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IOL Power Calculation in the Elderly Population Using the Kane Formula in Comparison to Existing Methods

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Abstract

Purpose: To assess the accuracy of the Kane formula for intraocular lens (IOL) power calculation in comparison to established formulas in the elderly population.

Setting: Shiley Eye Institute, University of California San Diego, USA.

Design: Retrospective cohort.

Methods: Retrospective data from 90 patients ≥75 years old who underwent uneventful cataract surgery with SN60WF IOL implantation were evaluated. The first operated eyes of patients with final best-corrected visual acuity 20/40 or better and axial length 22–26 mm were included. Prediction errors were calculated for Barrett Universal II (BUII), Haigis, Hoffer Q, Holladay 1, Kane and SRK/T formulas. A subgroup analysis based on age (75–84 and ≥85 years old) was performed.

Results: Use of both BUII and Kane formulas resulted in the highest percentage of eyes with prediction errors within ±0.50 D (72% each) and significantly higher than Hoffer Q, Holladay 1 and SRK/T (p=0.001). Rates of predictability within ±0.25 D and ±1.00 D were 31%-38% and 87% –92%, respectively, with no significant differences between formulas. No statistically significant difference was seen between formulas in the median absolute error. These tendencies remained consistent in both age groups when analyzed separately. Subgroup analysis showed better predictability of all formulas in the younger age group.

Conclusions: This is the first study evaluating the Kane formula exclusively in the elderly population. The Kane formula was found to be of equal accuracy to the BUII and superior to the Hoffer Q, Holladay 1 and SRK/T formulas. Very elderly patients may have reduced refractive precision using all formulas.

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INTRODUCTION

The number of elderly patients undergoing cataract surgery is constantly rising[1,2] as the world's population ages.[3,A] Since more elderly patients than ever before are in good health and able to maintain active lives, their expectations for optimal visual outcomes have increased. Addressing IOL power calculation accuracy in the elderly is essential, as the predictability of IOL calculation formulas may be age dependent.[4–6] A recent study by our group evaluated IOL power calculation using two formulas, the Holladay 1 and the Barrett Universal II (BUII), in the very elderly population (≥85 years old) and compared predicted refractive outcomes to those of their younger counterparts aged 75–84 years old.[6] There was reduced accuracy of the Holladay 1 formula in the very elderly population. Similar trends, though not statistically significant, were shown for the BUII formula.

The Kane formula is a new IOL power calculation formula that uses theoretical optics combined with regression and artificial intelligence components.[7,8] Since the introduction of the Kane formula (September 2017), few studies have evaluated its accuracy in comparison to existing formulas. Our search of the literature yielded only four major studies analyzing the formula, among them three by Kane and his colleagues.[7–10] To the best of our knowledge, there are no published data that have assessed the accuracy of the Kane formula only in the elderly and very elderly. Moreover, previous studies that included elderly individuals, were composed of a younger average population, while our study was exclusively composed of patients aged 75 years or older. This current study evaluating the Kane formula is the first to solely focus on the elderly population. This expands our previous comparison to other commonly used formulae and aims to determine which is the best predictor of postoperative refractive outcomes in these individuals.

METHODS

This study was performed in a single tertiary setting at the Shiley Eye Institute, University of California, San Diego. The study conformed to the tenets of the Declaration of Helsinki and was approved by the Institutional Review Board office of the University of California, San Diego.

Patients Selection:

Consecutive medical records of patients ≥75 years old who had undergone cataract extraction by experienced anterior segment surgeons at the Shiley Eye Institute, University of California, San Diego, between January 2015 and May 2018 were retrospectively reviewed. Selection criteria are detailed previously.[6] According to protocols for studies of intraocular lens formula accuracy described by Hoffer et al.,[11] only patients with a final best spectacle-corrected visual acuity (BCVA) 20/40 or better and an axial length (AL) of 22–26 mm were included. Moreover, only patients who received the same IOL model (SN60WF, Alcon Laboratories, Inc., Fort Worth, TX) also were included. Only one eye from each study subject was included. If both eyes were eligible, the second eye surgery was excluded. All included patients underwent ocular biometry one month prior to surgery with partial coherence interferometery (IOLMaster, V. 5.2.1, Carl Zeiss Meditec, Inc., Dublin, CA) and corneal tomography (Pentacam HR, Version 6.08r30; Oculus, Wetzlar, Germany). All cataract surgeries involved a temporal clear corneal incision, phacoemulsification, and implantation of an IOL into the capsular bag. IOL choice was made at the discretion of the surgeon. All included patients had a documented follow-up visit 1–3 months post operatively, during which manifest refraction at an examination lane length of 20 feet was performed by an optometrist. Exclusion criteria, as specified by Sella et al.,[6] included patients with missing follow-up data, low quality of biometry measurements defined by a signal-to-noise ratio (SNR) ≤ 2 by the IOLMaster with no alternative immersion ultrasound biometry, history of refractive surgery, eyes with significant ocular comorbidities, or surgical complications.

Intraocular Lens Calculations:

Preoperative measurements including AL, keratometry (K) values, and anterior chamber depth (ACD), defined as axial distance from the corneal epithelium to anterior lens surface, as well as selected IOL power, patient demographic data, and each eye's pre-operative manifest refraction were collected.

A predicted refraction for the implanted IOL was calculated using five formulas: BUII (V1.05), Haigis, Hoffer Q, Holladay 1, Kane and SRK/T. Calculations for Kane and BUII formulas were performed using their online calculators (available at: https://www.iolformula.com/ and https://calc.apacrs.org/barrett_universal2105/, respectively). Optional values were not inserted. Haigis, Hoffer Q, Holladay 1 and SRK/T formulas were calculated with a self-programmed Excel software spreadsheet (Microsoft 365 Office ProPlus, Microsoft Inc.), that had been checked against IOLMaster biometer, programmed using the original publications and errata.[12–15] IOL power calculations were performed using optimized constants for the Zeiss IOLMaster as specified by the User Group for Laser Interference Biometry (ULIB) website (available at: http://ocusoft.de/ulib/c1.htmhttp://ocusoft.de/ulib/c1.htm). Constants optimization was derived externally as described in the JCRS editorial by Wang et al.[16]

Post-operatively, BCVA and stable manifest refraction were documented. A prediction error for each formula was calculated by subtracting the predicted refraction from the postoperative spherical equivalent (SE) refraction for the IOL power that had been implanted. The mean error for each formula was verified to equal zero, thereby validating lens constants optimization. Following, median absolute error (MedAE), mean absolute error (MAE) and the percentage of eyes within ±0.25 D, ±0.50 D and ±1.00 D of each formula were compared.[11,16] A corresponding subgroup analysis based on age (75–84 and ≥85 years old) was performed.

Statistical Analysis:

Statistical analysis was performed with the SPSS package (version 21.0, SPSS, Inc.). A p-value < 0.05 was considered statistically significant.

Power analysis for paired data was performed to determine the minimum sample size for statistically significant results. A difference of 0.125 D, half of the standard refractive interval, was considered to be clinically significant. A SD of 0.30 D was assumed. Based on a two-tail test, an alpha level of 0.05 and a power of 80%, a minimal sample size of 46 eyes was required.

Data were checked for normality using the Shapiro-Wilk test and normality assessment plots. Descriptive statistics are presented as a mean ± standard deviation (SD) for normal distributed variables and as a median with interquartile range (IQR) for non-normal distributed variables. Mean and median values of absolute errors were reported, regardless of compliance to normal distribution, as described by Wang et al.[16]

One sample t-test or Wilcoxon signed rank test for one sample, as indicated, were used to evaluate whether the mean refractive prediction error of each formula is different from zero.

For assessing the differences between absolute errors of the formulas, Friedman's test was performed. Wilcoxon Signed-Rank test was used for post hoc analysis. The Cochran's Q test was used to compare the percentage of eyes within ±0.25 D, ±0.50 D and ±1.00 D of the predicted refraction. The McNemar test for paired proportions was applied for significant results.

The absolute error of each formula was compared between the two age groups using the two-sided nonparametric Mann-Whitney test. The percentage of eyes within a refractive goal of ±0.25 D, ±0.50 D and ±1.00 D of the predicted refraction for each formula was compared between the age groups using the Chi-square test.

Multiple logistic regression analysis for the achievement of ±0.50 D was carried out including age, gender, mean corneal power, ACD, and AL. Multivariate linear regression analysis, using a stepwise method, was conducted to assess absolute errors.

RESULTS

Table 1 summarizes patients' preoperative collected data. All formulas had mean prediction errors close to zero, all of which were not significantly different from zero. BUII and Kane formulas resulted in the highest percentage of eyes with prediction errors within ±0.50 D (72.22%), and were found significantly better than Hoffer Q (61.11%, p=0.006 and p=0.021, respectively), Holladay 1 (58.89%, both p=0.004) and SRK/T (61.11%, both p=0.013). No significant differences were seen between formulas in the proportion of eyes with SE refraction within ±0.25 D from target refraction (31.11%-37.78%). Rates of predictability within ±1.00 D ranged between 86.67% (Haigis) and 92.22% (BUII), with no significant differences between formulas. Fig. 1 presents the refractive outcomes within the range of ±0.25 D, ±0.50 D and ±1.00 D using all formulas. No statistically significant difference was seen between formulas in MedAE and MAE. BUII (0.33 D and 0.44 D, respectively), and Kane (0.35 D and 0.46 D, respectively) formulas showed a tendency toward lower results. Data summarizing predicted refractive errors are presented in Table 2.

The two age groups did not differ in baseline characteristics except in ACD, which was lower in patients ≥85 years old compared to ages 75–84 (p=0.019). A non-significant longer AL of 0.22 mm was seen in the older group. Subgroup analysis showed that in patients 75–84 years old, a statistically significant higher proportion of eyes within ±0.50 D of attempted

SE refraction was achieved using the Kane formula (82.61%) compared with SRK/T (65.22%, p=0.021) and Holladay 1 (65.22%, p=0.021) formulas. In patients ≥85 years old, higher proportions were observed using BUII (65.91%) compared with the Hoffer Q (50.00%, p=0.039) formula. No other significant differences in rates of predictability within ±0.50 D were noted in the two age groups. No significant difference was seen among formulas in rates of predictability within ±0.25 D and ±1.00 D in each age group.

All formulas showed higher proportion of SE refraction within ±0.25 D, ±0.50 D and ±1.00 D in patients 75–84 years old compared with patients ≥85 years old, which reached statistical significance for SRK/T (p=0.019) and Holladay 1 (p=0.037) within ±0.25 D, Kane (p=0.024), Hoffer Q (p=0.034) and Haigis (p=0.032) within ±0.50 D and SRK/T (p=0.047), Holladay 1 (p=0.014) and Haigis (p=0.010) within ±1.00 D. In addition, all formulas showed a trend towards lower MedAE and MAE in patients 75–84 years old compared with patients ≥85 years old, with statistically significant results for Haigis and Hollady 1 (p=0.024 and p=0.026, respectively). Complete refractive outcomes for each age group are presented in Table 3.

Multivariate regression analysis showed a statistically significant effect of mean K and age on the absolute error of all formulas (Table 4). Logistic regression analysis for a final refraction within ±0.50 D of target refraction supported the relationship between age and the predictive refractive errors of the Haigis formula (p=0.034), Hoffer Q formula (p=0.021) and Kane formula (p=0.013). Mean K was associated with a refraction achievement within ±0.50 D for BUII (p=0.006), Hoffer Q (p=0.023), Holladay 1 (p=0.012), Kane (p=0.003) and SRK/T (p=0.005). ACD effected calculations with BUII (p=0.034) and Holladay 1 (p=0.022). Table 5 presents complete logistic regression analyses.

DISCUSSION

In this study, we found that the Kane formula was equal to the BUII and statistically significantly superior than Hoffer Q, Holladay 1 and SRK/T formulas in refractive predictability rate within ±0.50 D (72%). Although not statistically significant, these two formulas showed a tendency toward lower MedAE and MAE compared to other formulas. Interestingly, no advantage to any formula was found in the rate of predictability within ±0.25 D, which is probably best explained by the relatively small number of eyes in our cohort.

Our results are in concordance with the current literature comparing established formulas with the Kane formula. Connell and Kane compared the Kane formula and two other formulas which were recently updated (RBF 2.0 and Holladay 2 with a new AL adjustment) with existing popular ones (BUII, Haigis, Hoffer Q, Holladay 1, Olsen and SRK/T).[7] They showed that using AL, K, and ACD biometric variables, the Kane formula was a more accurate predictor of actual postoperative refraction than the other formulas evaluated. The Kane formula had the lowest MedAE and MEA (0.231 D and 0.329 D, respectively) and the highest percentage of eyes within ±0.25 D, ±0.50 D and ±1.00 D prediction errors (52.4%, 77.9% and 96.6%, respectively). Darcy et al.[8] validated these findings in a cohort of 10,930 eyes from the UK National Health Service, and found the Kane formula having the lowest

MedAE (0.302 D), lowest MAE (0.377 D) and the highest percentage of eyes predicted within ±0.25 D, ±0.50 D and ±1.00 D (42.6%, 72.0% and 95.2%, respectively) in comparison to BUII, Haigis, Hoffer Q, Holladay 1, Holladay 2, Olsen, RBF 2.0, and SRK/T. Melles et al.[10] analyzed the Kane formula based on their previous dataset composed of 18,501 patients, implanted with 1,3301 SN60WF IOLs and 5,200 SA60AT IOLs.[17] The Kane formula was the most accurate with 83.1% of eyes predicted within ±0.50 D of SE refraction and showing the lowest MedAE and MAE. A recent study by Savini et al.[9] evaluated the accuracy of different formulas based on measurements by a swept-source optical coherence tomography optical biometer. The Kane formula exhibited MedAE of 0.200 D, MAE of 0.257 D and 62.00%, 90.00% and 100.00% of eyes within ±0.25 D ±0.50 D and ±1.00 D of target refraction, respectively. In addition, the Kane formula in their study was among the formulas found to yield the lowest MedAE and highest percentage of eyes with a prediction error of ±0.50 D or less with statistical significance.

Our reported MedAE and MAE were higher than the aforementioned studies and our percentage of eyes achieving postoperative SE refraction within ±0.25 D, ±0.50 D and ±1.00 D was lower than previously published. We attribute this to our study’s population composed exclusively of elderly patients. While our study focused on the elderly, with a median age of 84 (IQR: 76–92) years old (49% of subjects ≥85 years old), mean ages in the earlier studies were generally younger (Connell and Kane: 77.8 ± 9.6, Darcy et al.: 75.33 ± 9.72, Savini et al.: 77.2 ± 10.0).

Overall, our study exhibited lower accuracy than the current benchmark for the general population using all formulas. On average, The Swedish National Cataract Register study[18] indicated an absolute deviation within ±0.25 D, ±0.50 D and ±1.00 D from target refraction in 47%, 71% and 93% of eyes, respectively. Melles et al.[17] reported in a large multicenter study for the SN60WF IOL, 41%-50%, 71%-81% and 96%-98% of eyes within ±0.25 D, ±0.50 D and ±1.00 D using different formulas in patients 72.8 ± 9.0 years old. For comparison, our prediction within ±0.25 D ranged from 31% to 38%, within ±0.50 D from 59% to 72% and within ±1.00 D from 87% to 92%. Indeed, the results of our study demonstrate better accuracy in patients 75–84 years old in comparison to the very elderly, ≥85 years old, using various formulas. All formulas exhibited a higher proportion of SE refraction within ±0.25 D, ±0.50 D and ±1.00 D and lower MedAE and MAE in patients 75–84 years old, reaching statistical significance for Holladay 1 and SRK/T for predictability within ±0.25 D; Haigis, Hoffer Q and Kane within ±0.50 D; Haigis, Holladay 1 and SRK/T within ±1.00 D; and Haigis and Hollady 1 for MedAE. In addition, multivariate regression analysis showed a statistically significant effect of age, together with mean K, on the absolute refractive errors of all formulas. Moreover, logistic regression analysis for the achieving of SE refraction within ±0.50 D from target supported the relation between higher predictability and younger age (Haigis, Hoffer Q and Kane), flatter average K (BUII, Hoffer Q, Holladay 1, Kane and SRK/T), and deeper ACD (BUII and Holladay 1).

We previously reported lower precision in refractive results for the very elderly.[6] Our current study further supports these results by comparing multiple formulae’s accuracy among the two age groups, suggesting the Kane formula as well as the BUII formula may be among the most accurate in the elderly population. We previously suggested that changes in anatomical features related to age may influence effective lens position (ELP) estimation and therefore, explain the refractive differences in the very elderly compared to younger counterparts. Among these changes are decrease in ACD,[5,19,20] changes in the angle structures,[21] and increased zonular laxity and fragility.[22] In addition, in accordance with the impact of mean K found in our regression analysis, an increase in corneal power with increasing age could potentially also affect refractive predictability in this age group.[23–25] Although, this increase was not demonstrated in our patients, showing no difference in average K between groups (p=0.191), it is possible that a larger dataset, similar to these studies, is needed to exhibit this change. Interestingly, Kane et al.[26] formerly evaluated the Kane formula in a specific population of patients with keratoconus. To address these patients' specific anterior/posterior corneal ratio, a modified corneal power was used. The Kane keratoconus formula resulted in a reduction in MAE of 20% to 39% compared with other modern IOL formulas, including the original Kane formula, suggesting group-specific modifications can improve refractive outcomes in patients with unique characteristics in which the formula's performance is suboptimal.

The Kane formula does not take age into consideration, similarly to the other formulas evaluated, which can partially explain the differences in accuracy when used for elderly patients. The significant separate association of age to refractive outcome, found by logistic regression and multivariate analysis, suggests patient's age is an important variable. On the other hand, it is necessary to exclude first a confounding effect of other variables. It is therefore crucial to address this group's specific anatomical characteristics.[5,20–25] Therefore, it would be of interest to investigate correlation of AL, keratometry and ACD with the refractive outcome in this population in a larger series of patients and to compare the elderly group to another age group. As age may represent differences in anatomical features of elderly patients, regression equation to adjust significant values may improve the predictability of the formula for this age group.

There are some limitations to this study. First, due to our IOLMaster version, the Kane formulas was evaluated without optional values of lens thickness (LT) and central corneal thickness (CCT). According to the developers,[7,8] the Kane formula requires the AL, K, ACD and gender to make its predictions. LT and CCT significantly improve the accuracy of the formula, however, are optional. Nevertheless, as our results, showing an advantage of the Kane formula, were demonstrated without the formula's optimal performance, our findings reinforce the use of the Kane formula in the elderly population. We hypothesize that including all variables in the calculation algorithm may improve the results even further. In addition, Connell and Kane[7] evaluated the Kane formula using three different IOLMaster models, thus including cases with no LT and CCT similarly to us. They found no statistically significant difference in accuracy between the different IOLMaster biometers. Finally, this measurement limitation reflects real-life experiences of practices worldwide, who do not have access to newer biometers. Similarly, an improvement in the prediction of the BUII formula would be expected if all optional parameters were available. Additional potential limitations include external validity limiting the extrapolation of our finding to different IOL types and short or long eyes and the multiple surgeons that were included in the analysis. The above, however, may very well represent real-life variability.[6]

In conclusion, the current results indicate a more predictable refractive outcome in the elderly using the Kane formula, as well the BUII. This should be taken into consideration during pre-operative IOL calculation in the elderly. A larger cohort study allowing to investigate regression equations to improve the predictability of the formula in this age-group is desirable.

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VALUE STATEMENT

What Was Known

- Very elderly patients undergoing cataract surgery may be prone to reduced refractive precision, particularly with utilization of the Holladay 1 formula.
- The new Kane formula shows excellent predictability in the general population.

What This Paper Adds

- This is the first study to evaluate the Kane formula in the exclusively elderly population.
- The Kane formula was found more accurate than most common vergence formulas and equal to the Barrett Universal II in the elderly population.
- All included formulas show lower accuracy in the very elderly compared with elderly patients.

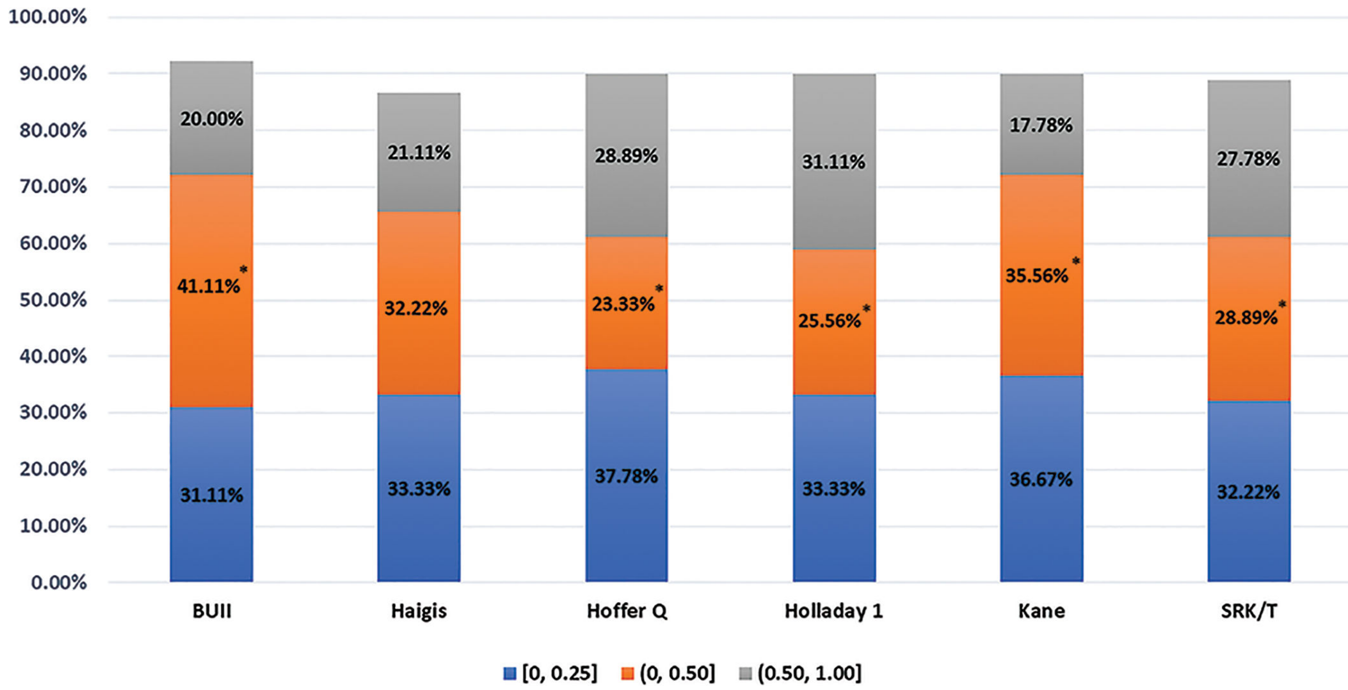

Fig. 1:

Stacked histograms comparing the percentage of cases within ±0.25 D, ±0.50 D and ±1.00 D of predicted spherical equivalent refraction outcome for the entire data set.

BUII = Barrett Universal II.

* Kane and BUII > Hoffer Q, Holladay 1 and SRK/T ($p<0.05$).

Table 1.

Demographics and preoperative characteristics.

	All	≥75–84	≥85	p-value
Female, n (%)	57 (63.3%)	33 (71.7%)	24 (54.5%)	0.091
OD, n (%)	42 (46.7%)	24 (52.2%)	18 (40.9%)	0.284
Age (yrs), median [IQR, range]	84 [8, 75 – 95]	78 [5.25, 75 – 84]	86 [2.75, 85 – 95]	<0.001
AL (mm)	23.75 ± 0.92 [22.06 – 25.89]	23.64 ± 0.88 [22.06 – 25.89]	23.86 ± 0.95 [22.11 – 25.72]	0.257
Average K (D)	43.84 ± 1.61 [40.68 – 48.81]	44.06 ± 1.71 [40.68 – 48.81]	43.62 ± 1.49 [40.96 – 46.08]	0.191
ACD (mm)	2.98 ± 0.36 [2.20 – 3.77]	3.07 ± 0.34 [2.45 – 3.77]	2.89 ± 0.36 [2.20 – 3.57]	0.019
IOL Power (D)	21.04 ± 2.29 [15.0 – 25.5]	21.01 ± 2.03 [16.5 – 24.5]	21.08 ± 2.57 [15.0 – 25.5]	0.888
BCVA prior surgery (logMAR), median [IQR, range]	0.30 [0.30, 0.00 – 2.00]	0.30 [0.30, 0.00 – 2.00]	0.40 [0.32, 0.10 – 2.00]	0.190
BCVA post-surgery (logMAR), median [IQR, range]	0.10 [0.18, 0.00 – 0.30]	0.10 [0.18, 0.00 – 0.30]	0.10 [0.18, 0.00 – 0.30]	0.424

Presented values are mean ± SD [range] unless specified otherwise.

OD = right eye, AL = axial length, K = keratometry, ACD = anterior chamber depth, BCVA = best-corrected visual acuity.

Table 2.

Mean predicted error and median and mean absolute predicted error for all IOL formulas.

	* Prediction Error (D) *Median (IQR)*	** Absolute Prediction Error (D) *Mean ± SD* *Mean ± SD* *[range]*
BUII	0.03 ± 0.59	0.33 (0.41)
		0.44 ± 0.38 [0.01 – 1.89]
Haigis	−0.01 ± 0.63	0.37 (0.48)
		0.49 ± 0.40 [0.02 – 1.89]
Hoffer Q	−0.05 ± 0.65	0.37 (0.55)
		0.49 ± 0.42 [0.00 – 1.82]
Holladay 1	−0.08 ± 0.61	0.39 (0.41)
		0.47 ± 0.40 [0.00 – 1.93]
Kane	0.02 ± 0.61	0.35 (0.45)
		0.46 ± 0.39 [0.00 – 1.95]
SRK/T	−0.02 ± 0.63	0.38 (0.45)
		0.48 ± 0.41 [0.01 – 2.09]

*All P = NS

**P = 0.609 (Friedman Test)

BUII = Barrett Universal II

Table 3.

Subgroup analysis of refractive prediction errors of the formulas compared by age.

	75–84	≥85	p-value
BUII			
MedAE (D)	0.31	0.39	0.069
MAE ± SD (D)	0.36 ± 0.28	0.53 ± 0.45	
% within ±0.25 D	32.61%	29.55%	0.754
% within ±0.50 D	78.26%	65.91%	0.191
% within ±1.00 D	97.83%	86.36%	0.056
Haigis			
MedAE(D)	0.34	0.42	0.024
MAE ± SD (D)	0.38 ± 0.30	0.60 ± 0.46	
% within ±0.25 D	41.30%	25.00%	0.101
% within ±0.50 D	76.09%	54.55%	0.032
% within ±1.00 D	95.65%	77.27%	0.010
Hoffer Q			
MedAE(D)	0.31	0.49	0.053
MAE ± SD (D)	0.39 ± 0.32	0.60 ± 0.49	
% within ±0.25 D	43.48%	31.82%	0.254
% within ±0.50 D	71.74%	50.00%	0.034
% within ±1.00 D	95.65%	84.09%	0.087
Holladay 1			
MedAE(D)	0.30	0.45	0.026
MAE ± SD (D)	0.37 ± 0.30	0.58 ± 0.46	
% within ±0.25 D	43.48%	22.73%	0.037
% within ±0.50 D	65.22%	52.27%	0.212
% within ±1.00 D	97.83%	81.82%	0.014
Kane			
MedAE(D)	0.32	0.42	0.055
MAE ± SD (D)	0.37 ± 0.27	0.56 ± 0.47	
% within ±0.25 D	45.65%	27.27%	0.070
% within ±0.50 D	82.61%	61.36%	0.024
% within ±1.00 D	95.65%	84.09%	0.087
SRK/T			
MedAE(D)	0.28	0.46	0.058
MAE ± SD (D)	0.38 ± 0.31	0.57 ± 0.48	
% within ±0.25 D	43.48%	20.45%	0.019
% within ±0.50 D	65.22%	56.82%	0.414
% within ±1.00 D	95.65%	81.82%	0.047

BUII = Barrett Universal II, MedAE = median absolute prediction error, MAE = mean absolute prediction error.

Table 4.

Multivariate linear regression model of the absolute prediction error

Parameter	BUII		Haigis		Hoffer Q		Holladay 1		Kane		SRK/T	
	R2 = 0.14		***R2 = 0.14***		***R2 = 0.12***		***R2 = 0.11***		***R2 = 0.14***		***R2 = 0.10***	
	B	p-value	B	p-value	B	p-value	B	p-value	B	p-value	B	p-value
Age	0.02	0.048	0.03	0.001	0.02	0.006	0.02	0.008	0.02	0.003	0.02	0.028
Average K	0.06	0.017	0.06	0.029	0.06	0.032	0.06	0.022	0.06	0.013	0.06	0.022
ACD	−0.20	0.070										

BUII = Barrett Universal II, B = unstandardized coefficient B, ACD = anterior chamber depth, K = keratometry.

Table 5.

Logistic regression analysis for the achievement of spheroequivalent refraction of ±0.50D

Parameter	BUII		Haigis		Hoffer Q		Holladay 1		Kane		SRK/T	
	OR (CI), p-value		***OR (CI), p-value***		***OR (CI), p-value***		***OR (CI), p-value***		***OR (CI), p-value***		***OR (CI), p-value***	
Gender	1.33 (0.43–4.06)	0.621	2.16 (0.74–6.26)	0.157	1.92 (0.68–5.45)	0.219	1.03 (0.38–2.81)	0.947	1.46 (0.46–4.65)	0.525	1.18 (0.43–3.20)	0.747
Age	0.93 (0.84–1.04)	0.213	0.89 (0.80–0.99)	0.034	0.89 (0.80–0.98)	0.021	0.94 (0.86–1.04)	0.233	0.86 (0.76–0.97)	0.013	0.95 (0.86–1.05)	0.314
ACD	6.17 (1.15–33.23)	0.034	3.14 (0.71–13.93)	0.133	3.26 (0.74–14.28)	0.118	5.88 (1.29–6.87)	0.022	5.16 (0.93–28.73)	0.061	2.31 (0.55–9.76)	0.253
AL	0.59 (0.29–1.20)	0.145	0.63 (0.32–1.22)	0.170	0.82 (0.43–1.58)	0.562	0.73 (0.38–1.39)	0.339	0.58 (0.28–1.20)	0.141	0.63 (0.33–1.20)	0.162
Mean K	0.59 (0.40–0.86)	0.006	0.73 (0.52–1.03)	0.072	0.67 (0.47–0.95)	0.023	0.64 (0.45–0.91)	0.012	0.55 (0.36–0.81)	0.003	0.60 (0.43–0.86)	0.005

BUII = Barrett Universal II, OR = odds ratio, CI = confidence interval, ACD = anterior chamber depth, AL = axial length, K = keratometry.