ORIGINAL ARTICLE

Refractive aim and visual outcome after phacoemulsification: A 2-year review from a Tertiary Private Eye Hospital in Sub-Saharan Africa

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Abstract

Aim: To review the short-term visual outcome of phacoemulsification in adults with uncomplicated cataracts in Eye Foundation Hospital, Lagos, Nigeria.

Materials and Methods: A retrospective review of records of patients that had phacoemulsification between January 2012 and December 2013 in Eye Foundation Hospital, Lagos, Nigeria, was done. Preoperative visual acuity, refractive aim, intraoperative complications, postoperative unaided, and best-corrected visual acuity at 1 and 3 months were analyzed. Only eyes of adults that had phacoemulsification for uncomplicated cataracts were included in the study, all pediatric cataracts and eyes with ocular comorbidities were excluded. Common ocular comorbidities excluded were corneal opacity/corneal scar, glaucoma, uveitis, pseudo exfoliation syndrome, moderate and severe nonproliferative diabetic retinopathy, macula edema, proliferative diabetic retinopathy, eye trauma, age-related macular degeneration, previous corneal surgery, glaucoma surgery, and previous or simultaneous vitreoretinal surgery.

Results: A total of 157 eyes of 119 patients who met the inclusion criteria were analyzed.

There were 60 (50.4%) females and 59 (49.6%) males, with age range from 31 to 91 years and a mean of 65.3 ± 11.10 years. Only eyes with available data were analyzed at 1 and 3 months postoperatively. In 112 eyes (85.7%), the refractive aim was met, 21 eyes (14.3%) did not meet their refractive aim, 20 eyes (12.7%) were excluded, the refractive aim could not be determined from the records as surgeons did not specify, and in 4 eyes, the required information was missing from the case files. An unaided visual acuity of 6/18 and better was achieved in 134 eyes (85.4%) at 1 month and 126 eyes (85.9%) at 3 months whereas best-corrected vision of 6/18 and better was achieved by 145 eyes (92.4%) at 1 month and 146 eyes (98.0%) at 3 months.

Conclusion: Surgical outcomes after phacoemulsification are comparable with international benchmarks for good outcomes, with 85.4% of eyes achieving within 1 D of spherical equivalent of the refractive aim, 92.4% and 98.0% of eyes also achieving best-corrected visual acuities of 6/18 and better at 1 and 3 postoperative months, respectively. Unaided vision of 6/18 and better was also achieved in 85.4% and 85.9% at 1 and 3 postoperative months, respectively.

Key words: Best-corrected visual acuity, phacoemulsification, refractive aim

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Introduction

Cataracts are the leading cause of blindness worldwide, accounting for almost half (48.3%) of the causes of blindness.[1] Most cataract blind persons live in developing countries, where blindness is associated with considerable disability and mortality, resulting in large economic and social consequences.[2] In a recent survey in Nigeria, the prevalence of cataract blindness was 1.8% (95% confidence interval: 1.57–2.05) in individuals 40 years and older, being responsible for 45.3% and 43.0% of blindness and severe visual impairment, respectively.[3] Cataract blindness is reversible; a short surgical procedure can fully restore vision.

Cataract surgery is one of the most frequently performed intraocular surgeries worldwide. In the United States alone, over 3 million cataract surgeries are done in a year.[4] Phacoemulsification (phaco) is the first choice cataract surgery procedure in most developed countries.[5,6] It is, however, less common in sub-Saharan Africa because of cost considerations and a paucity of trained phaco surgeons. Phaco offers the advantages of early postoperative visual recovery, and a higher percentage of eyes achieve refractive aim.[7] For cataract surgery to be perceived as successful and ultimately to ensure patient satisfaction, an improvement in visual acuity is paramount. Thus, the "expected" vision must be as close as possible to "achieved" vision.[8,9]

One of the more common ways to benchmark phaco surgery outcome is to assess the percentage of eyes achieving a postoperative spherical equivalent refraction within 1.0 D of the target.[10] Other ways of assessing outcome include percentage of eyes achieving unaided vision of 6/18 or 6/12 and better, the total range of refractive errors postoperatively as well as visual function and quality of life assessment with various available tools.[11,12] When using visual acuity and postoperative spherical equivalent to assess phaco outcome, one is not only assessing the quality of the surgery, but also the quality of biometry service, availability of required intraocular lenses (IOL), medical record efficiency, effective refraction procedures, and indeed the overall management of the cataract patients. Available clinical guidelines from The Royal College of Ophthalmologists of London adopted a standard of 85% within ± 1 D of target and 55% within ± 0.5 D of target.[13-15] Some studies also[13,16-18] suggest that 85–90% of patients undergoing routine cataract surgery should be able to achieve a final spherical equivalent refraction within 1 D of the predicted value (refractive aim).

The Eye Foundation Hospital Group (EFHG) is one of a few private tertiary institutions in Nigeria. The EFHG has its headquarters in Ikeja with 3 other branches in Abuja, Victoria Island, and Ijebu Imushin. All cases evaluated in this series come from the headquarters in Ikeja Lagos where phaco is the procedure of choice for patients with cataracts. This present study aims to review and report our visual acuity outcomes and attainment of refractive aim after phacoemulsification over a 2-year period and compare our results with previous reports and the Royal College of Ophthalmologist of London benchmark.

Aims

To review the short-term visual outcome of phacoemulsification in adults with uncomplicated cataracts in Eye Foundation Hospital, Lagos, Nigeria.

Materials and Methods

A retrospective review of records of patients that had phacoemulsification between January 2012 and December 2013 in Eye Foundation Hospital, Lagos, Nigeria, was done. This study had Institutional Review Board approval and adhered to the Declaration of Helsinki. Preoperative clinical data collected included preoperative refraction, preoperative visual acuity, target refraction, postoperative unaided and best-corrected vision at 1 and 3 months, postoperative refraction, and intraoperative complications. For axial length measurements and lens power determinations, the IOLMaster (Carl Zeiss Meditec AG, Jena, Germany) was preferably used in 97 (61.8%) eyes and the Alcon Ophtha scan (Alcon, Inc., Fort Worth, TX) was used for 60 (38.2%) eyes because the density of the cataracts did not allow measurements with the IOLMaster. Formulas such as the Hoffer Q (for axial lengths <22), Holladay, Hoffer Q, SRK-T (for axial lengths 22.0–24.5), Holladay (for axial lengths 24.5–26), or SRK-T (for axial lengths >26) were used where applicable.

All pediatric cataracts and eyes with ocular comorbidities were excluded. Common ocular comorbidities excluded were corneal opacity/corneal scar, glaucoma, uveitis, posterior synechiae, pseudo exfoliation syndrome, moderate and severe nonproliferative diabetic retinopathy, macula edema, proliferative diabetic retinopathy, eye trauma, age-related macular degeneration, corneal surgery, glaucoma surgery, vitreoretinal surgery, and any further relevant ocular surgeries.

Outcome measures to be considered are the achievement at 3 months after surgery of: Maximum absolute deviation of 1 diopter (D) between target refraction and postoperative spherical equivalent (primary end point, refractive aim), best-corrected visual acuity of at least 6/18 (visual outcome), and unaided visual acuity of at least 6/18.

Seven consultant ophthalmologists with comparable surgical skills and experience, who form the group practice, did the

surgeries included in this study. To determine cataract refractive outcomes, we computed the postoperative manifest refractions at 1 and 3 months of cataract surgery. The difference between the preoperative target refraction and the actual postoperative manifest refraction (spherical equivalent) was calculated in diopters. Logistic regression was used to assess the relationship between outcome of phacoemulsification (refractive aim and visual acuity) and likely predictive indices (preoperative visual acuity, intraoperative complications, postoperative complications, axial length, and average keratometric reading) as well as demographic factors (age and gender). $P < 0.05$ was considered to be statistically significant (confidence level = 95%).

Results

A total of 157 eyes of 119 patients who met the inclusion criteria were analyzed. There were 60 (50.4%) females and 59 (49.6%) males. The age range was from 32 to 91 years; mean of 65.3 ± 11.10 years. The age distribution is seen in Table 1; 72.3% of patients were above the age of 60 with 34.5% of patients in their seventh decade. The range of spherical equivalence before the surgery was from −7.00 D to 4.25 D. The mean ± spherical equivalence before the surgery was determined to be −0.43 ± 1.74 D. The range of spherical equivalence after the surgery was from − 4.38 D to 2.00 D. The mean ± spherical equivalence after the surgery was determined to be −0.74 ± 1.08 D. The difference between target and postoperative refraction ranged from −3.5 to + 2.0 D, with an average of 0.4 ± 1.4 D. In 112 eyes (85.7%), the refractive aim was met, 21 eyes (14.3%) did not meet their refractive aim, and 20 eyes (12.7%) were excluded as the refractive aim could not be determined from the records.

Table 1: Demography of included patients

	Frequency	Percentage
Age (years)		
39 and below	3	2.5
40-49	5	4.2
50-59	25	21.0
60-69	41	34.5
70-79	34	28.6
80 and above	11	9.2
Gender		
Female	60	50.4
Male	59	49.6

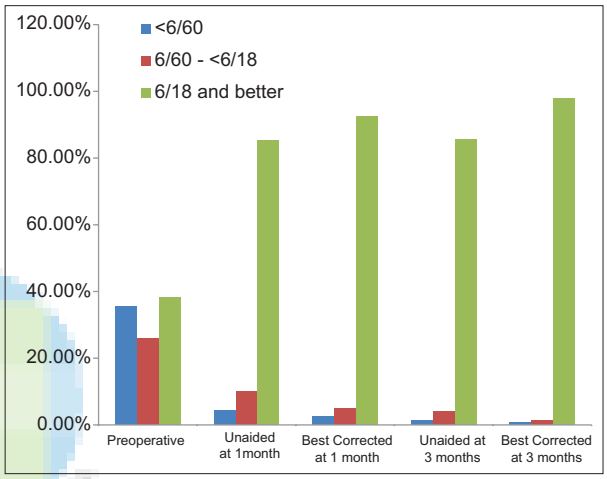

Figure 1: Percentage of eyes achieving visual acuity categories

Table 2: Binary logistic regression identifying factors influencing refractive aim in phacoemulsification

Groups	Coefficients	Statistical significance	Odds ratio (O.R)	95.0% Confidence interval for O.R	
				Lower	Upper
Age (years)					
>65	−0.109	0.909	0.897	0.138	5.819
<65					
Gender					
Male	0.751	0.568	2.119	0.161	27.958
Female					
Diabetes					
Diabetic	−0.119	0.916	0.888	0.099	8.002
Nondiabetic					
Hypertension					
Hypertensive	1.328	0.207	3.772	0.479	29.690
Nonhypertensive					
Preoperative visual acuity					
Poor/borderline	−1.109	0.296	0.330	0.041	2.638
Good					
Intraoperative complication					
Had complication	2.310	0.184	10.073	0.335	303.273
No complication					
Axial length	−3.404	0.103	0.033	0.001	1.998
Average K	−22.725	1.000	0.000	0.000	

Table 3: Comparison of visual and refractive outcomes with data from developed countries

Data source	BCVA (with comorbidities) >6/12	BCVA (no comorbidities > 6/12) (%)	Within 0.5 D of refractive aim (%)	Within 1 D of refractive aim (%)	Postoperative timing
UK, postgraduate teaching hospital (6)	Nil	96.6	44.6	72.3	3 weeks
Swedish national cataract register (20)	Nil	95	Nil	79.2	38 days (6 weeks)
Germany high-volume study centers (21)	Nil	98.5	80.3	97.3	3 months
Eye foundation hospital	Nil	94.7	Nil	85.6	3 months

BCVA=Best-corrected visual acuity

Preoperatively, 56 (35.7%) eyes had visual acuity <6/60, 41 (26.1%) eyes between 6/60 and <6/18, while 60 (38.2%) eyes had 6/18 and better. An unaided visual acuity of <6/60 was seen in seven (4.5%) eyes at 1 month after phaco, 16 (10.2%) eyes had between 6/60 and <6/18, while 134 (85.4%) eyes had visual acuity of 6/18 and better. At 1 month after phaco, a best-corrected visual acuity of < 6/60 was seen in four (2.5%) eyes, eight (5.1%) eyes had between 6/60 and <6/18, while 145 (92.4%) eyes had 6/18 and better.

At 3 months after phaco, an unaided visual acuity of <6/60 was seen in two (1.3%) eyes, 21 (14.1%) eyes had visual acuity between 6/60 and 6/18, while 126 (85.9%) had 6/18 and better, 2 eyes were not included because of missing data. Best-corrected visual acuity of <6/60 was seen in one (0.7%) eye at 3 months after phaco, two (1.3%) eyes had between 6/60 and <6/18, and 146 (98.0%) eyes had 6/18 and better, eight eyes with missing data were not included in the analysis [Figure 1]. Intraoperatively, three (1.9%) eyes had posterior capsule rupture with vitreous loss, one (0.6%) had eye rupture of zonules, and one (0.6%) eye had iris trauma with hyphema. Most of the eyes (152, 96.8%) had no intraoperative complication.

The following factors were subjected to binary logistic regression to identify significant factors influencing meeting refractive goal in phacoemulsification: Age, gender, diabetes, hypertension, preoperative visual acuity, and intraoperative complication. Beta coefficient and odds ratio were also determined. With $P > 0.05$ in all cases, binary logistic regression did not identify any of the factors as a significant influence on meeting refractive aim after phaco [Table 2].

Discussion

The present thinking about cataract surgery has gone beyond considering it as a procedure merely to prevent blindness. It is now seen as a refractive procedure with the intention of obtaining best possible refractive and visual outcomes for optimal patient satisfaction.[4,7] Phaco that gives better visual and refractive results when compared to other cataract surgical techniques is prominent in developed countries.[19,20] Physicians practicing in the developing countries also have a strong desire to give the best to their patients.

There were almost equal numbers of females (60, 50.4%) and males (59, 49.6%) in our study sample, but a higher percentage (72.3%) of patients were older than 60 years with 34.5% in their seventh decade of life. This finding correlates with results from the Nigerian survey that shows a high prevalence of blindness occurs (4.7%) in the seventh decade, although females had an overall higher prevalence (4.4%) of blindness compared to males (4.0%) (F - 22.23; $P < 0.001$).[3] The Beaver Dam study[21] similarly found an increase in the cumulative incidence of cataracts with age also; with a female preponderance.

The spherical equivalent of a lens is the algebraic sum of the value of the sphere and half the cylindrical value, i.e., sphere + cylinder/2. This value is often used to assess the postoperative refractive changes after phaco, as it accounts for both the sphere and cylinder changes.[7,22] In our study eyes, there was a reduction in the range of spherical equivalence from −7.00 D to 4.25 D preoperatively to −4.38 D to 2.00 D postoperatively, the difference between target and postoperative refraction ranged from −3.5 to +2.0 D, with an average of −0.4 ± 1.4 D; this was comparable with the study by Simon *et al.*[7] that found a difference that ranged from −4.5 to + 2.5 D, with an average of 0.1 ± 0.6 D.

In our cohort of patients at 3 months postoperatively, 85.7% achieved within 1 D of refractive aim. This result is comparable with the range between 72% and 95% reported in a developed country as well as the suggested standard of above 85%.[13-18] Unaided visual acuities of 6/18 and better was also achieved in 85.9% of eyes, while best-corrected vision of 6/18 and better was achieved in 98% of eyes at 3 months postoperatively [Figure 1]. The visual improvements actually occurred as early as a month after surgery, 92.4% of eyes already had best-corrected vision of at least 6/18. To be better able to compare outcomes, further analysis of our data was done and revealed that 94.7% of eyes had best-corrected vision of 6/12 and better

by the 3rd postoperative month. This value was comparable with 95% seen in the Swedish National Cataract Register, an average of 98.5% seen in seven high-volume cataract centers in Germany and 96.6% in a United Kingdom teaching hospital facility [Table 3].[9,23,24] As with quoted studies,[9,22,23] we also excluded eyes with comorbidities when assessing visual outcomes after phaco. Our results are also much better than the average best-corrected visual outcome seen in the recent Nigerian blindness survey where only 30.8% had a good outcome (i.e., presenting vision of ≥6/18) after surgery, although it should be noted that none of the analyzed patients in the survey had phacoemulsification.[3]

To achieve good visual and refractive outcomes after cataract surgery, every institution needs to pay adequate attention to all aspects of care of the cataract patients, an effective biometric service needs to be in place. There are three more common preoperative biometric methods in use today: Contact ultrasonography, immersion ultrasonography, and partial coherence interferometry (PCI)/IOLMaster. Contact ultrasound biometry requires more skillful personnel and has often been noted to have less accurate axial length measurements because of the possibility of inadvertently indenting the eye. The water immersion method is cumbersome and uncomfortable for the patients. The IOLMaster uses the double-beam PCI technology and has been found to have a precision of 10 times that of the ultrasound. It is easier to use, does not touch the patients' eye, highly reproducible, and less dependent on sudden eye movements.[16,25-27] In our institution, the resident doctor in each of the units does the biometrics with the IOLMaster (Carl Zeiss Meditec AG, Jena, Germany) or the Alcon Ophtha scan when the density of the cataract prevents measurements with the preferred method. Formulae such as the Hoffer Q (for axial lengths <22), Holladay, Hoffer Q, SRK-T (for axial lengths 22.0–24.5), Holladay (for axial lengths 24.5–26), or SRK-T (for axial lengths >26) were used where applicable.[25] All surgeons set a refractive aim and thus ensure whether the right lenses are used, as they have to subsequently sign off on the lens to be used for each patient. Occasionally in developing countries, the challenge might be with availability of the correct IOL to use after appropriate biometry; hence, we maintain a large central store of IOLs with powers between −5.0 D and 30.0 D.

Posterior capsular rupture with or without vitreous loss is the most common intraoperative complication during cataract surgery and is widely regarded as the benchmark complication to judge surgical quality.[28,29] A study by Johnston *et al.*[30] in the United Kingdom found an overall posterior capsule rupture rate of 1.92% for all categories of surgeons analyzed and 1.41% for independent, more experienced surgeons; this is comparable to the 1.9% seen in our study. A recent publication by Ti *et al.*,[31] analyzing the rate of intraoperative capsular rupture in a tertiary hospital in Singapore, also found an overall rupture rate of 1.8%, which is comparable. As with Johnston *et al.*,[30] a higher percentage of capsule rupture occurred among learning surgeons (residents) compared to the experienced faculty (3.4–1.4%), further emphasizing the importance of surgeon competence in phaco outcomes. It is also important to note that eyes with posterior capsule rupture and vitreous loss are at a risk of other intra- and post-operative complications such as retained soft lens material, cystoid macular edema, anterior chamber inflammation, vitreous in anterior chamber, retinal detachment, raised intraocular pressure, retained nuclear fragments in the anterior chamber, and acute corneal decompensation. A recent study by Sparrow *et al.*[32] showed that a torn posterior capsule was the main modifiable adverse risk indicator and was powerfully associated with visual acuity loss. A reduction in the rate of capsule rupture and successful management whenever it occurs will greatly improve outcomes. Our aim, therefore, is to achieve lower complication rates, especially with posterior capsule rupture. This we believe will help improve overall visual outcomes. We realize that the smaller number of cases included in our study could have given a falsely higher complication rate. The retrospective design of the study also accounted for the cases of incomplete or missing data for some analysis.

The two more common phaco techniques employed by surgeons in our center are divide and conquer and its modification phaco stop and chop. In the latter technique, horizontal chop techniques are employed after initial sculpting and cracking the lens to give two hemi fragments. Stop and chop is preferred for grade 4 nuclei. It is not clear in literature if any of the phaco techniques is superior to others in terms of visual outcome, but there is suggestive evidence that phaco chop might be associated with significantly less endothelial cell loss when compared to divide and conquer for grade 4 cataracts.[33,34] However, regardless of particular phaco technique used, it is important to reduce complications to the barest minimum. Proficiency with different techniques is an advantage. Sutures were only used when there was a concern about wound integrity, and removal was usually done within the 1st month. Overall phaco is safely done in our institution and visual as well as refractive outcomes are comparable with developed countries, we believe that with adequate planning, phaco can become the procedure of choice for cataract surgery in sub-Saharan Africa.

Conclusion

The surgical outcomes after phacoemulsification are comparable with international benchmarks for good outcomes, with 85.4% of eyes achieving within 1 D of spherical equivalent of the refractive aim, 92.4% and 98.0% of eyes also achieving best-corrected visual acuities of 6/18

and better at 1 and 3 postoperative months, respectively. Unaided vision of 6/18 and better was also achieved in 85.4% and 85.9% at 1 and 3 postoperative months, respectively.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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