RAY TRACING SOFTWARE
Advantage of ray tracing over existing IOL power calculation formulae is that it works for every eye
by Cheryl Guttman Krader in Fort Lauderdale

Improving the predictability of refractive outcomes has become an important focus in cataract surgery. Ray tracing software for IOL power calculation is a promising method for achieving this goal, according to studies presented at the annual meeting of the Association for Research in Vision and Ophthalmology.

A real ray tracing module (OphthARAY) found on a commercially available video-topometer (OphthTop, Hummel AG) was developed by Thomas Bende PhD, Jens Eininghammer PhD, and colleagues. The programme uses topography data acquired with the OphthaTop and separately obtained biometric information (IOLMaster, Carl Zeiss Meditec or Lenstar LS 900, Haag-Streit). A next-generation device (OphthASTAR), which is expected to be available late in 2012, will have integrated biometry so that all of the data necessary for IOL calculations will be captured with the push of a single button, noted Dr Bende, head of the Foundation for Basic Research in Ophthalmology, University of Tuebingen.

“The advantage of ray tracing over existing IOL power calculation formulae is that it works for every eye, regardless of axial length, astigmatism, or history of corneal surgery, and it can be applied in the future to eyes that undergo yet unknown methods of refractive surgery,” Dr Bende told EuroTimes.

“However, the output still depends on the quality of the input. As we believe accuracy can be optimised by integrating the software with the measurement device, we’ve developed a platform for obtaining all of the necessary measurements used in the ray tracing software,” he commented.

With the OphthARay programme, ray tracing is performed at each of the approximately 10,000 measured topographical points over a 9.0mm diameter.

“Our programme provides localised information about aberrations and thus can describe a truly customised lens that minimises total wavefront error. Currently, lens geometry specifications are divided so that surgeons can pick the best commercial lens in terms of spherocylindrical power and asphericity. Information on residual aberrations is provided as Zernike coefficients or ablation profiles for excimer laser or spectacle correction,” Dr Bende said.

Dr Bende and colleagues reported findings from a retrospective study comparing performance of the ray tracing software and the SRK/T formula for IOL power calculation in 50 virgin eyes that had been implanted with the ZCB00 single-piece aspheric acrylic posterior chamber IOL (Tecnis, AMO). Calculations with real ray tracing were done using the manufacturer’s geometric specification of the IOL and the preoperative topographic (C-Scan, Technomed) and biometric data (IOLMaster). The SRK/T formula calculations used the same preoperative data and the latest constants from the User Group for Laser Interference Biometry. Based on comparisons to the actual postoperative manifest refractive outcomes, use of the real ray tracing offered slightly better power prediction overall. Mean absolute error (MAE) of prediction in the overall cohort was 0.44 D for the ray tracing and 0.41 D for SRK/T. Analyses with eyes subdivided into three groups by axial length showed the benefit of ray tracing was driven by improved accuracy in long eyes (24-27 mm, n=13) where MAE was 0.26 D using ray tracing and 0.37 D using the SRK/T.

In another retrospective study, Kazuno Negishi MD, associate professor of ophthalmology, Keio University School of Medicine, Tokyo, Japan, and colleagues investigated the accuracy of IOL power calculations using OKULIX (OKULIX) ray tracing software in 23 eyes with a history of myopic LASIK. Prediction errors from calculations performed with the ray tracing software were compared with those obtained using the Haigis-L, Camellin-Calossi, and Shammas-PL formulae. The ray tracing calculations were performed using axial length measured with the IOLMaster and keratometry measured with the TMS2N (Tomey).

Mean arithmetic error was hyperopic using the ray tracing software (+0.64 D) and myopic using the three formulae (range -0.34 D to -0.86 D). MAE using the ray tracing software was 0.81 D and not significantly different compared with that obtained using any of the three formulae (range 0.63 to 1.16 D).

In predictability analyses, there were no statistically significant differences between ray tracing and the formula methods in proportion of eyes within 0.5 D of target refraction (39 per cent vs. 19 per cent to 50 per cent). However, the proportion of eyes within 1.0 D of target was higher using the ray tracing software (74 per cent) than the Camellin-Calossi formula (75 per cent) compared with Haigis-L (43 per cent). “OKULIX is very useful software to calculate IOL power in normal eyes, and this study shows it has value in eyes with a history of myopic LASIK, although surgeons should keep in mind a tendency for a hyperopic outcome,” said Dr Negishi.

“We believe the results of ray tracing might be even better using keratometry data based on anterior and posterior corneal curvatures rather than anterior curvature only, as is measured using the TMS2N. However, this requires validation.” Dr Negishi added that the relatively poor results obtained using the Haigis-L contrast with previous reports, and she postulated they may be partly due to the use of three non-optimised constants for a specific IOL in the study.

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percentages of eyes within ±0.5 D and ±1.0 D of intended correction

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<th>OKULIX</th>
<th>Haigis-L</th>
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