The Accuracy of Biometric Formulae for Intraocular Lens Power Calculation in a Teaching Hospital

Kevin S. Tang[1,2], Elaine M. Tran[1,2], Allison J. Chen[2,3], Michael L. Chen[4], David R. Rivera[1,2], Jorge J. Rivera[1,2], Paul B. Greenberg[1,2]

[1]Division of Ophthalmology, Alpert Medical School, Brown University, Providence RI, USA [2]Section of Ophthalmology, Providence VA Medical Center, Providence RI, USA
[3]Shiley Eye Institute and Department of Ophthalmology, University of California San Diego, San Diego CA, USA [4]Harvard University, Cambridge MA, USA

Introduction

- Cataract surgery is the most frequently performed ophthalmic procedure in the United States (US) and in the Veterans Health Administration (VHA)
- Continued improvements in optical biometry and intraocular lens (IOL) power calculation formulae have led to positive postoperative outcomes
- Relative accuracy of different formulae are affected by many factors, including axial length (AL)
- Refractive outcomes may be impacted in a teaching hospital by:
  - Resident surgeons of variable experience
  - Different personnel performing biometry and refractions
- This retrospective chart review investigated the most accurate biometric formula at a single teaching hospital and further compared formula accuracy in patients with short, medium, and long ALs

Methods

- Inclusion criteria:
  - Patients who received cataract surgery at the Providence Veterans Affairs Medical Center (PVAMC) using monofocal spherical SN60WF IOLs between November 2013 and May 2018
  - Only one eye was included from each patient
- Exclusion criteria:
  - Worse than 20/40 postoperative best corrected visual acuity (BCVA)
  - Posterior capsular rupture
  - Sulcus IOL
  - History of corneal disease
  - History of refractive surgery
  - AL or lens thickness (LT) not measurable by Lenstar optical biometer
  - No postoperative refraction within 3 weeks-4 months
- Predicted postoperative refractions extracted from software for the Barrett Universal II, Hill-Radical Basis Function (Hill-RBF), and Holladay 2 biometric formulae
- Calculated mean prediction error (ME), mean absolute prediction error (MAE), median absolute prediction error (MedAE), and percentage of eyes with prediction error of ±0.25 Diopters (D), ±0.5D, and ±1.00D for each formula
- Compared MAE among the three formulae using Friedman test
- Performed subgroup analyses for short (AL<22.0mm), medium (AL 22.0-25.0mm), and long eyes (AL>25.0mm)

Results

- Reviewed 1131 charts; 909 eyes met inclusion criteria
- Excluded patients:
  - 170 for lack of postoperative refraction within designated timeframe
  - 33 for <20/40 postoperative BCVA
  - 14 for complications
  - 5 for missing data
- Resident ophthalmologists were primary surgeons in 78.1% (710/909) of the cases
- Mean age was 74.5 ± 0.26 years
- Over the entire AL range:
  - Hill-RBF had the lowest MAE
  - No statistically significant difference in accuracy among the three formulae
- For AL subgroup analyses:
  - Hill-RBF had the lowest MAE for all three AL subgroups
  - No statistically significant difference in accuracy among the three formulae in all subgroups
  - All three formulae were least accurate in short eyes and most accurate in medium eyes
- For detailed tables of patient demographics and refractive outcomes, scan:

Table 1. Patient Demographics

Table 2. Refractive Outcomes

Conclusion

- The three formulae produced comparable outcomes for all ALs
  - Previous studies have demonstrated superiority of Barrett Universal II in most ALs
- Our MAEs for all formulae were comparable to values obtained in previous non-teaching hospital studies
- Short eyes posed the greatest challenge to predicting postoperative refraction error

References

1. Department of Veterans Affairs. Evaluation of Cataract Surgeris and Outcomes in the Veterans Health Administration Facilities. Veterans Health Administration; March 28, 2013 2013. 11-02487-158.
2. Gokce SE, Zeiter JH, Weikert MP, Koch DD, Hill W, Wang L. Intraocular lens power calculations in short eyes using 7 formulas. Journal of cataract and refractive surgery. 2017;43(7):892-897.
3. Melles RB, Holladay JT, Chang WJ. Accuracy of Intraocular Lens Calculation Formulas. Ophthalmology. 2017.
4. Hodge C, McAlinden C, Lawless M, Chan C, Sutton G, Martin A. Intraocular lens power calculation following laser refractive surgery. Eye and vision (London, England). 2015;2:7.
5. Kane JX, Van Heerden A, Atik A, Petsoglou C. Intraocular lens power formula accuracy: Comparison of 7 formulas. Journal of cataract and refractive surgery. 2016;42(10):1490-1500.
6. Kane JX, Van Heerden A, Atik A, Petsoglou C. Accuracy of 3 new methods for intraocular lens power selection. Journal of cataract and refractive surgery. 2017;43(3):333-339.

Poster presentation at the Alpert Medical School Summer Research Symposium (October 31, 2018)