratio of 1.1:1. All participants had manual small incision cataract surgery with posterior chamber intra ocular lens (IOL) implantation by four surgeons. The IOL powers ranged from +18.0D to +24.5D with a median of +20.5D for all patients regardless of biometry status. Pre-surgery biometry had been performed on 47 (54.0%) of the participants. Of these, 21(44.7%) had the biometry-calculated IOL power implanted; which is 24.1% of the total study population. The remaining 26 (55.3%) participants with biometry; 29.9% of the entire study cohort had available IOL power implantation, because the recommended IOL powers were not available at time of surgery (Table 1). For those who did not have pre-surgery biometry, choice of available IOL power was guided by patients' pre-surgery refractive status.

The difference between the IOL power recommended following pre-surgery biometry for 26 patients and the available IOL power (available IOL power 1) implanted at surgery is shown on Fig. 2. Taking emmetropia into consideration, nine (34.6%) out of the 26 available IOL powers implanted were within ±0.50D, while seven (26.9%) were within ±1.0D from the pre-surgery recommended IOL power (Fig. 2).

Only 7(8.1%) of all study participants had been refracted post-surgery, 5 (5.8%) of whom were wearing spectacle correction at presentation (See Table 1). Presenting visual acuity (PVA) was good in 32 (36.8%) participants and borderline in 41 (47.1%) of them. After refractive correction, the proportion of good outcomes increased to 78.1% with only 7 eye (8.1%) still having poor outcomes. A comparison of post-operative PVA and best-corrected visual acuity (BCVA) with the World Health Organization (WHO) recommended target at six weeks post-surgery is presented- Table 2. The post-operative PVA and BCVA did not differ by weather the IOL power implanted was biometry-calculated, guided by biometry (available 1) or refractive status of the patient (available 2). *P* =.645 and .146 for PVA and BCVA respectively (See Table 2).

Table 1. Cataract surgical history of study participants

Surgical parameter	Frequency (%) n = 87
Operated eye	
Right	40 (46.0%)
Left	47 (54.0%)
Pre-surgery biometry performed	
Yes	47 (54.0%)
No	40 (46.0%)
IOL power implanted	
Biometry-calculated IOL power	21 (24.1%)
Available IOL power 1	26 (29.9%)
Available IOL power 2	40 (46.0%)
Post-operative refraction performed prior to survey	
Yes	7 (8.1%)
No	80 (92.0)
Post-surgery spectacle wear at presentation	
Yes	5 (5.8%)
No	82 (94.2%)

IOL: intra-ocular lens, Available IOL power 1: IOL power choice guided by biometry, Available IOL power 2: IOL power choice guided by pre-surgery refractive status of patient

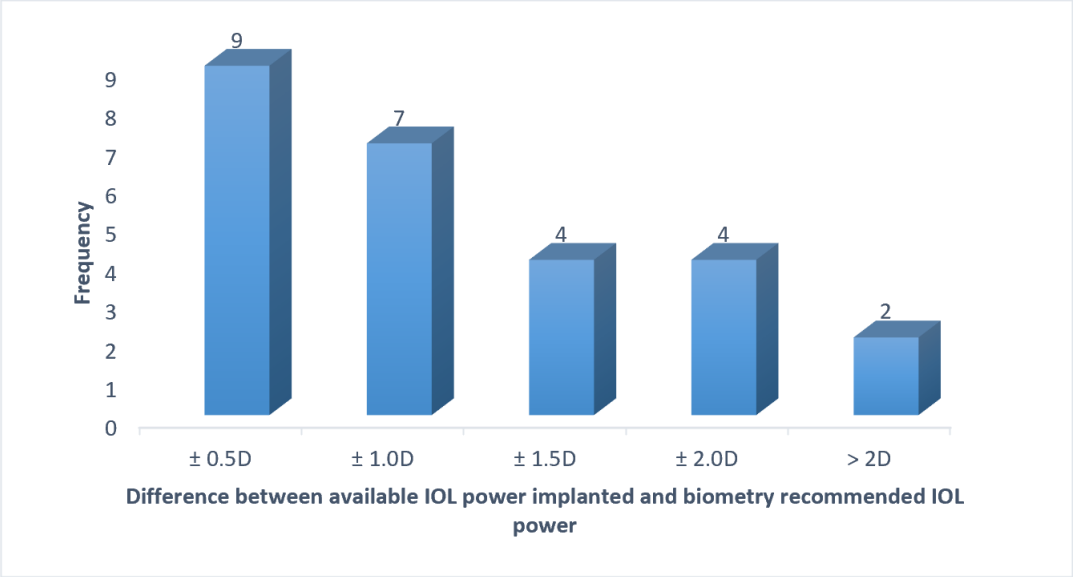

Fig. 2. Difference between available intraocular lens power implanted in 26 patients and biometry recommended IOL power

Table 2. Outcomes of cataract surgery in presenting visual acuity and best corrected visual acuity among study participants

Post-operative visual outcomes		Intraocular lens power implanted				WHO Threshold	Fisher's exact *P* Value
		BCIOL N (%)	AIOL 1 N (%)	AIOL 2 N (%)	Total N (%)		
PVA	**Good** (≥ 6/18)	9(28.1)	10(31.3)	13(40.6)	32(36.8)	>80	
	Borderline (6/18- 6/60)	9(22.0)	10(24.4)	22(53.7)	41(47.1)	<15	0.645
	Poor (< 6/60)	3(21.4)	6(42.9)	5(35.7)	14(16.1)	<5	
	Total	**21(24.1)**	**26(29.9)**	**40(46.0)**	**87 (100)**		
BCVA	**Good** (≥ 6/18)	13 (19.1)	21 (30.9)	34 (50.0)	68(78.1)	>90	
	Borderline (6/18- 6/60)	5(41.7)	2(16.7)	5 (41.7)	12(13.8)	<5	0.146
	Poor (< 6/60)	3(42.9)	3(42.9)	1(14.3)	7 (8.1)	<5	
	Total	**21(24.1)**	**26(29.9)**	**40 (46.0)**	**87(100)**		

WHO: World Health Organization, PVA: Presenting Visual Acuity, BCVA: Best-Corrected Visual Acuity, BCIOL: Biometry calculated IOL power, AIOL 1: IOL power choice guided by biometry, AIOL 2: IOL power choice guided by pre-surgery refractive status of patient

A total of 76 (87.4%) eyes had improvement in vision after refraction. Post-operative astigmatism ranging between -6.00D and +4.80D with an average of -1.70D was found in 64 (84.2%) of those refracted. But, 62 (81.6%) of the cylindrical corrections were equal to or greater than +1.00D. The average spherical and presbyopic correction of the cohort were +0.55D and +2.64D respectively. A total of 53 (69.7%) eyes had both spherical and cylindrical corrections (See Table 3).

Table 3. Post-operative refraction of study participants

Optical Correction in Diopters	Frequency (%)	Mean (Standard deviation)	Minimum Value	Maximum Value
Sphere	65 (85.5)	+0.55 (1.50)	-3.00	+5.00
Cylinder	64 (84.2)	-1.7 (2.29)	-6.00	+4.75
Near Add	76 (100)	+ 2.64(0 .43)	+1.50	+3.50

3.1 Discussion

In this study of clinical outcomes of surgery for age-related cataract with intraocular lens (IOL) implantation, the post-operative presenting visual acuity (PVA) in those who had surgery with biometry-calculated IOL power did not differ significantly from that of those who had available IOL power inserted. However, there was a significant difference between the best-corrected visual acuity (78% good, 8% poor) and PVA (37% good, 16% poor) in the distribution of the post-operative visual acuity by World Health Organization (WHO) categorization. Many population and hospital-based studies have consistently shown that successful cataract surgery with IOL implantation restores vision and reduces or eliminates blindness associated with cataract [15,16].

According to the WHO's recommendation, over 90% of patients operated for cataract should have good outcomes and less than 5% should have poor outcomes with best correction.[14] Hence, the visual outcome of our study cohort did not meet the standard set by the WHO. But is consistent with results of most cataract surgical outcomes from Nigeria and many other LMICs [5,17,18]. The recent proposal to use the effective cataract surgical coverage (eCSC) as indicator for monitoring the uptake and outcome of cataract surgery at the global level has raised the benchmark of good outcomes of cataract surgery even higher.[13] Through sustained, multi-sectorial collaboration, the WHO target for visual outcomes as well as the new eCSC threshold for good outcome set at 6/12 is achievable in developing nations as was demonstrated by Bogunjoko et al. [19]. It was observed that majority of the patients with borderline and poor PVA in this study either did not have pre-surgery biometry or the biometry-recommended IOL power was not implanted. Contrary to existing knowledge, the visual outcomes of those who had surgery with biometry-calculated IOL implantation where not significantly better than that of those who had surgery with available IOL implantation (*P* =.65 and .15 for PVA and BCVA respectively).

Available or standard IOL powers are often utilized where biometry equipment is unavailable, non-functional or the recommended IOL powers are not available at time of surgery as was observed in 26 of the study participants. The author of this current study did not come across any study that specifically compared visual outcomes of cataract surgery with available IOL and biometry-calculated IOL power. But one prospective study from Malawi reported that after refraction, the proportion of good PVA increased from 79% to 89% and proportion of poor PVA decreased from 1.5% to 0.9% with use of standard 22D IOL power [10]. In another study, Briesen et al. [20] reported that 71% of eyes operated for cataract in Kenya had good BCVA compared to the 57% that would have been obtained had standard IOL powers of 21D and 22D been used. In contrast, some authors from Nigeria have attributed the high proportion of poor outcomes recorded in their study cohort to the use of available IOL power rather than biometry-calculated [21].

It is worth noting that, residual uncorrected refractive error (URE) was the single most frequent cause of sub-optimal PVA in this study population. Similar findings were documented by other authors in Nigeria and India [22,23]. In contrast, some authors have reported unsuspected pre-existing comorbidity and posterior capsular opacity as the most common cause of sub-optimal vision after cataract surgery among their cohorts [5,17,20,24]. This study found that more than 80% of those whose vision improved with refraction had astigmatism of ≥1.00D. Probably due to placement of sutures in some patients or pre-existing corneal astigmatism as has been elucidated in some other studies [25-29]. Furthermore, Implantation of wrong IOL power has been identified as one of the pre-operative causes of residual post-operative refractive error [29,30]. Although both cataract surgical facilities in this study have functional biometry equipment's, it was observed that only about half of the study participants had biometry pre-surgery. First, one of the study facilities had recently installed biometry equipment's only five months prior to

commencement of the study, meaning that biometry was not performed on participants who had undergone cataract surgery earlier. Secondly, pre-surgery biometry in the second facility was not routinely performed due to inadequate manpower. These do not only highlight the limited infrastructure and human resources available for eye care in many low- and middle-income countries (LMICs), but also the efforts being made to change the narrative. Although, our study was not specifically designed to assess post-operative follow-up and refraction rates, we discovered that follow-up visit post-surgery and refraction rates in the study facilities were poor. This is corroborated by reports of a study which revealed that loss to follow up is as high as 20-30% in many LMICs as a result of the long travel distance, poor road infrastructure, high cost of transportation and failure to communicate the benefits to patients [17,20,31,32]. And that patients' who return for routine post-operative visits where more likely to be younger or had PVA in the severe visual impairment category or worse at early post-operative assessment [5,31]. This study has helped to address the huge backlog of post-operative URE among our study population.

The large difference in proportion of eyes with good outcomes before and after refraction in our study, highlights the importance of pre-surgery biometry, post-operative refraction and spectacle correction in enhancing clinical outcomes of cataract surgery. Although use of available or standard IOL power in cataract surgery is common practice in some resource-limited settings, surgical outcomes of cataract surgery has consistently be shown to greatly improve with accurate biometry and correct IOL power implantation in more advanced climes [20,31,32]. The observed lack of superiority in the use of biometry-calculated IOL in the current study raises the question of accuracy and validity of the biometry results and may suggest that IOL power determination or selection in the study facilities is less than ideal. It may also be that our sample size was too small to detect any difference between the groups. Additionally, although all participants had manual small incision cataract surgery with posterior chamber IOL implantation, variation in IOL position in the eye or surgical technique, both of which were not accounted for in this study could have biased our results towards the null. A comparative longitudinal study with larger sample size, standardized biometry equipment's, biometry technique and surgical technique will be useful in confirming or refuting the findings of this study. Additionally, future research to determine the accuracy of biometry and factors responsible for poor post-operative follow up in the study facilities will be of great value to improving the quality of their cataract services.

4. CONCLUSION

The use of biometry-calculated IOL power was not associated with superior visual outcomes in this study. However, regardless of the IOL power implanted, surgery for age-related cataract enhanced patients' vision. Majority of the study subjects had post-operative PVA in the borderline category with residual URE as the principal cause. Hence, more attention needs to be given to post-operative refraction of patients operated for age-related cataract, especially in setting where biometry is not routinely performed.

CONSENT

The author declares that 'Participants were recruited after signing a written informed consent to participate in the study and for publication of data'.

ETHICAL APPROVAL

Ethical approval was obtained from the ethics and review committee of Bingham University Teaching Hospital, the Faith Alive Foundation Hospital and from the London school of hygiene and tropical medicine. Participation was fully voluntary and at all times, the tenets of the declaration of Helsinki for research involving human subjects were upheld.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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