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Improved Refractive Outcomes With the Olsen IOL Calculation Formula

Because lens thickness matters: The LENSTAR optical biometer now features the Olsen IOL calculation formula for optimim prediction accuracy.

Over the years, with the introduction of new lens designs and technologies, cataract surgery has evolved into a refractive procedure that enhances the chance for patients to achieve spectacle independence postoperatively. In some recent published studies and series, in the range of 70% of patients undergoing cataract surgery achieve a manifest refraction within ±0.50 D of target.[1-3] Achieving the best refractive results demands excellent surgical skills, premium preoperative measurements, and use of the latest IOL power prediction methodologies such as the Olsen formula,[4] now included with the LENSTAR LS 900 (Haag-Streit; Figure 1).

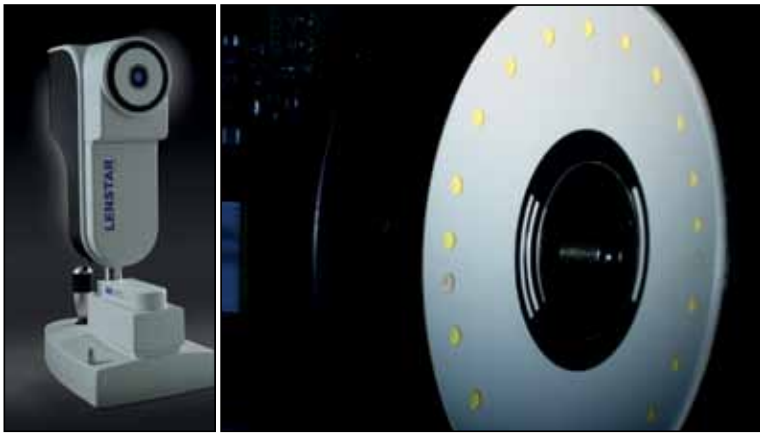

Figure 1. The LENSTAR LS 900 now features the Olsen formula for sophisticated IOL prediction in any type of eye.

TRADITIONAL IOL CALCULATION FORMULAS HAVE LIMITS

With traditional thin-lens IOL power calculation formulas, the optics of the cornea and the IOL are described as single refracting surfaces based on simple first-order approximations. This category of IOL calculation formulas estimates the effective lens position (ELP), a virtual IOL position that is back-calculated from the observed refraction after surgery based on the given thin-lens formula. As shown by Norrby,[5] inaccurate ELP estimation is a major source of error in IOL power calculation formulas.

Modern cataract surgery has surpassed the limits of traditional IOL calculation formulas. Aspheric and wavefront-based lens designs, incorporation of laser-assisted cataract surgery techniques, and the demands of patients who have previously undergone refractive surgery raise the need for more sophisticated IOL calculation methodology.

THE OLSEN FORMULA AND THE C-CONSTANT

The Olsen formula uses exact ray tracing and thick-lens considerations to account for the true physical dimensions of an eye's optical system. It uses the same technology employed by physicists to design telescopes and camera lenses. A key feature of the Olsen formula is accurate estimation of the IOL's physical position using a newly developed concept, the C-constant (Figure 2). The C-constant can be thought of as a ratio by which the empty capsular bag will encapsulate and fixate an IOL following in-the-bag implantation.[6] This approach predicts the IOL position as a function of preoperative anterior chamber depth and lens thickness, as shown in *The Olsen Formula; the C-Constant* on page 2.

Because this approach works independent of traditional factors such as eye length, keratometry (K), white-to-white dimension, IOL power, age, and gender,[6,7] it can work in any type of eye, including those that have previously undergone refractive surgery. Its only requirements are accurate measurements of anterior chamber depth and lens thickness, both of which are provided by the LENSTAR optical biometer.

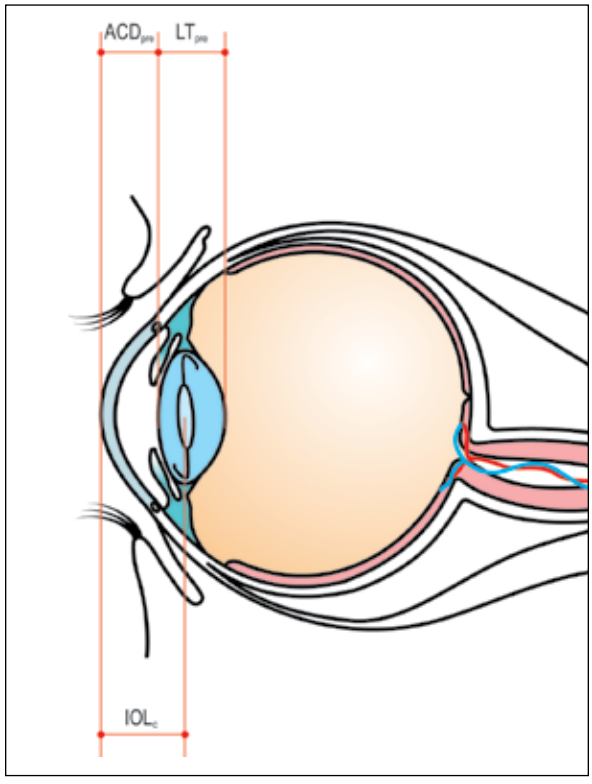

Figure 2. The C-Constant concept leads to accurate and unbiased prediction of the postoperative IOL position, based on measurement of the anatomical structures that are directly related to the lens position (anterior chamber depth and lens thickness).

CLINICAL EVIDENCE

Thomas Olsen, MD, PhD, has been continuously assessing the performance of his formula compared with second- and third-generation formulas including the SRK/T, Hoffer Q, Holladay 1, and Haigis. His dataset, now consisting of more than 2,000 cases, shows that, compared with the SRK/T in routine cases (excluding post-LASIK cases), the Olsen formula reduces the mean absolute error of IOL prediction by 15% and the number of residual refractive errors greater than 1.00 D by 50%.[4] Similar improvements are found over other formulas.

Warren E. Hill, MD, of Mesa, Arizona, and Edward J. Meier, MD, of Mason, Ohio, are currently assessing the performance of the Olsen formula in comparison with the Holladay 2 formula, a fourth-generation multivariable IOL calculation method, using lens thickness measurement as a parameter for improved IOL prediction accuracy. They are also evaluating the performance of the Olsen formula as compared with the SRK/T, Hoffer Q, Holladay 1, and Haigis formulas.

Preliminary data from more than 300 patients shows that a slightly higher number have reached refractive outcomes within ±0.50 D of intended correction with the Olsen formula than with the Holladay 2. More data are being collected to rate the significance of this improvement.

THE OLSEN FORMULA; THE C-CONSTANT

IOLc = center of the IOL
ACDpre = preoperative anterior chamber depth
LTpre = preoperative thickness of the crystalline lens
C = a constant related to the IOL type, determined as the mean value in a representative sample

CONCLUSION

The Olsen formula takes the science of IOL power calculation to the next level and eliminates the shortcomings of second-generation IOL calculation formulas. It incorporates the C-constant concept to predict IOL position after surgery. In addition to accurate K readings and axial length measurements, the keys to success with the Olsen formula are accurate preoperative measurements of the position and thickness of the crystalline lens, leading to an unbiased prediction of the IOL position—the very heart of any IOL calculation—and, consequently, of the IOL power prediction.

The Olsen formula, integrated into the LENSTAR, the only optical biometer featuring measurement of the crystalline lens, provides cataract surgeons with a reliable tool to accurately predict the IOL power in any eye. ■

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