Original Article

Analysis of accuracy of twelve intraocular lens power calculation formulas for eyes with axial hyperopia

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Access this article online
Quick Response Code:
Website:
www.saudijophthalmol.org
DOI:
10.4103/sjopt.sjopt_64_22

Abstract:

PURPOSE: The purpose was to compare twelve intraocular lens power calculation formulas for eyes smaller than 22.0 mm in terms of absolute error (AE), the percentage of postoperative emmetropia, and agreement interval in Bland–Altman analysis.

METHODS: The data of hyperopic patients who underwent uneventful phacoemulsification between January 2016 and July 2021 were reviewed. Intraocular lens power was calculated using Holladay 1, SRK/T, Hoffer Q, Holladay 2, Haigis, Barrett Universal II, Hill-RBF, Ladas, Kane, Emmetropia Verifying Optical (EVO), Pearl-DGS, and K6 formulas. Three months after phacoemulsification, refraction was measured, and the mean AE was calculated. The percentage of patients with full visual acuity (VA) without any correction, with ± 0.25D, ±0.5D, ±0.75D, and limits of agreement for each formula was established.

RESULTS: Seventy-two patients, whose ocular axial length (AL) ranged between 20.02 mm and 21.98 mm, were included. The Kane formula achieved the lowest mean AE of 0.09 ± 0.09 just before EVO (0.12 ± 0.09), Hill-RBF (0.17 ± 0.12), and Hoffer Q formulas (0.19 ± 0.16). In addition, with the Kane formula, the percentage of patients with full VA without any correction (80.6%) was the highest ahead of EVO and Hoffer Q formulas (51.5% and 50.0%, respectively). Finally, Kane, EVO, and Hill-RBF obtained the lowest agreement interval (0.4923, 0.5815, and 0.7740, respectively).

CONCLUSION: The Kane formula is recommended for intraocular lens power calculation for eyeballs with the AL smaller than 22.0 mm. The EVO formula gives very promising results in regarding the accuracy of intraocular lens power for hyperopic eyes.

Keywords:

Hyperopia, intraocular lenses, phacoemulsification

Introduction

Accurate intraocular lens (IOLs) power calculation is a very important aspect of phacoemulsification because patients' expectations for perfect vision after cataract surgery are still increasing.[1] The exactness of implant power estimation depends not only on the accuracy of the preoperative biometric data such as axial length (AL), keratometry (K), and anterior chamber depth (ACD) which inaccuracy in their measurement can contribute to 36%, 22%, and 42% of errors, respectively, but also most of all on the accuracy of IOL power calculation formulas.[2] Therefore, with the development of cataract surgery, many IOL power calculation formulas have been elaborated.[3-10] There are different classifications of IOL power calculation formulas; however, the most practical one is based on how the data are collected which is shown in Table 1.[11]

Most of the IOL power calculations are exact for eyes with AL ranging between 22.0 mm and 25.0 mm.[12] However, their accuracy for eyes shorter than 22.0 mm and longer than 25.0 mm is still questionable.[7,13] For many years, the Hoffer Q formula was recognized as the most accurate in calculating IOL power in hyperopic eyes.[8,14-17] However, the newly developed methods based on artificial intelligence or hybrid also have very promising results.[9,18,19] The Kane formula stands

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Submitted: 20-Apr-2022
Revised: 28-Oct-2022
Accepted: 16-Nov-2022
Published: 02-May-2023

How to cite this article: Stopyra W. Analysis of accuracy of twelve intraocular lens power calculation formulas for eyes with axial hyperopia. Saudi J Ophthalmol 2023;37:125-30.

Table 1: Intraocular lens power calculation formulas

Data-driven		Optical approach			Hybrid
Simple regression	Artificial intelligence	Simple thin-lens vergence	Interactive thick-lens vergence	Ray tracing	Combination
SRK	Hill-RBF	Binkhorst	Barrett	Olsen	Kane
SRK II		Holladay 1	EVO	Okulix	FullMonte
		Hoffer Q			Ladas
		SRK/T			
		Holladay 2			
		Haigis			

EVO: Emmetropia Verifying Optical

up among them.[10,20-22] However, there is still no agreement among cataract surgeons regarding the choice of the formula.

This study aimed to compare the IOL power calculation formulas for eyes shorter than 22.0 mm in terms of absolute error (AE) and the percentage of patients with full visual acuity (VA) without any correction after cataract surgery. In addition, the study tries to confront the accuracy of IOL power calculation formulas using Bland–Altman analysis with particular regard to the limits of the agreement interval. It is pioneering due to its method. Finally, a list of as many as 12 formulas proves the reliability of the study.

Methods

The data of patients with eyes of AL shorter than 22.0 mm and with the Wisconsin Grade 3 or 4 cataract who underwent uneventful sutureless phacoemulsification with mono-focal IOL implantation with 2.4 mm clear corneal incision between January 2016 and July 2021 were retrospectively reviewed. Based on Hoffer and Savini recommendations, only one eye per patient was included. Rigorous exclusion criteria were applied, such as corneal astigmatism >2.0 D, postoperative BCVA <0.8, the history of other ophthalmic procedures, i.e., vitrectomy, limbal relaxing incisions, and corneal refractive surgery, any intraoperative or postoperative complication as well as previous corneal diseases.

The study was conducted adhering to the tenets of the Declaration of Helsinki. Each patient signed informed consent for routine cataract surgery.

Preoperative optical biometry was performed with the use of Zeiss IOL Master 700 (Carl Zeiss Meditec AG, Jena, Germany), obtaining the following data for each patient, AL, K, ACD, lens thickness (LT), and white-to-white (WTW) as corneal diameter. IOL power was calculated with 12 different formulas (Holladay 1, SRK/T, Hoffer Q, Holladay 2, Haigis, Barrett Universal II, Hill-RBF, Ladas, Kane, Emmetropia Verifying Optical [EVO], Pearl-DGS, and K6). The keratometric index was used at 1.3375.

Each cataract surgery was performed by the same eye surgeon. Acrylic foldable intraocular lenses were implanted. Postoperative refraction was measured 3 months after cataract surgery.

Numerical error (NE) was defined as the difference between the real postoperative refractive outcome expressed as a spherical equivalent (equal to the sum of spherical power and half of cylindrical power) and the refraction predicted by each formula. A positive value indicated a hyperopic error, and a negative value referred to myopic error, while absolute value means AE. Based on the AE ≤0.12, the percentage of patients with full VA without any correction was established. In addition, the percentage of patients with ± 0.25D correction (0.13 ≤ AE ≤0.37), ±0.5D (0.38 ≤ AE ≤0.62), ± 0.75D (0.63 ≤ AE ≤0.87), and ± 1.0D (0.87 < AE) was counted.

Besides, Bland–Altman method comparing NE value of each formula and zero target expected after phacoemulsification was used, and Bland–Altman plots with the limits of the agreement interval for each formula were drawn. Proposed in 1983 by Bland and Altman analysis is a simple way to evaluate a bias between the mean differences and to estimate an agreement interval, within 95% of the differences of the second method, compared to the first one. Data can be analyzed both as unit differences plot and as percentage differences plot.[23-25]

Statistical analysis was performed using the Statistica 13.1 package (StatSoft Polska, Cracow, Poland). $P < 0.05$ was considered statistically significant unless it was necessary to apply the Bonferroni corrections for multiple comparisons, which reduced the significance level down to even 0.0023. Data distribution for normality was checked using the Shapiro–Wilk test. The nonparametric Kruskal–Wallis test was used to check statistically significant differences between groups. The Mann–Whitney *U* test (for quantitative variables) and the Chi-square test with Yates' corrections (for qualitative variables) were used for the between-pair of formula comparison. Systematic error and the degree of agreement were assessed with the Bland–Altman analysis and presented graphically.

Results

Seventy-two patients (32 men and 40 women) with the mean age of 70.8 ± 8.8, range: 55–94 years, were included in the study. The AL of the studied eyes ranged between 20.02 mm and 21.98 mm.

Out of the 12 evaluated formulas, the Kane achieved the lowest level of mean AE 0.09 ± 0.09 D, followed by EVO (0.12 ± 0.09) and Hill-RBF (0.17 ± 0.12). Descriptive statistic results of AE for each formula are listed in Table 2.

In terms of the AE, which indicates the expected correction after cataract surgery, the studied group was divided into five subgroups with expected emmetropia, ±0.25D, ±0.5D, ±0.75D, ± 1.0D, and more correction (AE ≤0.12, with range 0.13–0.37, 0.38–0.62, 0.63–0.87, and >0.87, respectively). The percentage distribution of the subgroups is presented in Figure 1. In the study, with the Kane formula, the percentage of patients with full VA without any correction (80.6%) was the highest ahead of EVO and Hoffer Q formulas (51.5% and 50.0%, respectively).

However, the following groups are more commonly used in the literature: expected emmetropia, ≤ ±0.25 D, ≤ ±0.5 D, and ≤ ±0.75 D as shown in Figure 2.

In addition, the Bland–Altman analysis has been performed. The study compared the mean NE of each IOL power calculation formula with zero target expected after cataract surgery. The limits of the agreement interval were calculated using NE and SD. IOL power calculation formula is all the more accurate, the smaller the agreement interval is. The calculation results are presented in Table 3 and illustrated graphically in Figures 3-5.

Discussion

This study demonstrated that the Kane formula achieved the lowest AE (0.09 ± 0.09) and the highest percentage of emmetropic patients (80.6%). In addition, the Kane formula obtained the lowest agreement interval by the Bland–Altman analysis (0.4923). It is, therefore, recommended for IOL power calculation for eyes with AL smaller than 22.0 mm. However, EVO and Hill-RBF also performed very well, only slightly worse than Kane (AE of 0.12 ± 0.09 and 0.17 ± 0.12, respectively; agreement interval of 0.5815 and 0.7740, respectively).

The Kane formula is based on theoretical optics and incorporates both regression and artificial intelligence components to refine prediction. It is a new IOL power formula created using several large data sets from selected high-volume surgeons that use a combination of theoretical optics, thin lens formulas, and "big data" techniques to make its predictions. It uses AL, K, ACD, LT, central corneal thickness, and gender of the patient to make its predictions.[11,21]

Currently, the Kane formula is gaining more and more recognition in the world literature.[10,11,20-22,26] Connell and Kane considering the accuracy of nine formulas (Hill-RBF, Kane, Holladay 2, Barrett, Olsen, Haigis, Hoffer Q, Holladay 1, and SRK/T) demonstrated that the Kane formula had the lowest mean absolute prediction error ($P < 0.001$ for all formulas). However, the study involved a relatively small number of short eyes.[20] Furthermore, Hipólito-Fernandes *et al*. proved that new-generation formulas, especially Kane, VRF-G, and EVO, might help us in achieving better refraction results. Although 828 patients were studied, different ALs

Table 2: Descriptive statistics of absolute error

	AE		
	Mean±SD	Median	Range
Holladay 1	0.31±0.18	0.27	0.01-0.73
SRK/T	0.30±0.18	0.27	0.02−0.86
Hoffer Q	0.19±0.16	0.13	0.00-0.62
Holladay 2	0.27±0.15	0.26	0.00-0.65
Haigis	0.29±0.24	0.25	0.01-0.87
Barrett Universal II	0.26±0.18	0.25	0.00-0.71
Hill-RBF	0.17±0.12	0.15	0.00-0.59
Ladas	0.35±0.13	0.34	0.14-0.69
Kane	0.09±0.09	0.06	0.00-0.40
EVO	0.12±0.09	0.12	0.00-0.41
Pearl-DGS	0.39±0.16	0.36	0.10-0.89
K6	0.37±0.17	0.35	0.01-0.82

AE: Absolute error, SD: Standard deviation, EVO: Emmetropia Verifying Optical

Table 3: The data of the Bland-Altman analysis

	NE	SD	NE +1.96 SD	NE −1.96 SD	Agreement interval
Holladay 1	0.0600	0.3499	0.7458	−0.6258	1.3716
SRK/T	−0.0436	0.3518	0.6460	−0.7332	1.3792
Hoffer Q	−0.0179	0.2481	0.4683	−0.5041	0.9724
Holladay 2	0.0097	0.3151	0.6272	−0.6077	1.2349
Haigis	−0.0081	0.3781	0.7330	−0.7491	1.4821
Barrett Universal	−0.0947	0.3575	0.6067	−0.6459	1.2526
Hill-RBF	0.0496	0.1974	0.4366	−0.3374	0.7740
Ladas	−0.1067	0.3554	0.5898	−0.8031	1.3929
Kane	0.0156	0.1256	0.2617	−0.2306	0.4923
EVO	−0.0244	0.1483	0.2663	−0.3152	0.5815
Pearl-DGS	−0.0326	0.4205	0.7916	−0.8569	1.6485
K6	0.0932	0.3985	0.8743	−0.6879	1.5622

NE: Numerical error, SD: Standard deviation, EVO: Emmetropia Verifying Optical

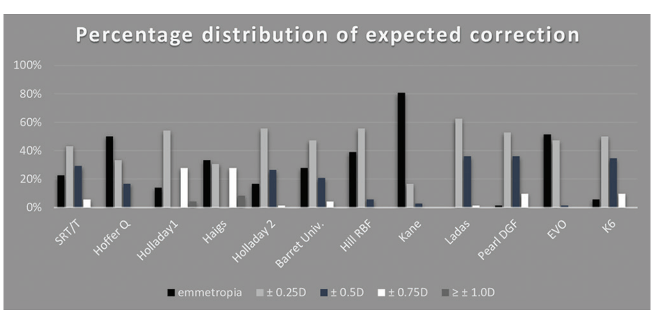

Figure 1: Percentage of eyes with emmetropia, ±0.25D, ±0.5D, ±0.75D, and ≥ ± 1.0D

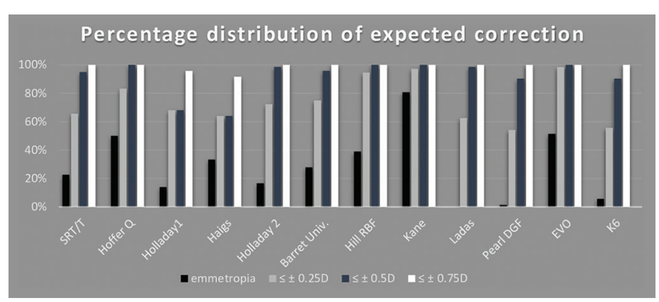

Figure 2: Percentage of eyes with emmetropia, ≤ ± 0.25D, ≤ ± 0.5D, and ≤ ± 0.75D

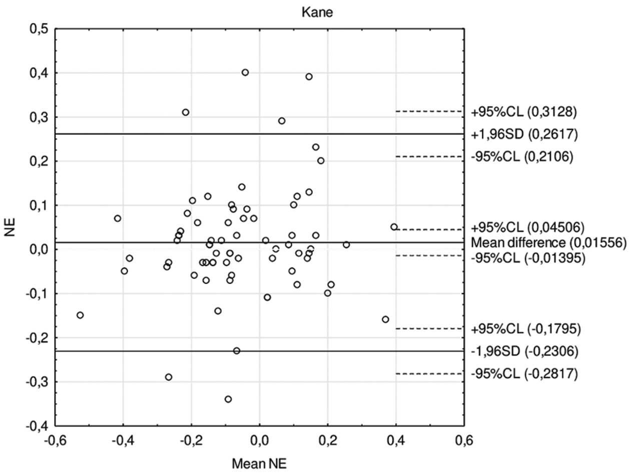

Figure 3: Bland-Altman plot for the Kane formula

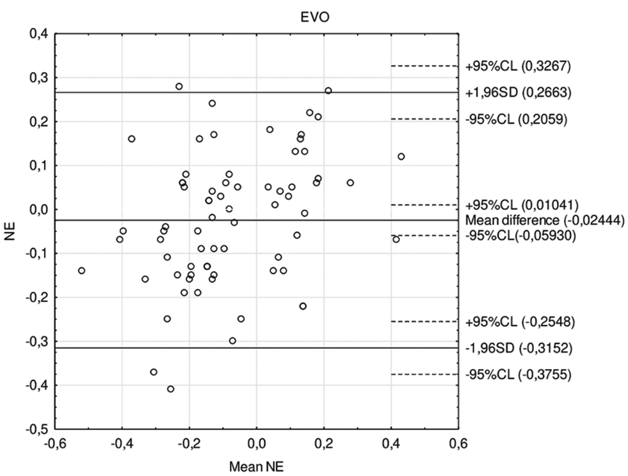

Figure 4: Bland-Altman plot for the EVO formula. EVO: Emmetropia Verifying Optical

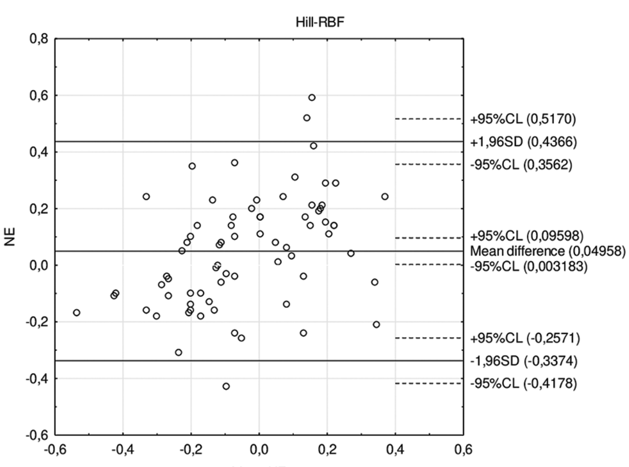

Figure 5: Bland-Altman plot for the Hill-RBF formula

were considered, and therefore, the hyperopic ones were relatively few. Nevertheless, using the Kane formula, the highest percentage of patients with refraction ≤ ± 0.75 was obtained (97.7%),[21] as in my study (100%). Yosar *et al*. studied the refractive outcomes after cataract surgery in nanophthalmos.[26] They proved the highest accuracy of the Kane formula, although they achieved only 40% of patients with refraction ≤ ± 0.5. However, they considered only four formulas (Hoffer Q, SRK/T, Barrett Universal II, and Kane) and studied extreme short eyeballs (AL ranged between 18.24 mm and 20.99 mm).[26] Aristodemou *et al*. observed the following correlation, with the decrease of axial AL below 22.00 mm, AE increased, i.e., the accuracy of the formula decreased.[17]

EVO formula is a thick-lens vergence formula based on the theory of emmetropization.[21] It is freely available online. Recently, several papers have been published proving the high accuracy of the EVO formula in calculating the power of IOL, especially in short eyeballs. Carmona-González *et al*., in their 2020 retrospective study which involved 481 patients, realized that EVO and Haigis were the best at predictive refractive outcomes in the short eyes subgroup.[9] They compared as many as 11 formulas, including the newest ones, such as Hill-RBF, Ladas, Kane, Barrett Universal II, and Olsen. Hipólito-Fernandes *et al*. in the group of 82 eyes with a length <22.0 mm, obtained the lowest mean AE for the EVO formula.[21]

Contrary, 2018 meta-analysis based on 10 observational studies involving 1161 eyes showed that the Holladay 2 formula achieved the smallest mean AE but without statistical significance.[7] However, the meta-analysis did not consider the latest IOL power calculation formulas like Hill-RBF, Kane, EVO, Ladas, or K6. On the other hand, Kane *et al*., in their 2017 study, concluded that new methods (Ladas, Hill-RBF, and FullMonte) for predicting the postoperative refraction had failed to yield more accurate results than the current formulas (Barrett Universal II and Holladay 1). This study comprised 3122 eyes which was enough group to reach reliable conclusions.[27] However, they included neither the Kane formula nor the EVO formula.

Carifi *et al*. did not observe any statistically significant difference in the mean AE of Hoffer Q, Holladay 1, Haigis, and Holladay 2 formulas.[15] They studied extremely short eyeballs with highly powerful IOL (range of powers + 35.0 D to + 40.0 D); therefore, they obtained a high mean AE value of 0.95 D. In addition, they involved only 28 eyes in their study; therefore, the result could be unreliable. Similarly, Doshi *et al*. proved no statistically significant differences in the mean AE of Hoffer Q, Holladay 1, and SRK/T formulas.[1] They obtained a much higher mean AE values, i.e., 0.59 D, 0.57 D, and 0.54 D, respectively, compared to the current study, i.e., 0.19 D, 0.31 D, and 0.30 D, respectively. However, they used the immersion ultrasound technique to obtain AL values which are a less accurate method than using IOL Master.

Most often, the research methodology is based on the calculation of AE using an absolute value of a difference between postoperative and predicted spherical equivalences of refractive error.[1,12,16-18] Only a few authors have considered the percentage of patients with postoperative hyperopia after phacoemulsification and even the receiver operating characteristic curve method.[28,29] In this context, the use of the Bland–Altman methodology is a pioneering idea.

Bland and Altman established a method to quantify the agreement between two quantitative measurements by constructing the limits of the agreement interval. These statistical limits are calculated using the mean and the SD of the differences between two measurements. To check the assumptions of normality of differences and other characteristics, they used a graphical approach. The resulting graph is a scatter plot XY, in which the Y-axis shows the difference between the two paired measurements (A-B) and the X-axis represents the mean of these measures (A/2 + B/2). An ideal model would claim that the measurements obtained by one method or another gave exactly the same results. Hence, all differences would be equal to zero.[23,25] In practice, we develop an agreement interval – the smaller, the more precise the method is. Each formula was compared in the study in terms of NE with the standard, i.e. refraction equal to zero. Considering the limits of the agreement interval, the greatest accuracy of the Kane formula just before EVO and Hill-RBF was proved (0.4923, 0.5815, and 0.7740, respectively).

In addition, considering the NE, we can estimate whether the formula produces myopic or hyperopic results. In the study, most of the formulas induced myopic outcome, while only five formulas targeted hyperopia (e.g., Hill-RBF, K6, Holladay 1). Similar results were achieved by Hipólito-Fernandes *et al*. In their study, among the newest formulas, only Hill-RBF and VRG-F gave hyperopic scores.[21]

There are several limitations to the study. All patients had implanted the same model of IOL; hence, these results may not be generalizable to IOL models of a different design. The IOLs evaluated in the study were of anterior asymmetric biconvex, and many other IOL designs, such as equi-biconvex, were also common. The differences in IOL shape could affect the prediction errors and change the relative performance of the formula tested. One eye surgeon is the next limitation of this study. Research with only a single surgeon is unlikely to reach the number of cases required for significance and in themselves may be biased.

The relatively narrow range of the eyeballs' length (from 20.02 mm to 21.98 mm) is a limitation of this study also. However, even in Aristodemou *et al*.'s study on 8108 eyes, 457 of which had AL <22.00 mm, eyeballs not shorted than 20.00 mm were examined.[17] Although the group of patients doesn't seem like a lot in my study, there are many published articles where the number of patients was even smaller.[6,15,30-32] Thus, Cooke and Cooke[6] as well as Gavin and Hammond[30] studied 41 eyes, Wang and Chang 33,[31] Carifi *et al*. 28,[15] and Roh *et al*. only 25 eyes.[32] On the other hand, there were studies with more eyes – Aristodemou *et al*. 457,[17] Gökce *et al*. 86,[14] and Eom *et al*. 75 eyes involved.[33]

The lack of the Olsen formula is the next limitation of this study. The key feature of the Olsen formula is accurate estimation of the IOL's physical position using a newly developed concept, the C-constant (a ratio by which the empty capsular bag will encapsulate and fixate an IOL following in-the-bag implantation). This approach predicts the IOL position as a function of preoperative ACD and LT and works independently of traditional factors such as AL, K, WTW, IOL power, age, and gender.[34]

In addition, pupil dilatation was not considered in the study. There are reports on the influence of pupil dilation on the accuracy of IOL power calculation formulas. However, it concerned neither the Kane formula nor the EVO formula, but only Barrett Universal II, Haigis and SRK/T formulas.[35,36]

Finally, parameters such as K, ACD, and LT were not considered in terms of the accuracy of IOL power calculation formulas in the study. On the other hand, some authors found notable biases in the prediction errors of most of the formulas when plotted versus not only AL but also K, ACD, and LT.[37]

Conclusion

The study shows that the Kane formula is recommended for IOL power calculation for eyes with AL smaller than 22.0 mm, but the EVO formula is very accurate as well. Both of these formulas achieved the best results both in terms of AE and using the Bland-Altman methodology with an agreement interval. Although the reliability of the presented results could be limited due to a small number of the studied group, the whole concept of such a method seems promising.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1. Doshi D, Limdi P, Parekh N, Gohil N. A comparative study to assess the predictability of different IOL power calculation formulas in eyes of short and long axial length. J Clin Diagn Res 2017;11:C01-4.
2. Lee AC, Qazi MA, Pepose JS. Biometry and intraocular lens power calculation. Curr Opin Ophthalmol 2008;19:13-7.
3. Shrivastava AK, Behera P, Kumar B, Nanda S. Precision of intraocular lens power prediction in eyes shorter than 22 mm: An analysis of 6 formulas. J Cataract Refract Surg 2018;44:1317-20.
4. Wendelstein J, Hoffmann P, Hirnschall N, Fischinger IR, Mariacher S, Wingert T, *et al.* Project hyperopic power prediction: Accuracy of 13 different concepts for intraocular lens calculation in short eyes. Br J Ophthalmol 2022;106:795-801.
5. Luo Y, Li H, Gao L, Du J, Chen W, Gao Y, *et al.* Comparing the accuracy of new intraocular lens power calculation formulae in short eyes after cataract surgery: A systematic review and meta-analysis. Int Ophthalmol 2022;42:1939-56.
6. Cooke DL, Cooke TL. Comparison of 9 intraocular lens power calculation formulas. J Cataract Refract Surg 2016;42:1157-64.
7. Wang Q, Jiang W, Lin T, Wu X, Lin H, Chen W. Meta-analysis of accuracy of intraocular lens power calculation formulas in short eyes. Clin Exp Ophthalmol 2018;46:356-63.
8. Batkov EN, Pashtayev NP, Mikhaylova VI. Calculation of intraocular

lens power in surgical treatment of extreme hyperopia. Vestn Oftalmol 2019;135:21-7.
9. Carmona-González D, Castillo-Gómez A, Palomino-Bautista C, Romero-Domínguez M, Gutiérrez-Moreno MÁ. Comparison of the accuracy of 11 intraocular lens power calculation formulas. Eur J Ophthalmol 2021;31:2370-6.
10. Darcy K, Gunn D, Tavassoli S, Sparrow J, Kane JX. Assessment of the accuracy of new and updated intraocular lens power calculation formulas in 10 930 eyes from the UK National Health Service. J Cataract Refract Surg 2020;46:2-7.
11. Xia T, Martinez CE, Tsai LM. Update on intraocular lens formulas and calculations. Asia Pac J Ophthalmol (Phila) 2020;9:186-93.
12. Chen C, Xu X, Miao Y, Zheng G, Sun Y, Xu X. Accuracy of intraocular lens power formulas involving 148 eyes with long axial lengths: A retrospective chart-review study. J Ophthalmol 2015;2015:976847.
13. Wang Q, Jiang W, Lin T, Zhu Y, Chen C, Lin H, *et al.* Accuracy of intraocular lens power calculation formulas in long eyes: A systematic review and meta-analysis. Clin Exp Ophthalmol 2018;46:738-49.
14. Gökce SE, Zeiter JH, Weikert MP, Koch DD, Hill W, Wang L. Intraocular lens power calculations in short eyes using 7 formulas. J Cataract Refract Surg 2017;43:892-7.
15. Carifi G, Aiello F, Zygoura V, Kopsachilis N, Maurino V. Accuracy of the refractive prediction determined by multiple currently available intraocular lens power calculation formulas in small eyes. Am J Ophthalmol 2015;159:577-83.
16. Hoffer KJ, Savini G. IOL power calculation in short and long eyes. Asia Pac J Ophthalmol (Phila) 2017;6:330-1.
17. Aristodemou P, Knox Cartwright NE, Sparrow JM, Johnston RL. Formula choice: Hoffer Q, Holladay 1, or SRK/T and refractive outcomes in 8108 eyes after cataract surgery with biometry by partial coherence interferometry. J Cataract Refract Surg 2011;37:63-71.
18. Nemeth G, Modis L Jr. Accuracy of the Hill-Radial basis function method and the Barrett universal II formula. Eur J Ophthalmol 2021;31:566-71.
19. Siddiqui AA, Juthani V, Kang J, Chuck RS. The future of intraocular lens calculations: Ladas super formula. Ann Eye Sci 2019;4:19.
20. Connell BJ, Kane JX. Comparison of the Kane formula with existing formulas for intraocular lens power selection. BMJ Open Ophthalmol 2019;4:e000251.
21. Hipólito-Fernandes D, Elisa Luís M, Gil P, Maduro V, Feijão J, Yeo TK, *et al*. VRF-G, a new intraocular lens power calculation formula: A 13-formulas comparison study. Clin Ophthalmol 2020;14:4395-402.
22. Ryu S, Jun I, Kim TI, Kim EK, Seo KY. Accuracy of the Kane formula for intraocular lens power calculation in comparison with existing formulas: A retrospective review. Yonsei Med J 2021;62:1117-24.
23. Giavarina D. Understanding Bland Altman analysis. Biochem Med (Zagreb) 2015;25:141-51.
24. Doğan NÖ. Bland-Altman analysis: A paradigm to understand correlation and agreement. Turk J Emerg Med 2018;18:139-41.
25. Bland JM, Altman DG. Agreed statistics: Measurement method comparison. Anesthesiology 2012;116:182-5.
26. Yosar JC, Zagora SL, Grigg JR. Cataract surgery in short eyes, including nanophthalmos: Visual outcomes, complications and refractive results. Clin Ophthalmol 2021;15:4543-51.
27. Kane JX, Van Heerden A, Atik A, Petsoglou C. Accuracy of 3 new methods for intraocular lens power selection. J Cataract Refract Surg 2017;43:333-9.
28. Liu J, Wang L, Chai F, Han Y, Qian S, Koch DD, *et al*. Comparison of intraocular lens power calculation formulas in Chinese eyes with axial myopia. J Cataract Refract Surg 2019;45:725-31.
29. Stopyra W. Comparison of the accuracy of six intraocular lens power calculation formulas for eyes of axial length exceeding 25.0mm. J Fr Ophtalmol 2021;44:1332-9.
30. Gavin EA, Hammond CJ. Intraocular lens power calculation in short eyes. Eye (Lond) 2008;22:935-8.
31. Wang JK, Chang SW. Optical biometry intraocular lens power calculation using different formulas in patients with different axial lengths. Int J Ophthalmol 2013;6:150-4.
32. Roh YR, Lee SM, Han YK, Kim MK, Wee WR, Lee JH. Intraocular lens power calculation using IOLMaster and various formulas in short eyes. Korean J Ophthalmol 2011;25:151-5.
33. Eom Y, Kang SY, Song JS, Kim HM. Use of corneal power-specific constants to improve the accuracy of the SRK/T formula. Ophthalmology 2013;120:477-81.
34. Olsen T, Hoffmann P. C constant: New concept for ray tracing-assisted intraocular lens power calculation. J Cataract Refract Surg 2014;40:764-73.
35. Teshigawara T, Meguro A, Mizuki N. Influence of pupil dilation on the Barrett universal II (new generation), Haigis (4^{th} generation), and SRK/T (3^{rd} generation) intraocular lens calculation formulas: A retrospective study. BMC Ophthalmol 2020;20:299.
36. Autrata D, Chrapek O, Drahorád S. Effect of pharmacological pupil dilation on intraocular lens power calculation in patients indicated for cataract surgery. Cesk Slov Oftalmol 2021;77:192-200.
37. Melles RB, Holladay JT, Chang WJ. Accuracy of intraocular lens calculation formulas. Ophthalmology 2018;125:169-78.