A-constant optimisation is worth it

Wolfgang Haigis

O PTIMISING the A-constant can help surgeons come closer to their intended target refractions, according to German researchers.

“We can identify the sources of error in obtaining target refraction, and minimise them with clinical success. These include systematic errors, errors in measurement, and optimisation of A-constants,” said Wolfgang Haigis PhD, of the Würzburg University Eye Clinic, Würzburg, Germany, at the annual Congress of German Ophthalmic Surgeons (D O C).

IOL constants are not derived from one standard procedure and therefore require optimisation to make sense in a given situation. In fact, even manufacturer constants are averages, at best, Dr Haigis explained.

The A-constant stems from the original SRK formula P=a0 -0.9K-2.5L, in which A is the constant used to determine the lens’ refractive power, P is the refractive power of the emmetropic lens, K is corneal refractive power, and L is the axis length. Dr Haigis noted, however, that there is not just one A-constant, but that different SRK formulas require different constants, such as SRK-T and SRK-II A-constants.

Furthermore, depending on the IOL power formula, there are more constants like the ‘surgeon factor sf’ of the Holladay 1, the Haigis constants a0, a1, a2, and others. To convert different IOI constants, linear translation formulas are used. However, as different measuring and working methods need to be accounted for, lens constants must be individualised for each individual surgeon, Dr Haigis believes.

Different ultrasound methods would require their own constants, he explained. For instance, using contact (associated with eye denting) or non-contact (no eye denting) ultrasound gives different A constant values when calculated with a given IOL strength. The non-contact ultrasound A-constant has to be stronger than the A-constant for contact-ultrasound, in the order of almost 1 D.

Additionally, there are different A-constants for different measuring techniques, such as contact-ultrasound and keratometry or IOI LMaster (PCI), according to relevant studies on the subject. It has also been shown that different surgical centres require different constants.

Dr Haigis explained that using different axial length ranges to determine A-constants would yield differences in constants of around -0.5 D if based on long eyes only, while A-constants from short eyes only would differ by 0.5 D, which are appreciable differences, he observed.

The ‘surgeon factor’ can only arise from the capsulorhexis and the incision, which are standardised and therefore no longer constitute a source of error, noted Rupert Menapace MD, one of the session moderators.

“Most surgeons perform a temporal cut of the same diameter and an overlapping capsulorhexis. This factor does not really have to be ‘individualised’ as all surgeons basically do the same thing,” he observed.

Making surgical outcome predictable through reproducing temporal cuts helps to avoid induced astigmatism and get closer to target refraction. The data that Dr Haigis analysed, however, showed that although surgical factors were identical - same method, patient type, incision technique in the steepest meridian - there were still differences in achieved refraction, Dr Haigis said.

Fundamentally, A-constants are not suitable to describe the optic behaviour of a lens over the entire dioptre strength range, he observed.

Although more sophisticated machinery incorporates optimisation programmes (such as the Alcon O cuscan and IO LMaster which calculate A-constants for the surgeon according to the values he inputs, these built-in optimisation programmes do not cover other factors (e.g., additional refractive procedures like LRI, position of the incision etc.) influencing target refraction predictions, he noted.

Dr Haigis explained that using the mathematical characteristics of the Gaussian error function reveals how much of the refractive prediction is correct. If the error is around 1.0 D, then 95.5 per cent are correctly predicted within ± 2 D, and an error of 0.5 D indicates a correct prediction of up to 99.9 per cent.

Errors in postoperative refraction may have various sources. Biometry itself, for instance, can measure different axis lengths depending on the machine used, all of which have individual internal signal processing and coupling modes. For instance, two different ultrasound biomeetry machines from the same company can give systematically different axis lengths and anterior chamber depths, Dr Haigis noted.

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Keratometry can yield diverse corneal refractive powers; through different machine calibrations and measuring methods. For instance, in comparing the O bscan with the IOL Master, Dr Haigis showed systematic differences in measurements.

The lens itself can also be a source of error, due to varying IOI refractive power definitions, reference temperatures, production scatter, and imprecise constant information. Without conforming to the ISO-norm (since 1999) that describes the permissible production tolerances, the error ensuing from the IOI alone and the use of different methods can be as high as the error from both biometry and keratometry together.

All Reuscher MD, who presided over the D O C congress’ cataract session, was concerned about the fact that the manufacturer values for A-constants were somewhat unreliable.

“Surgeons rely on these values and implement them to calculate target refraction for their cataract patients,” Dr Reuscher said.

The problem, Dr Haigis explained, lies in the fact that there are currently no international standards. To establish more clarity, he and colleagues at the University Eye Clinic Würzburg compiled A-constants of roughly 80 different lenses, with manufacturer constants, Haigis constants, Holladay constants, SRK constants, etc., which are available to eye doctors (www.augenklinik.uni-wuerzburg.de/ulib/c1.htm) for reference.

Eyes deviating from normal geometry can also yield imprecise measurements, for instance from pathologic changes like staphylomas, or corneal changes such as could occur after corneal surgery. In addition, needing to go beyond the range of validity of the IOI formula can be the cause of erroneous results.

Dr Haigis noted that systematic errors could be minimised through individualisation of lens constants. Measurement errors can be reduced through improvements in the measuring technique. Modern measuring techniques like PCI have a typical standard deviation for postoperative predictability of 0.5 D (depending on the axial length).