To compare the accuracy of intraocular lens calculation formulae in the prediction of postoperative refraction device in eyes with short axial length (<22mm)

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Introduction

Accurate intraocular lens (IOL) power calculation in cataract surgery is very important to achieve the best postoperative target refraction and high patient satisfaction. For short eyes, the IOL power calculation formulas are less accurate than in normal size eyes, which presents challenges for cataract surgeons.

In this study, we aim to compare the refractive outcome using different IOL calculation formulas (Barrett Universal II, Haigis, Hoffer Q, Holladay 1, Olsen, SRK/T, Hill BRF II, Kane and EVO 2.0).

Methods:

This was a retrospective chart review conducted for adult patients who underwent uncomplicated cataract surgery with implantation of monofocal posterior chamber IOL at Broadmeadows hospital during Jan 2012- Jan 2020. All patients had post operative refraction at 4 weeks minimum. All patients received implantation of an Alcon AcrySof IQ SN60WF intraocular lens. Only one eye was randomly selected in eligible patients. Post op mean error (ME) and mean absolute refractive error (APE) was calculated, before and after adjusting the mean to zero, for each formula and compared.

Results

- Total No of eyes: 129
- Male: Female- 29:100
- Mean post op refractive error : -0.61 D (SE)

	Mean	SD
Age	74.53	7.6
AL	21.64	0.3
ACD	2.78	0.33
LT	4.67	0.44
Mean K	45.63	1.57

Pre op characteristics
AL- axial length
ACD- anterior chamber depth
LT- lens thickness
K -keratometry

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No Financial Conflicts Of Interest

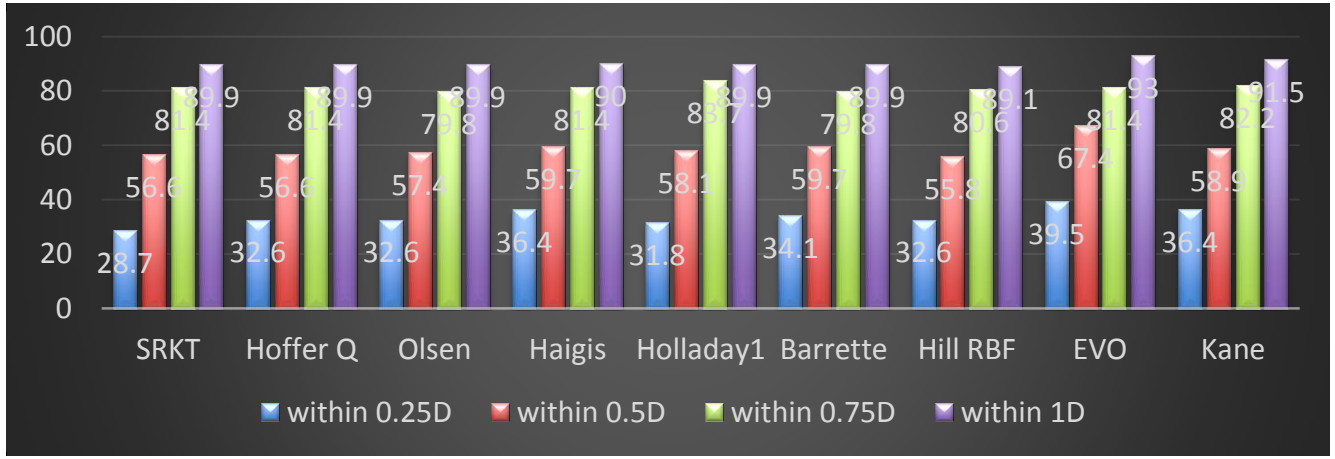
Results

After adjusting the mean to zero, EVO formula had

- least MPE of 0.46
- Least median error of 0.38

	Before adjusting to zero						After adjusting to zero					
	ME	SD	Range	MAE	SD	Median	ME	SD	Range	MAE	SD	Median
SRK T	-0.248	0.68	0.96 to -3.38	0.53	0.49	0.38	0.00	0.68	1.21 to -3.13	0.52	0.44	0.46
Hoffer Q	-0.519	0.692	0.88 to -3.58	0.63	0.59	0.5	0.00	0.69	1.4 to -3.06	0.52	0.45	0.46
Olsen	**-0.13**	0.693	1.41 to -3.27	0.52	0.47	0.42	0.00	0.69	1.54 to -3.14	0.52	0.46	0.4
Haigis	-0.152	0.708	1.94 to -3.44	0.52	0.51	0.37	0.00	0.71	2.1 to -3.29	0.52	0.49	0.44
Holladay 1	-0.317	0.671	0.97 to -3.45	0.53	0.52	0.39	0.00	0.67	1.28 to -3.14	0.50	0.44	0.42
Barrett	-0.255	0.687	1.11 to -3.56	0.52	0.52	0.39	0.00	0.69	1.37 to -3.3	0.52	0.46	0.42
Hill RBF	-0.256	0.701	1.07 to -3.42	0.54	0.52	0.4	0.00	0.70	1.33 to -3.16	0.52	0.46	0.42
EVO	-0.235	0.625	1.19 to-3.38	**0.47**	0.47	0.37	0.00	0.63	1.42 to -3.15	**0.46**	0.42	**0.38**
Kane	-0.228	0.714	2.53 to-3.36	0.53	0.53	**0.36**	0.00	0.71	2.76 to -3.13	0.51	0.49	0.39

Table showing mean error (ME) and mean absolute predicative error (MAE) with each formula before and after adjusting the mean to zero



The graph shows % of eyes within +/- 0.25D, +/-0.5D, +/- 0.75D and +/- 1D

EVO formula had maximum number of eyes within

- 0.25D (39.5%)
- 0.5D (67.4%) and
- 1 D (93%) group

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Discussion and Conclusion

Study	Short eye	No. of eyes	Formula used	Conclusion
Gokce[1]	<22 mm	86	Barrett Universal II, Haigis, Hill-RBF, Hoffer Q, Holladay 1, Holladay 2, Olsen	Mean APE adjusted to zero, no significant difference in Med AE
Connell[2]	<22 mm	156	Holladay 1, Holladay 2, Barrett Universal II, Haigis, Hoffer Q, SRK/T, T2	No statistically significant difference in MAE and Med AE
Melles[3]	< 22.5 mm	1270	Barrett Universal II, Haigis, Hoffer Q, Holladay 1, Holladay 2, Olsen, SRK T	Barrett had the lowest mean absolute prediction error for short eyes and the Hoffer had the greatest
Roberts[4]	< 22mm	21	Holladay II, SRK/T Hoffer, Hill RBF, Barrett Universal	The Hill- RBF provided the lowest mean numerical error
Current study	<22mm	129	Barrett Universal II, Haigis, Hoffer Q, Holladay 1, Olsen, SRK T, EVO, Hill RBF, Kane	No significant difference in mean APE when adjusted for zero

Literature review

Conclusion

The refractive outcome was more myopic than expected. The EVO formula gave least mean absolute prediction error after adjusting to zero though there was no statistically significant difference between the formulas.

1. Intraocular lens power calculations in short eyes using 7 formulas, Gokce et al, J Cataract Refract Surg 2017; 43:892–897 Q 2017
2. Comparison of the Kane formula with existing formulas for intraocular lens power selection. Connell BJ, Kane JX. BMJ Open Ophthalmology 2019;4:e000251. doi:10.1136/ bmjophth-2018-0002513.
3. Accuracy of Intraocular Lens Calculation Formulas. Melles et al. Ophthalmology 2018;125:169-178 ª 2017 by the American Academy of Ophthalmology
4. Comparison of Hill-radial basis function, Barrett Universal and current third generation formulas for the calculation of intraocular lens power during cataract surgery. Roberts et al, Clinical and Experimental Ophthalmology 2018; 46: 240–246 doi: 10.1111/ceo.13034