To compare the accuracy of three different formula for calculation of IOL power for cataract surgery

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Abstract

Introduction - Accurate IOL power calculation is an important step for achieving postoperative emmetropia fter cataract surgery.

Aim - To compare the accuracy of three different formula for calculation of IOL power for cataract surgery.

Materials and Methods - It is a prospective randomized comparative study at tertiary level hospital. Total 150 eyes randomized into three groups of 50 eyes each. In group A, SRK/T formulae is used. In group B, Holladay 1 formulae is used. In group C, Hoffer Q formulae is used. Post operative vision and refraction status is evaluated at completion of six weeks in all the eyes and analysed with appropriate statistical method.

Results - The mean of post operative un aided visual acuity at the end of follow up period of six weeks was 0.32+/-0.12 with SRK/T formulae, 0.32+/-0.16 with Holladay 1 formulae and 0.31+/-0.14 with Hoffer Q formulae in log MAR units. The mean of post operative spherical equivalent at the end of follow up period of six weeks was -0.41+/-0.87, -0.59+/-1.02 and -0.52+/-0.94 in groups A, B and C respectively. The mean deviation for the predicted IOL power was -0.257+/-0.703, -0.256+/-0.666 and -0.256+/-0.612 in groups A, B and C respectively.

Conclusion - The accuracy of the three formula used was high, predictable and reliable. We do not find any statistical significant difference between the accuracy of these three formula.

Keywords - SRK/T formulae, Holladay 1 formulae, Hoffer Q formulae.

Introduction

The target of present days cataract surgery is not just only its extraction but also to achieve post operative emmetropia. For this reason lot of emphasis is being given to IOL power calculation. It is well established that the dioptric power of the phakic eye depends upon corneal curvature, crystalline lens power, position of the lens and axial length of eye. Emmetropic phakic eyes shows a wide range of variation in these variables, despite the overall identical refraction. Biometry is a clinical procedure for the measurement of the various dimensions of the eye and its components. These measurements are taken prior to cataract surgery to calculate IOL power. Calculation of the IOL power requires precise measurement of two key variables. 1. The anterior corneal curvature in two orthogonal

meridians, measurement of which is done by manual or automated keratometry. 2. The axial length of eye, measurement of which is done by applanation or immersion A scan. The axial length of the eye is measured from the corneal vertex to the fovea. Broadly the formula for IOL power calculation are divided into two groups. 1. Theoretical formula eg Binkhorsts, Fyodorovs and Hoffers. 2. Regression formula eg SRK/T, Holladay 1 and Hoffer Q. Regression formula for IOL power calculation to achieve emmetropia are based on the equation $P = A - BL - CK$ where A, B and C are constants.

Aims and Objectives

To compare the accuracy of three different formula for calculation of IOL power for cataract surgery

Materials and Methods

This prospective randomized comparative study was conducted in the Ophthalmology department of NRCH New Delhi, a tertiary level teaching hospital. Sample size was calculated to be 150 with confidence interval of 95% for > 0.5 dioptre post operative refractive error, at two tailed alpha value (0.05) and a beta value (0.2). The patients were randomized into three groups of 50 each by generating a random number table on internet and IOL power was calculated by the following formula group wise

Group A   SRK/T

Group B   Holladay 1

Group C   Hoffer Q

During the course of the study unaided and best corrected visual acuity at Snellen chart is recorded. Preoperative refraction, keratometry and axial length measured. Then finally IOL power calculation was done with respective formulae setting in the A scan machine. The patient underwent microincision phacoemulsification surgery with implantation of foldable hydrophilic IOL of very reputed international brand. Post operatively, the patients were followed up at day 1, week 1, week 3 and week 6. At every visit visual acuity, automated refraction and automated keratometry performed. Post operative spherical equivalent and deviation from predicted value was calculated for each eye at the end of 6 weeks.

Statistical analysis was done by using ANOVA among three groups for continuous variables. Categorical variables were analyzed using chi square test.

Results

The mean preoperative keratometric readings (K-1) were 43.53+/-1.64D, 43.86+/-1.33D and 43.27+/-1.58D (K-2) 43.72+/-1.50D, 43.34+/-1.25D and 43.56+/-1.57D in group A, B and C respectively. The mean axial length was 22.99+/-0.89 mm, 23.12+/-0.83 mm and 23.30+/-0.97 mm in group A , B and C respectively.120 (80 %) eyes had average length and the remaining 18 (12%) eyes had short and 12 (8%) had long axial length.

The mean emmetropic IOL power calculated in group A , B and C respectively was 21.67+/-2.08, 21.06+/-1.70 and 21.18+/-2.24D.

The mean post operative un aided visual acuity at the end of 6 weeks was 0.34+/-0.12, 0.32+/-0.16 and 0.31+/-0.14 respectively in group A , B and C respectively by log MAR units. Where as best corrected visual acuity was 0.21+/-0.10, 0.19+/-0.91 and 0.17+/-0.10 respectively.

The mean of post operative spherical equivalent at the end of six month follow up period was -0.41+/-0.87, -0.59+-1.02 and -0.52+/-0.94 in group A,Band C respectively.

The mean deviation for the predicted IOL power was -0.257+/-0.703, -0.256+/-0.666 and -0.256+/-0.512 D in group A , B and C respectively. The number of patients with post operative spherical refractive error was 73 (48.66%) in which 61 (83.56%) eyes were myopic and 12 (16.43%) were hypermetropic at the end of follow up period of six weeks.p value at period of 6 weeks was not statistically significant. The number of patients with post operative refractive error range of -0.50D was 127 (84.66%) with 41 (82%) , 42 (84 %) and 44 (88%) in group A, B and C respectively. The number of eyes with a post operative refractive error within the range of +/-2D was 146 (97.33%) with 48 (96%), 49 (98%) and 49 (98%) in group A , B and C respectively.

Table 1: Comparison of deviation in different axial lengths

Axial Length		Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD	p value
Short	n	9	4	5	0.052
	Mean ± SD	0.177 ± 0.314	0.030 ± 0.724	(-)0.976 ± 1.29	
	Range	(-)0.29 - 0.61	(-)0.81 - 0.89	(-)3.09 - 0.14	
Average	n	40	43	37	0.319
	Mean ± SD	(-)0.367 ± 0.734	(-)0.265 ± 0.679	(-)0.149 ± 0.415	
	Range	106.06 ± 41.61	102.66 ± 36.09	101.68 ± 31.82	
Long	n	1	3	8	0.291
	Mean ± SD	0.25 ± 0.0	(-)0.510 ± 0.384	0.011 ± 0.535	
	Range	0.25 - 0.25	(-)0.78 - (-)0.07	(-)0.72 - 0.70	

Table 2) No of patients within the range of +/-0.5D Refractive error

	Group A	Group B	Group C	p value
No of patients within the range of +/-0.5D Refractive error	41 (82%)	42 (84%)	44 (88%)	0.698
No of patients within the range of +/-1D Refractive error	45 (90%)	48 (96%)	48 (96%)	0.345
No of patients within the range of +/-2D Refractive error	48 (96%)	49 (98%)	49 (98%)	0.773

Discussion

The accuracy and predictability of A scan biometry using different regression formula was analyzed in a randomized prospective comparative study of 150 patients after defining proper inclusion and exclusion criteria. The IOL power calculated by the three formula was in the range of +15.75D to 26.52D. The IOL implanted were within range of 15.00 to 26.50D. 27.33% eyes had an IOL power implanted in the range of 15.00 to 20.00D.In a similar study done by S M Thompson et al, the IOL powers implanted were in the range of 21.0 to 24.0D in 69.10% of the eyes. The post operative best corrected visual acuity at the end of follow up period of six weeks was not statistically significant difference among three groups. The BCVA in our study at 6 weeks following surgery showed 74.67% eyes with visual acuity in the range of 0.2-0.5 log MAR units, 14% with BCVA > 0.2 and 8.33% with a BCVA < 0.5 log MAR units. In the study conducted by Roberto Zaldiver et al 78% had a post operative BCVA in the range of 0.2-0.5 log MAR units, 12% had BCVA <0.5 log MAR units and 10% eyes had the post operative BCVA > 0.2 log MAR units which is similar to the results of our study. The mean spherical equivalent of post operative refractive error at the end of 6 weeks follow up period was -0.41+/-0.87 in group A, -0.59+/-1.02 in group B and -0.52+/-0.94D in group C with no statistical significant difference. In the study conducted by Julio Narvaez et al comparing the accuracy of IOL power using the Hoffer Q, Holladay 1, Holladay 2, and SRK/T formula, there was no statistical significant difference in the accuracy of the all four formula in post operative refractive out come. which is similar to our study. 73 (48.66%) eyes in our study had aresidual refractive error. 61 (40.66%) eyes had residual refractive error on the myopic side where as 12 (8%) had refractive error towards hyperopic side.

The optimization of visual results after cataract surgery is dictated by the predictive efficacy of the intra ocular lens to be implanted in the eye. The present study showed a high and similar predictive value for the common formula used for IOL power calculation. All the formula accurately predicted the emmetropic power of IOL to be implanted, which was within acceptable range of variation when performed on separate occasions for pre operative measurements.

Conclusion

The visual acuity post cataract surgery largely depends on the predicted power of implanted IOL, which can be estimated by different formula. The present study showed similar predictive value of the three formula used for pre operative calculation in cataract surgery. All the three formula predicted accurately in all axial length range used in our study (short, average and long). The accuracy of the three formula used was high in predicting the emmetropic powers of IOL to be implanted, which was within acceptable range of variation and reproducible as performed on several separate occasions for pre operative measurement. Thus we can say that any of the three formula used in study (SRK/T, Holladay 1 and Hoffer Q) can be applied in clinical practice to calculate IOL power in cataract patients.

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