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# COMPARISON OF REFRACTIVE OUTCOME IN POST CATARACT SURGERY PATIENTS USING FOUR DIFFERENT IOL POWER CALCULATION FORMULAE

**Ophthalmology**

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## ABSTRACT

Cataract surgery with the advent of modern techniques has resulted in few complications and increasing emphasis is being placed on the refractive outcomes. Implantation of intraocular lens (IOL) is a critical step of the surgery and accurate calculation of IOL power is quintessential for attaining the desired refractive outcomes. In this study we compared four IOL power calculation formulae( Hoffer Q, Holladay, SRK II and SRK/T ) to find out the most appropriate one for the Indian population .We found no statistically significant difference in the accuracy of IOL power prediction with the Hoffer Q, Holladay, SRK II and SRK/T formulas in 3 subsets of axial lengths among 200 patients who underwent manual small incision cataract (SICS) surgery.

## KEYWORDS

intraocular lens , axial length , small incision cataract surgery

## INTRODUCTION:

Cataract surgery is the most common intraocular surgical procedure performed in India. With modern techniques, complications are uncommon and so increasing emphasis is being placed on the refractive outcomes. The introduction of intraocular lens implantation (IOL) has revolutionized cataract surgery. The accurate calculation of IOL power is essential for attaining the desired refractive outcomes after cataract surgery. The accuracy mainly depends on preoperative biometric data( axial length), IOL power calculation formulas and IOL power quality control by the manufacturer. [1] Studies based on preoperative and postoperative ultrasound biometry demonstrated that 54% of the errors in predicted refraction after IOL implantation can be attributed to AL measurement errors [2] Therefore, precise preoperative measurement of AL is the most critical step to improve IOL power prediction. [3]

## MATERIALS AND METHODS :

This study aims to compare the refractive outcomes in post cataract surgery patients using four different IOL power calculation formulas( SRK II, SRK T , Holladay , Hoffer Q ) and to analyze which formula has a better predictive outcome in different axial length subsets. The study is designed as a prospective, randomized, comparative, interventional study was undertaken at tertiary eye care atChennai between 2013-2015 for 18 months .

### Inclusion criteria

- All senile uncomplicated cataracts with lens grading of Nuclear Sclerosis grade III and less
- Age of patient > 40 years
- With controlled diabetes and hypertension
- Pre-operative K reading of astigmatism of 1.00D or less

### Exclusion criteria

- Congenital , developmental, and Complicated cataract.
- Lenticular subluxation.
- Any ocular pathology other than cataract causing dimunitionof vision.
- Any patients who had undergone previous ocular surgery .
- > 3D ametropia between two eyes.
- Keratometry readings <40 and >50.
- Failure to place lens in the bag

### Procedure:

The study was approved by the hospital ethical committee and all patients enrolled in the study consented .A total of 200 eyes of patients attending Outpatient department of tertiary Eye Hospital were randomly selected and included in the study.All patients were examined for visual acuity recording by Snellen's visual acuity chart, Slit-lamp bio-microscopy, non-contact tonometry and fundus examination with 90 D or 78 D.Astigmatism was measured by Topcon 8800 automatedkeratometer.IOL power was calculated with contact A-scan biometry using SRK II, SRK/T, HOLLADAY and HOFFERQ formulas by the same person.A constant used was the same for all formulae.Preoperative investigations like complete haemogram, random blood sugar, urine routine and blood pressure measurement were done.All eyes underwent SICS with 6.5mm temporal incision.All cases were operated by a single surgeon and same type of PCIOL will be placed in the capsular bag.The power of IOL inserted was based on SRK/T formula.

Patients were examined on post-operative day 1, 1week, 1 month and 3months. Uncorrected and best corrected visual acuity were recorded. Post operative refraction was performed using autorefractometer and streak retinoscope. The deviation from predicted refractive error was compared while using each of the IOL formulas.At last follow up visit, approximately 3 months following the operation unaided (UCVA) and best corrected visual acuity (BCVA) will be tested using a Snellen chart.The difference between the predicted outcome and actual outcome is the variance in spherical equivalence and it will be noted as the Mean Absolute Error (MAE).

All patients were uniformly put on antibiotic and steroid eye drops in a tapering dose for the next 6 weeks. The patients were discharged on the following day after assessment.All patients were reviewed after one week, at one month and at 3 months. At one month, refraction was done for all cases. The difference between the expected and postoperative calculated refraction was noted. Spectacles were issued at the end of one month and the patients were asked to review again after 3 months.All data was entered into microsoft excel spreadsheet and statistical analysis was done using statistical software SPSS 20.0.0.

## RESULTS:

The study undertaken included 200 cases. All the patients underwent a small incision cataract surgery with a posterior chamber intraocular lens implantation .The results were analysed and the following observations were made.

Out of the 200 patients included in the study, 90 patients were male (45%) and 110 patients were female (55%).In our study , patients in the age group > 60 years formed the largest group (n=127 ,63%). The axial length distribution is as follows, 157 patients (78.5%) had the axial length of 22-24 mm followed by 39 cases (19.5%) with axial length <22 mm and 4 cases (2%) were with axial length >24mm. The IOL power calculation with various formulas is shown in Table 1.

**Table 1 Intraocular lens power calculation with various formulas by ultrasonic biometry in all patients (*n* =200)**

| | Mean±SD | *P* |
|---|---|---|
| Axial length (mm) | 22.5 +/- 0.77 | |

| | | |
|---|---|---|
| Keratometric value (D) | 44.66 +/- 1.55 | |
| Absolute error- SRK T (D) | 0.06+/-0.04 | 0.09 |
| Absolute error- SRK II(D) | 0.02+/-0.05 | 0.08 |
| Absolute error- Holladay (D) | 0.08+/-0.10 | 0.10 |
| Absolute error- Hoffer Q (D) | 0.08+/-0.09 | 0.12 |

The mean K value was 44.66 +/- 1.55
The mean AL value was 22.5 +/ - 0.77

**Post op spherical refractive equivalent with SRK T formula.**
**Axial length less than 22mm -** Total number of patients were 37 out of 200 (18.5%). Post operatively sixteen patients were hypermetropic (43.24%), nine were emmetropic (24.32%), twelve were myopic (32.43%).

**Axial length between 22-24mm**- Total number of patients were 159 out of 200 (79.5%). Post operatively sixty patients were hypermetropic (37.73%), fifty-six were emmetropic (35.22%), forty three were myopic (27.04%).

**Axial length more than 24mm**- Total number of patients were 4 out of 200(2%). Post operatively all 4 patients were emmetropic (100%).

**Post op spherical refractive equivalent with SRK II formula.**
**Axial length less than 22mm -** Total number of patients were 37 (18.5%) out of 200. Post operatively 16 patients were hypermetropic (43.24%), 10 were emmetropic (27.02%), 11 were myopic (29.72%).

**Axial length between 22-24mm**- Total number of patients were 159 out of 200(79.5%). Post operatively 51 patients were hypermetropic (32.07%), 58 were emmetropic (36.47%), 50 were myopic (31.44%).

**Axial length more than 24mm**- Total number of patients were 4 out of 200 (2%). Post operatively both two patients were hypermetropic (50%) and one each were emmetropic(25%) and myopic(25%)

**Post op spherical refractive equivalent with HOLLADAY formula.**
**Axial length less than 22mm -** Total number of patients were 37 out of 200 (18.5%). Post operatively 13 patientswere hypermetropic (35.13%), 12 were emmetropic (32.43%), 12 were myopic (32.43%).

**Axial length between 22-24mm**- Total number of patients were thirty 159 out of 200 (79.5%). Post operatively 64 patients were hypermetropic (40.2%), 46 were emmetropic (28.9%), 49 were myopic (30.8%).

**Axial length more than 24mm**- Total number of patients were 4 out of 200 (2%). Post operatively both 3 patients were emmetropic (75%) and 1(25%) was hypermetropic

**Post op spherical refractive equivalent with HOFFER Q formula.**
**Axial length less than 22mm -** Total number of patients were 37 out of 200 (18.5%). Post operatively 14 patients were hypermetropic (37.83%), 8 were emmetropic (21.62%), 15 were myopic (40.5%).

**Axial length between 22-24mm**- Total number of patients were 159 out of 200(%). Post operatively 66 patients were hypermetropic (41.5%), 38 were emmetropic (23.89%), 55 were myopic (34.59%).

**Axial length more than 24mm**- Total number of patients were 4 out of 200 (2%). Post operatively both 3 patients were emmetropic (75%) and 1 (25%) was hypermetropic

## DISCUSSION :

Our study using optimized lens constants, applanation ultrasound biometry, and a single surgeon performing surgery with modern techniques statistically compared the refractive outcomes in 200 eyes . Patients were divided into three subgroups according to their axial lengths. The 4 commonly used IOL formulas : SRK T, SRK II ,HOLLADAY and HOFFER Q were calculated for all the patients. Surgery was performed using SRK T for all patients. Post operatively at the end of 4 weeks ,the refractive status was calculated and the expected outcome if the other formulas were to be used assessed. All datas were tabulated and compared.

Postoperatively, 69 patients were emmetropic using SRK/T and SRK II, 61 with Holladay and 49 with Hoffer Q. The target post operative refractive spherical error was assigned to be within +/- 1D and the rest of the patients were grouped into hypermetropic or myopic errors. The post operative spherical refractive error thus calculated with SRK/T was 62% within target post op refractive spherical equivalent error , 65.5% with SRK II , 61% with Holladay and 59% with Hoffer Q.

Our study concluded that all the above formulas compared , did not vary in their refractive outcomes in a statistically significant manner and also when they were divided into different axial length subsets , none of them proved superior.

In another retrospective study, Narváez Jet al [4] compared the accuracy of intraocular lens power prediction using the Hoffer Q, Holladay 1, Holladay 2, and SRK/T formulas in 643 eyes undergoing cataract surgery. Similar to our study , they found that no formula was more accurate than the others. The formulas were also equally accurate when eyes were stratified by axial length. These findings were consistent with a study done by Donoso et al.[5]

Wang JK et al [6] performed a study on Intraocular lens power calculation using the IOLMaster and various formulas in eyes with long axial length. This study included 68 eyes with an AL longer than 25.0 mm that had phacoemulsification with IOL implantation. SRK/T, SRK II, and Holladay 1 formulas resulted in similar accuracy of IOL power prediction in eyes with higher myopia. The IOL power calculated using the Haigis formula predicted the best refractive outcome in long eyes.

Hoffer[7] found in another study that the Hoffer Q formula to be significantly more accurate than the SRK and SRK II (P < .0001 and P <.004 respectively) and equal to the Holladay 1 and SRK/T formulas.He also reported mean absolute error in 317 eyes with 4 commonly used formulas (Hoffer Q, Holladay 1,Holladay 2, and SRK/T) in subjects stratified by axial length but did not perform statistical analysis. But in our study Hoffer Q formula performed similar to the other formulas in all the 3 subgroups of axial length.

## LIMITATIONS OF OUR STUDY:

In our study, the axial length was measured using applanation ultrasound, But the AL measured by applanation ultrasound is significantly shorter than that measured by the IOL Master. This was the major limitation of our study.

## CONCLUSION:

We found no statistically significant difference in the accuracy of IOL power prediction with the Hoffer Q, Holladay, SRK II and SRK/T formulas in 3 subsets of axial lengths among 200 patients who underwent manual SICS surgery. The 4 formulas were equally accurate at all axial lengths.

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