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Original Research Article

Study of accuracy of biometric measurements in relation to intra ocular lens power calculation

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ABSTRACT

Introduction: Preoperative eye biometric measurements are critical for calculating IOL power, so it is essential to grasp how the various biometric parameters interact. The aim of this study is to determine the predictability and influence of biometric values on power calculation.
Aim: To determine the relationship between IOL power and biometric values.
Materials and Methods: It is an observational cross-sectional study done at a tertiary care center in Mysore, Karnataka. 110 eyes undergoing cataract surgeries were evaluated in the study over a period of four months. Preoperative biometry was performed and IOL power was calculated by SRK–II and A-scan. Pearson correlation coefficient matrix was tabulated. Model was obtained using multiple linear regression analysis. The comparison was made among all 6 models using the R square value and the standard error of the estimate.
Results: Ka had a positive correlation with the Kh (r=0.955) and Kv(r=0.963), which had a weak negative correlation with AL (r =-0.358). Model 2 (SRK II-IOLP= (-0.900)*Ka + (-2.500)*AL+118.200) had the highest R square with no error, indicating the highest predictability in estimating IOLP. Estimating IOLP using an A-scan was a significant predictor but had the highest error with an R Square value of 0.206.Model 1 (A-scan- IOLP=(-0.191) *Ka +(-1.002)*AL+52.445) was the second most successful model. Ka can provide better predictability with both the methods to calculate the IOLP and AL.
Conclusion: There is a limited evidence in comparing both the formulas. The SRK-II IOLP measurement showed higher accuracy using Ka and AL with no error in refractive error. A scan provided precise biometry data and IOL power calculation within an average range of ALs. The SRK- II formula's predictability is higher than the A-scan formula.

1. Introduction

Successful cataract surgery is determined by the final refractive outcome and patient's satisfaction. It is crucial to calculate preoperative intraocular lens (IOL) power to achieve the required refractive outcome.[1] Biometry is important, which includes axial length (AL), keratometry (K) values and anterior chamber depth (ACD) to calculate IOL power.[2,3] Optical biometry provides several advantages, such as it is a fast and easy-to-use technique. Compared to ultrasonography, optical biometry provides reduced risk of trauma and infection, increased patient comfort and improved accuracy and repeatability of measurements.[4]

To obtain optimum outcomes, an accurate IOL power formula should be used.[5] The variability in parameters used in the formula can lead to significant refractive errors postoperatively, requiring the use of glasses which would negate the sole purpose of cataract surgery.[5] Both SRK-II and A-scan can be used to calculate the IOLP. However,

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there is limited evidence in comparing both the formulas.

Also, other independent variables can be used to calculate the IOLP using SRK-II and A-scan; however, which variable suits best with minimum errors is also a matter of research.

Hence, the present study attempts to establish the association between IOL power and keratometric values and to scrutinize the predictability of IOL power with the steeper and flatter meridian.

2. Materials and Methods

2.1. Aim

To determine the relationship between IOL power and biometric values.

2.2. Objectives

Primary objective- To determine the relationship between IOL power and biometric values.

Secondary objective- Study of accuracy of biometric measurements in relation to Intra Ocular Lens Power calculation.

2.3. Study design

Observational cross-sectional study on 110 eyes at a tertiary care center in Mysore, Karanataka undergoing cataract surgeries over a period of 4 months from January 2021 to April 2021 was performed. The study was approved by Institutional Ethical Committee.

2.4. Inclusion and Exclusion criteria

Adult patients aged ≥ 35 years with significant cataract and normal intraocular pressure were included. Patients with any history of corneal infections, significant corneal opacity, active corneal pathologies, recent contact lens use and systemic diseases such as rheumatoid arthritis, ocular trauma or previous ocular surgeries were excluded from the study.

Informed written consent was obtained from all patients before starting the study. Demographic parameters, including age and sex of patients, were recorded. Pre-operatively, keratometric values, axial length and IOL powers were measured prospectively.(Table 1)

2.5. Statistical analysis

All the data analyses were performed using IBM SPSS ver. 25 software. Frequency distribution and descriptive analysis were performed to obtain the baseline characteristics of the study population. Pearson correlation coefficient matrix was tabulated with the help of Pearson correlation. Multiple linear regression analysis was performed to obtain the model summary, including R square, adjusted R square and standard error of the estimate to predict the best model out of 6 models.(Tables 1, 2, 3, 4, 5, 6, 7 and 8) A model formula was generated using predictors: (Constant), K average, Kh, Kv and Axial length and dependent variable (A-scan IOLP and SRK II-IOLP). The comparison was made between both the dependent variables using the R square value and the standard error of the estimate. A p-value of <0.05 is considered significant.

3. Results

The mean age of the study population was 64.08±9.13 years which ranged from 35 to 83 years. Majority were females [59 (53.6%) while the remaining 51 (46.4%)] were males.

Model 2 had the highest R square with no error in the present study, indicating the highest predictability in estimating IOLP. Model to calculate IOLP using SRK (using Ka and AL).(Table 2)

4. Discussion

Accurate and predictable IOL power calculations are essential for achieving the intended outcomes and patient satisfaction after cataract surgery.[6,7]

In the present study, Ka had a positive correlation with the Kh (r=0.955) and Kv (r=0.963), which had a weak negative correlation with AL (r =-0.358). In line with the present study, Hoffer et al. also reported a good correlation between AL (r= 0.9995) and K measurements (r =9959) in 50 eyes with cataracts. The MAE in IOL power prediction was 0.455 ± 0.32 D with the OLCR unit and 0.461 ± 0.31 D with the PCI unit.[8]

The A-Scan optical biometer is based on technology similar to that of the GOLD standard instrument. In the present study, we compared its performance with the established gold standard, the SRK-II instrument to compare the utility of both for routine cataract surgery.

In the present study, model 2 (SRK II-IOLP = (-0.900)*Ka + (-2.500)*AL+118.200) had the highest R square with no error, indicating the highest predictability in estimating IOLP. Model to describe calculating IOPL using SRK method using Ka and AL.

Estimating IOLP using an A-scan was a significant predictor but had the highest error with a R Square value of 0.206. Model 1 (A-scan- IOLP= (-0.191)*Ka + (-1.002)*AL+52.445) was the second most successful model in present study.

On analyzing both the models (model 1 and 2), it is clear that Ka can provide better predictability with both the methods (A-scan and SRK-II) to calculate the IOLP along with AL.(Tables 3 and 4) The AL measurement of the IOL biometer is considered the current gold standard and is comparable to other biometry devices in routine use.(Table 2)

Table 1: Descriptive analysis for baseline characteristics of the study population

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
KH	110	41.50	49.75	44.7927	1.72319
KV	110	39.25	48.75	44.0905	1.90075
Axial length	110	16.52	25.68	22.7065	1.07461
A scan-IOLP	110	14.00	27.00	21.2220	2.21963
K average	110	41.00	49.13	44.4416	1.73824
SRK II-IOLP	110	14.49	39.33	21.4362	2.57996

Table 2: Pearson correlation coefficient matrix

	KH	**KV**	**AL**	**K average**	**SRK II-IOLP**	**A scan-IOLP**
KH	1	0.840**	-0.353	0.955	-0.212	0.052
KV	0.840	1	-0.335	0.963	-0.235	-0.003
AL	-0.353	-0.335	1	-0.358	-0.824	-0.432
A scan-IOLP	0.052	-0.003	-0.432	0.024	0.435	1
K average	0.955	0.963	-0.358	1	-0.234	0.024
SRK II-IOLP	-0.212	-0.235	-0.824	-0.234	1	0.435

AL: Axial length

Table 3: Multiple linear regression analysis (Model 1)

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.454a	.206	.191	1.99656

a. Predictors: (Constant), K average, Axial length

Coefficients[a]

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
			Std. Error	Beta		
	(Constant)	52.445	7.900		6.639	.000
1	Axial length	-1.002	.191	-.485	-5.257	.000
	K average	-.191	.118	-.149	-1.618	.109

a. Dependent Variable: A scan-IOLP

Model Equation: A scan- IOLP= (-0.191)*Ka +(-1.002)*AL+52.445

Table 4: Multiple linear regression analysis (Model 2)

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
2	1.000a	1.000	1.000	.00000

a. Predictors: (Constant), K average, Axial length

Coefficients[a]

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
			Std. Error	Beta		
	(Constant)	118.200	.000		628634054.864	.000
1	Axial length	-2.500	.000	-1.041	-551104882.229	.000
	K average	-.900	.000	-.606	-320919793.977	.000

a. Dependent Variable: SRK II-IOLP

Model Equation: SRK II-IOLP = (-0.900)*Ka +(-2.500)*AL+118.200

Table 5: Multiple linear regression analysis (Model 3)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.101a	.010	-.008	2.22889

a. Predictors: (Constant), KV, KH

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			Std. Error	Beta		
1	(Constant)	18.689	5.579		3.350	.001
	KH	.239	.228	.186	1.046	.298
	KV	-.185	.207	-.159	-.895	.373

a. Dependent Variable: A scan-IOLP

Model 3 Equation: A scan- IOLP= (0.239)*Kh + (-0.185)* Kv+18.689

Table 6: Multiple linear regression analysis (Model 4)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.461a	.212	.190	1.99782

a. Predictors: (Constant), Axial length, KV, KH

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			Std. Error	Beta		
1	(Constant)	51.274	8.004		6.406	.000
	KH	.089	.207	.069	.431	.667
	KV	-.260	.186	-.222	-1.395	.166
	Axial length	-.995	.191	-.482	-5.214	.000

a. Dependent Variable: A scan-IOLP

Model 4 Equation: A scan- IOLP= (0.089)*Kh +(-0.260)* Kv+ (-0.995)*AL+51.274

Table 7: Multiple linear regression analysis (Model 5)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.237a	.056	.038	2.52998

a. Predictors: (Constant), KV, KH

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			Std. Error	Beta		
1	(Constant)	36.333	6.333		5.737	.000
	KH	-.073	.259	-.049	-.283	.778
	KV	-.263	.235	-.194	-1.120	.265

a. Dependent Variable: SRK II-IOLP

Model 5 Equation: SRK II-IOLP = (-0.073)*Kh +(-0.263)* Kv+36.333

5. Limitations of the Study

A larger sample could increase the power of the study. However, considering the results in our study for the refractive errors obtained with the IOL power designed for emmetropia using the SRK-II or the A-Scan device, we can assume that showing a significant difference between the 2 biometers would need a study with a very large sample, which was beyond the scope of the present study.

6. Conclusion

In conclusion, the SRK-II IOLP measurement showed higher accuracy using Ka and AL with no inaccuracy in refractive error measurement. A-Scan also provided precise biometry data and IOL power calculations in cataract patients within an average range of ALs. There are significant differences between the instruments (models 1 and 2) on clinical impact. The SRK- II formula's predictability is higher than the A-scan formula. These

Table 8: Multiple linear regression analysis (Model 6)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	1.000a	1.000	1.000	.00000

a. Predictors: (Constant), Axial length, KV, KH

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			Std. Error	Beta		
1	(Constant)	118.200	.000		.	.
	KH	-.450	.000	-.301	.	.
	KV	-.450	.000	-.332	.	.
	Axial length	-2.500	.000	-1.041	.	.

a. Dependent Variable: SRK II-IOLP

Model 6 Equation: SRK II-IOLP = (-0.450)*Kh +(-0.450)* Kv+ (-2.500)*AL+118.2

Table 9: Comparing all the models with their summary

Model	Equation	R2	SE of the Estimate	P-value
Model 1	A scan- IOLP= (-0.191)*Ka + (-1.002)*AL+52.445	0.206	1.99656	<0.001
Model 2	SRK II-IOLP = (-0.900)*Ka + (-2.500)*AL+118.200	1.000	.00000	<0.001
Model 3	A scan- IOLP= (0.239)*Kh + (-0.185)* Kv+18.689	.010	2.22889	0.001
Model 4	A scan- IOLP= (0.089)*Kh + (-0.260)* Kv+ (-0.995)*AL+51.274	.212	1.99782	<0.001
Model 5	SRK II-IOLP = (-0.073)*Kh + (-0.263)* Kv+36.333	.056	2.52998	<0.001
Model 6	SRK II-IOLP = (-0.450)*Kh + (-0.450)* Kv+ (-2.500)*AL+118.2	1.000	.00000	

results suggest that both SRK-II and A-Scan biometers can be used for routine clinical practice to acquiring accurate biometry measurements for IOL power calculation.(Table 9)

7. Source of Funding

None.

8. Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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