How close are we? An audit of biometry of a tertiary care hospital in Karachi

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Abstract

Objective: To evaluate the accuracy of biometry in the post-op phase of cataract surgery.

Methods: This study was conducted at Liaquat National Hospital, Karachi, from June 2015 to July 2016, and comprised the audit of patients who underwent cataract surgery during the period. Keratometry was done on Haag-Strait manual keratometer and A-scan was done by applanation contact method on SonoMed machine. Theoretic-T formula was used to calculate desired intraocular lens power for all kinds of axial lengths. A single surgeon operated upon the same Alcon Constellation phacoemulsification machine. Postoperative follow-up was done by monitoring auto refraction and visual acuity on days 1, 7, 30 and 90. SPSS 21 was used for data analysis.

Results: Of 244 patients, 121(49.60%) were males and 123(50.40%) were females. There were 123(50.40%) right eyes and 121(49.60%) left eyes. Overall, 132(54.10%) achieved postoperative refraction within ±0.5 D of target and 193(79.10%) within ±1 D of target. Age, gender and laterality had no significant effect on outcomes ($p>0.05$ each).

Conclusion: Postoperative refraction corresponded quite closely with global recommendations.

Keywords: Emmetropia, Biometry, Keratometry, IOL specific constants. (JPMA 68: 81; 2018)

Introduction

The aim of modern cataract surgery is to improve the uncorrected vision as much as possible and minimise the post-op refractive error. However, recent studies have shown that post-op surprises more than 1 D are more than 6%.[1] Although this incidence is not too high but in term of patients' expectations it is significant.[2] Many surveys regarding pre- and post-op cataract surgery indicate high expectations of the patient. Most of these patients hope to get rid of glasses or contact lenses, but emmetropia was achieved in less than 50% cases.[3] It has been noted in different studies that ophthalmic and systemic co-morbidities have a significant role in post-op refractory surprises.[4] Another cause is incorrect lens position.[5] Other factors causing refractive surprises include mislabeling of intraocular lens(IOL) power by the manufacturers and iatrogenic errors.[6] For minimising these refractive errors many methods have been adopted[7] but among them, precise biometry is the most effective method to minimise the refractive surprise.[8] Biometry has two components; keratometry and axial length measurement. Choice of a formula for IOL calculation is also very important as no single formula is a good enough predictor for all axial lengths.[9] It has been found that 54% of the refractive surprises were due to errors in axial length measurement. Of these 38% were due to errors in predicting the post-op IOL position and 8% were due to errors in keratometry measurements.[1]

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The Royal College of Ophthalmologists, in its most recent Cataract Surgery Guidelines[10] has adopted a standard of 85% within ±1 D of target and 55% within ±0.5 D of target. To the best of our knowledge, no such study has been conducted in Pakistan to evaluate the accuracy of biometry despite it being one of the most routinely performed ocular surgeries. The current study was planned to use biometry to calculate the necessary power of IOL before cataract surgery and to measure the refractive state of the eye postoperatively. The aim of the study was to evaluate accuracy in biometry and to highlight our shortcomings in order to further improve the results and thus enhance patient satisfaction.

Patients and Methods

This audit of cataract surgery outcome was conducted from June 2015 to July 2016 at the Department of Ophthalmology, Liaquat National Hospital, Karachi. All surgeries were done by a single surgeon. By using World Health Organisation (WHO) software, and setting the benchmark at 55±0.5D, the sample size was calculated with 7% margin of error and α+95%. After permission was obtained from the institutional ethics committee, all patients who underwent cataract surgery during the study period were enrolled on the basis of convenience consecutive sampling. All those with simple age-related cataracts with no ocular conditions that can limit the final visual outcome were included, while all patients of glaucoma, maculopathies, traumatic cataract and those with previous ocular surgeries were excluded. Incomplete records were also excluded. Verbal informed consent was taken for data collection after explaining

ANNEXURE

PERFORMA FOR DATA COLLECTION:
MR number: _____ DATE: _____
NAME: _____ AGE: _____
GENDER: _____

EYE TO BE OPERATED: right / left
PRE OP REFRACTION:
LENS TO BE IMPLANTED:
POST OP REFRACTION:
A. DAY 1:
B. DAY 7:
C. DAY 30:
D. DAY 90:

the whole process to the patients. All demographic information was recorded on a predesigned proforma (Annexure). A detailed history was followed by a detailed examination using autorefraction, Snellen's chart, slit lamp and 90D lens for fundoscopy. In case of no view of the posterior chamber, B-scan was done accordingly. Once cataract was diagnosed and surgery was planned, keratometry was done on Haag-Strait manual keratometer and A-scan was done by applanation contact method on SonoMed machine. Theoretic-T formula was used to calculate the desired IOL power for all kinds of axial lengths. The surgeon conducted all procedures using the same Alcon Constellation phacoemulsification machine. Post-op follow-up was done by monitoring autorefraction and visual acuity on days 1, 7, 30 and 90.

SPSS 21 was used for data analysis. Mean and standard deviations were calculated for qualitative variable like age, and frequency and percentages were calculated for quantitative variables like gender and laterality. Paired tests and repeated measure of analysis of variance (ANOVA) were applied to compare refraction in different time intervals.

Results

Of the 244 patients, 121(49.60%) were males and 123(50.40%) were females. There were 123(50.40%) right eyes and 121(49.60%) left eyes. Overall, 193(79.10%) within ±1 D of target that were declared acceptable. The rest 51 (20.90%) were within unacceptable range. Out of 193 (79.10%) acceptable cases, further132 (54.10%) fall in accurate range i.e.±0.5D (Table-1).

Though there were slight predispositions found regarding male gender and right eye and the outcome was more favourable in the 46-65 year age group, none of them were statistically significant (P>0.05 each) (Table-2).

Table-1: Demographic and outcome.

	N (%)
Age(years)°	53.79±10.85
Gender	
Male	121(49.6)
Female	123(50.4)
Eye	
Left	121(49.6)
Right	123(50.4)
Visual Acuity	
Acceptable	193(79.1)
Not Acceptable	51(20.9)

°Mean±SD.
SD= Standard Deviation

Table-2: Comparison within the sample.

	N (%)		P-Value
	Acceptable (n=193)	Not Acceptable (n=51)	
Age Group			
≤45 years	62(32.1)	12(23.5%)	0.359
46-65 years	108(56)	30(58.8)	
>65 years	23(11.9)	9(17.6)	
Gender			
Male	100(51.8)	21(41.2)	0.177
Female	93(48.2)	30(58.8)	
Eye			
Left	96(49.7)	25(49)	0.927
Right	97(50.3)	26(51)	

Chi square test applied.
P≤0.05 considered as significant.

Table-3: Axial length calculation formula.

Axial Length (mm)	Formula
< 22	Hoffer Q
22.0-24.5	Average of Hoffer-Q, Holladay and SRK-T*
24.6-26.0	Holladay
>26.0	SRK-T*

*An approximate formula established by Sanders, Retzlaff and Kraft to determine the power of an intraocular lens implant P, in aqueous, to render the eye emmetropic (and ignoring the lens thickness)
P = A - 2.5X - 0.9K
where A is a numerical term specific to the implant and to the manufacturer. X is the axial length of the eye (in mm) and K is the average keratometer reading (in dioptres). The formula gives satisfactory results for eyes of average length.

Discussion

Biometry has become one of the most important steps in modern cataract surgery and achieving emetropia is the single most important factor for any patient. Despite a large number of our happy and contented patients, we

decided to undergo a strict audit to cross-check our results objectively in terms of refraction and compare it to global standards. Since almost every person will have to undergo cataract surgery once in their lives and the outcome will be permanent, it is prudent to be extra careful about our calculations. No routine audit is done in our part of the world which leads to continued suffering of our patients. We share our results with the hope that not only we will improve our accuracy but this discussion will be helpful for others as well.

In reality, biometric measurements are not perfectly accurate and it is not yet possible to measure all of the physiological variabilities between eyes; the measurements and IOL prediction algorithms therefore rely upon a large number of assumptions which are not accurate in every case. The biggest source of error (35.5%) is inaccuracy in the IOL formulas' predictions of the post-operative IOL position. Inaccuracies in axial length and keratometry measurements, either arising from the measurements themselves or associated underlying assumptions, account for 17.0% and 10.1% of the error, respectively.[11] However, further refinements to the predictive accuracy of post-op emmetropia can be made.

Axial lengths can be measured by contact, optical or immersion methods. The main disadvantage of the non-contact optical methods is their inability to obtain axial length measurements in approximately 10% eyes, typically those with dense posterior sub-capsular cataracts.[12] Though in our experience our population tends to seek treatment later and for denser cataracts, making optical methods ineffectual for them. For these eyes, ultrasonic axial length measurement is required, and in the United Kingdom contact ultrasound is the method of choice with immersion methods rarely used.[13] Immersion method is non-contact so more accurate but less comfortable for the patient.

Regarding choice of IOL power calculating formula, the Royal College of Ophthalmologists' recommended IOL calculation formulae depending on the axial length of the eye.

IOL constant for any formula is not constant and should be modified accordingly. Firstly, IOL constants, provided by the manufacturer, are mostly estimated for contact biometry. So it should be noted that non-contact imersiona and optical methods give axial lengths slightly larger due to the absence of corneal indentation. User group for Laser Interference Biometry (ULIB) can be utilised for estimating a newer constant for such cases if non-contact IOL constant is not available.[14] IOL constant optimisation can also be done from post-op refractive outcome data (around 50 eyes) into either the IOL master, or by using online service of Dr Haigis.[11] For optimisation of IOL constant, all eyes should have a stable refractive error and best-corrected visual acuity of 6/12 or better and as wide a range of axial length as possible and preferably all measurements should be done using the same devices for keratometry and axial length.

The second most predictable modification is of second eye on the basis of first eye which has been already operated upon but is only applicable to half of the eyes. Aristodemou et. al. reported a series of 2,129 patients who had undergone bilateral sequential cataract surgery, and confirmed that a 50% correction factor improved the accuracy of the prediction for the second eye such that 4% more eyes achieved within ±1 D of target and 19% within ±0.5 D.[15] Olsen further demonstrated that the correction factor was dependent upon the formula used (e.g. 0.38 for SRK/T and 0.27 for the Olsen formula) (Table-3) demonstrates various IOL power calculating formulae currently in practice.[15]

Jivrajka et. al. conducted a prospective study of 250 patients undergoing bilateral sequential surgery, which confirmed a significant improvement in second eye outcome when the second eye IOL selection was adjusted using a 50% correction factor for first eye phacoemulsification (PE).[16]

Surgeon-related modification of IOL is not always required. It is suggested to compare surgeon specific mean errors with other surgeons for the same IOL. A surgeon-related modification may be considered if this exceeds zero value.

Another study of 257 eyes suggested that the use of keratometry-specific IOL may improve the proportion of eyes achieving within ±1 D of target by 2.3% and within ±0.5 D of target by 6.2%. However, it was too small to be conclusive.[17]

IOL manufacturers generally do not share IOL tolerances with the surgeons. According to the ISO criteria, for an IOL labelled between 0 and 15 D, its true power must be within ±0.3 D of the labelled power, between 15.5 and 25 D the allowed tolerance is ±0.4 D, between 25.5 and 30 D it is ±0.5 D, and above 30 D the true power is permitted to be up to ±1 D from the labelled power. For the lowest power IOLs, the resulting error at the spectacle plane may be up to ±0.2 D, but for IOLs greater than 30 D the error resulting from manufacturing tolerance may be as high as ±0.7 D.[18]

There are certain limitations of this study. Biometry was done by different individuals so it can be a confounding

factor, depending on their years of training. Furthermore, non-contact methods especially Zeiss IOL master have even less associated refractory surprises. Also, some IOLs, especially in half dioptric powers, are not available in our setup, so in some cases the most accurate IOL was not inserted. Besides, a single formula (theoretic-T) was used for all kinds of axial lengths.

Conclusion

Despite using contact techniques and older equipment, the range of our patients' post-op refraction corresponded quite closely with global recommendations. With the introduction of automated keratometry and optical biometry, we can expect further improvement in these outcomes. Residents also need to be trained about choosing IOL power calculating formulas. We hope we shall be able to meet international standards soon.

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