Commentary: Era of endless possibilities—Looking for a near-perfect intraocular lens calculating formula

The goal of an exact intraocular lens (IOL) power calculation is to get an IOL that perfectly suits the customized needs of a particular patient. The advancement of far superior equipment for accurately calculating the axial length (AL) of the human eye and the advent of near-perfect mathematical formulas to achieve the appropriate estimations have undoubtedly improved the accuracy with which the IOL power can be calculated by the ophthalmologists.[1-3]

In order to calculate the power of IOL following values need to be known:

1. AL of the eye
2. Corneal curvature (K), these two parameters are calculated before the implantation.
3. A—Constant is provided by the IOL manufacturer, and
4. Estimated lens position (ELP) postoperatively needs to be estimated mathematically before the implantation.

In the previously used IOL calculating formulas ELP was kept at a constant 4 mm level but in the modern IOL calculating formulas, the expected ELP is measured by relating it to AL and K values. ELP will be lesser in shorter and flatter cornea eyes. Whereas ELP will be of higher values in longer and steeper cornea eyes. Thus, newer genra IOL calculating formulas has helped in accurate prediction of the ELP and hence more and more patients achieving emmetropia.[3]

Since 1975 there has been modification and development in the IOL calculating formulas, in the first generation Sanders Retzlaf Kraff (SRK) and Binkhorst formulas came, in the second generation SRK-II formula were developed, SRK/T, Hoffer-Q, Holladay formulas were developed among the third generation, Holladay-2, Haigis and Olsen formulas were validated as the fourth generation and lastly in the fifth generation formulas Universal Barrett-II, EVO, Kane, Wong Koch, SToP, and Hill-RBF were recognized.[4]

These formulas are very well programmed into the upgraded and latest versions of IOL Master, Lenstar, and ultra-modern ultrasonographic instruments, thus, eliminating any need for older IOL calculating formulas based on regression technique. As we all know that cataract surgery is no more a lens extraction surgery but a very demanding refractive surgery and hence to achieve emmetropia, newer IOL calculating formulas are very much in trend.[4]

Aristo-demou *et al*. compared the Hoffer-Q, Holladay1, and SRK/T formulas in 8108 eyes across the entire AL and found

out that Hoffer-Q was best for ALs below 21 mm, the Holladay 1 was proven to be good for eyes with AL from 23.5 mm to 26 mm and in the longer eyes SRK/T was superior. Narvaez *et al*. compared Holladay 2, Hoffer-Q, Holladay 1, and SRK/T formulas and found no significant difference between them. Olsen *et al*. compared Haigis, Hoffer-Q, Holladay 1, and SRK/T and found out for ALs of more than 27 mm SRK/T were the best. Despite being very popular in the United States, Holladay 2 has not been proven to be more precise as compared to other newer generation formulas.[4]

Recently Kane *et al*. compared Barrett Universal II, EVO 2.0, Haigis, Hill-RBF 2.0, Holladay 1, Holladay 2, Hoffer Q, Kane, Olsen, and SRK/T IOL calculating formulas in high axial hyperopia (using the Alcon SA60AT IOL of 30 or greater diopter [D] power) and found out that Kane formula is more accurate in such eyes followed by Haigis and least accurate in Hoffer-Q.[5]

Rotating Scheimpflug cameras had their presence for the last 15 years. Their advent had really helped in measuring both the curvature of the cornea that is anterior and posterior. This characteristic feature helps them to be an excellent tool to precisely measure the IOL power in eyes with the previous history of myopic or hyperopic laser *in-situ* keratomileusis (LASIK), photorefractive keratectomy (PRK), or small incision lenticule extraction (SMILE). Oculus developed the first instrument Pentacam with a rotating Scheimpflug camera. Since then many authors had investigated its role to improve IOL power calculation in eyes with the previous history of corneal refractive surgery. Borasio *et al*. in the year 2006 came with the BESSt formula, that rectifies the K value (on a calculation by the Gaussian optics formula) so that it can be used with the popular new generation thin-lens formulas. Holladay *et al*. in the year 2009 explained the equivalent K-reading (EKR) that considers the posterior corneal curvature values into the calculation. Kim *et al*. in the same year modified the standard SRK/T formula by measuring the "true net K power" by a modified Gaussian optics formula to determine the IOL power precisely in such eyes. Schuster *et al*. in the recent time has used the posterior-to-anterior corneal radius ratio to adjust the SRK/T and Holladay 1 thin lens formulas by means of regression technique better known as the "Schuster/Schanzlin- Thomas-Purcell (SToP)" IOL calculator and describing it as the best one for post surface ablated eyes.[6]

But all said and done the target emmetropia is still around 60% only even after using the best of the instruments and IOL calculating formulas. This will keep on aspiring ophthalmologist and researcher to keep on adding newer variables in the IOL calculating formulas and developing a "near-perfect" technique-driven formula to achieve emmetropia in almost all cataract surgeries.

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