Ask the Expert: Advanced Optical Biometry Primer

Warren E. Hill, MD, answers frequently asked questions about achieving better outcomes with the LENSTAR LS 900.

With one button push, the LENSTAR LS 900 (Haag-Streit, Bern, Switzerland; Figure 1) simultaneously calculates seven optical measurements including axial length, central corneal power, central corneal thickness, anterior chamber depth, lens thickness, horizontal corneal diameter, and pupil diameter. This biometer uses optical low-coherence reflectometry to measure along the visual axis and dual-zone autokeratometry to measure the central corneal power without touching the eye. The end result is a truly accurate estimation of IOL power.

Figure 1. The Lenstar LS 900 simultaneously calculates seven optical measurements.

MEASUREMENTS

Keratometry (K). The LENSTAR's dual-zone autokeratometry feature takes measurements using 32 reference points located in two concentric rings of 1.65 and 2.3 mm (Figure 2). Every time the operator hits the trigger button to produce a scan, 128 measurements are acquired. The keratometry measurement process as recommended with five sets of readings (scans) results in a total of 640 keratometry measurements.

Axial measurements. Anterior chamber depth, lens thickness, and the refractive axial length are simultaneously achieved using optical biometry (Figure 3). The measurement of axial length includes a display of the anterior cornea and posterior cornea, the anterior chamber depth, the lens thickness, as well as the location of the vitreoretinal interface and the retinal pigment epithelium.

The operator is quickly able to validate that the placement of the electronic calipers are in the correct position prior to accepting each measurement. The LENSTAR LS 900 can also be used to measure the postoperative pseudophakic lens thickness, which may be helpful in confirming the correct lens power following a refractive surprise.

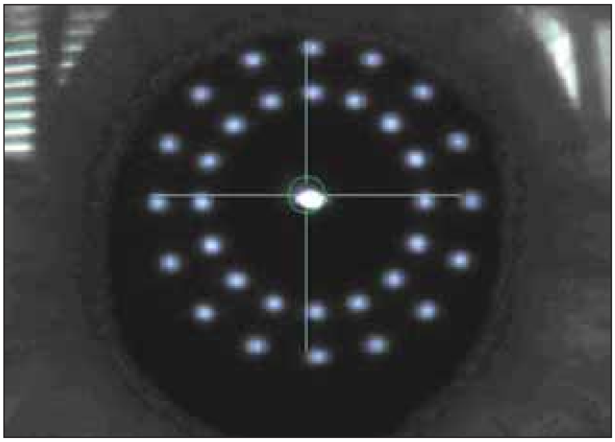

Figure 2. Dual-zone autokeratometry takes measurements using 32 reference points located in two concentric rings.

Other features. Measurement data from the LENSTAR LS 900 can be imported directly into standalone software such as the Holladay IOL consultant or Dr. Olsen's PhacoOptics program. The latter is the newest theoretical formula, which was created by Thomas Olsen, MD, of Denmark. (For more information, visit www.phacooptics.com.) This not only saves time but virtually eliminates the risk of data entry errors.

QUESTION AND ANSWER

Recently, in an Eyetube exclusive webinar, Warren E. Hill, MD, of Mesa, Arizona, shared his insights on the latest generation of the LENSTAR and concluded with a lively question-and-answer session. This advertorial recaps Dr. Hill's answers to some frequently asked questions. For a video of the complete webinar, please visit: http://eyetube.net/?v=sodog.

Q: What numbers from the LENSTAR LS 900 can be used with the ASCRS online post-keratorefractive calculator?

Dr. Hill: Measurements made with the LENSTAR LS 900 and the IOLMaster can be used interchangeably with the ASCRS online post-keratorefractive calculator.

Q: Does the LENSTAR LS 900 measure retinal thickness?

Dr. Hill: It does; however, a default value of 0.2 mm is currently displayed due to US Food and Drug Administration (FDA) regulatory issues. Future software versions will have the correct retinal thickness for each measurement.

Q: Do measurements with the LENSTAR LS 900 take longer than with the IOLMaster (Carl Zeiss Meditec, Jena, Germany)?

Dr. Hill: I take five measurements with the LENSTAR, each of which takes about 5 seconds. With the IOLMaster software version 5.4, I have to push the button 20 times for the axial length, three times for the keratometry, three times for the white-to-white, and once for the anterior chamber depth. That is a total of 27 button pushes as opposed to five with the LENSTAR.

It typically takes about 3 minutes or less for my staff to complete the entire measurement process on both eyes. Afterward, the operator can review the measurements and delete and take additional measurements if necessary. I think this feature is one of the strongest aspects of the LENSTAR LS 900. Rather than having to accept the measurements blindly, the operator can choose which measurements he or she likes based on validation critera and delete the others, taking additional measurements in their place.

Q: Are there any type of cataracts for which the LENSTAR LS 900 does not produce accurate readings?

Dr. Hill: It is not a matter of accuracy; it is a matter of getting a reading at all. In general, if you can get through the cataract, the measurement will be accurate. If the instrument cannot penetrate the cataract, such as a hand-movements or light-perception cataract, the LENSTAR LS 900 cannot measure the axial length.

Q: What is your opinion about using the LENSTAR LS 900 with silicone–oil-filled eyes?

Dr. Hill: The measurement process is no different for a phakic or aphakic eye with silicone oil than it is for a normal eye without silicone oil.

Q: Would you use LENSTAR LS 900 measurements with the Haigis-L formula for premyopic and hyperopic eyes?

Dr. Hill: The Haigis-L formula is similar to the Haigis formula, except for that it uses a linear algorithm to correct the central corneal power. The Haigis-L correction algorithm is based on the keratometry spherical equivalent, and because the difference in the spherical equivalent of LENSTAR LS 900 K values and the spherical equivalent of IOLMaster K values have been shown to be clinically insignificant, there should be no problem.

Q: What are the validation criteria for anterior chamber depth, lens thickness, and axial length?

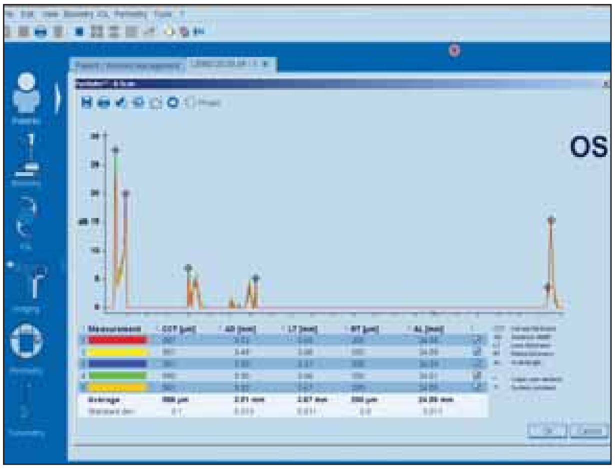

Figure 3. Anterior chamber depth, lens thickness, and the refractive axial length are simultaneously achieved using optical biometry.

Dr. Hill: The operator needs to look at the positions of the electronic calipers to confirm that they are in the correct location. If any of the calipers end up in the wrong place, they are simply repositioned. After the positions of the electronic calipers for each measurement have been confirmed, if any significant outliers are identified, they are removed. Additional measurements can be taken if needed. So, rather than just accepting a number, the operator is able to validate each component and make adjustments as needed. However, it is uncommon that the electronic calipers need to be adjusted.

Q: For patients with dry eye, is there a lubricant that will not affect the results?

Dr. Hill: With autokeratometry, we are essentially using the cornea as a reflective mirror. If a patient has chronic dry eye, the instillation of artificial tears immediately before the measurement is not going to fix the problem. Therefore, if the patient has a history of significant dry eye, we may give them artificial tears to use 1 to 2 days before we do the measurements. If a patient comes to see us from far away and needs the measurements taken the same day, I would ask the patient to apply drops for about 20 to 30 minutes before I took the measurements. This should help to hydrate the corneal surface.

Q: For surgeons using the LENSTAR LS 900 and the Holladay 2 formula, what else can we do to increase our accuracy?

Dr. Hill: The Holladay 2 is a wonderful formula for predicting effective lens position and a standard for many practices. Additionally, the newest theoretical formula is the PhacOptics program.

Q: In your practice, which gives a better mean absolute error, Haigis or the Holladay 2?

Dr. Hill: Each theoretical formula has its own calculation accuracy personality. The Holladay 2 is great at calculating the effective lens position. However, the Holladay 2 formula assumes that the lens geometry is the same across all power ranges, and within the last few years we have begun to understand that this may not be the case.

The Haigis formula has three strengths. First, it is a newer-generation formula that incorporates a measured anterior chamber depth as part of the effective lens position calculation. Second, it is immune to the artifact of very flat or very steep K values produced by prior keratorefractive surgery. And, third, it is able to take into account variations in lens geometry across the power range. That is why the Haigis formulas has three lens constants (a0, a1, and a2).

Q: Which K values should be used: Manual Ks, auto-Ks, or sim-Ks?

Dr. Hill: You should never expect K readings from multiple devices to correspond, because they often measure different areas and employ different algorithms. What you want is something that is predictable and consistent, and for us that is generally auto-K readings. What we like especially about the autokeratometry feature of the LENSTAR LS 900 is that we have access to what everything looks like, such as the reflected image on the cornea. In general, you always want to use that same instrument for all of your lens power measurements to limit variability.

Q: If our practice only uses SRK/T and Hoffer Q, what would be the advantage of having the LENSTAR LS 900?

Dr. Hill: This instrument is really about the future of lens power calculations, and therefore it is best used with more advanced formulas, like the Haigis, Holladay 2, or Olsen.

Q: What is the most frequent mistake when starting with the LENSTAR LS 900?

Dr. Hill: If there is one mistake, it would be accepting whatever any biometer tells you is correct, whether optical or ultrasound. As I like to say, you need to turn on your brain when you turn on the instrument. You have access to all of the information involved in the measurement process, but you must validate the details. If something comes up that is not quite right, you can go back and repeat the measurements. The key is that you can

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actually identify problems that may occur. What I like about Haag-Streit is they are treating us like grown-ups—they are giving us the ability to make our own decisions—and this is new to a lot of people, especially those who are just used to pressing a button and accepting any measurement.

Q: Do you feel that premium lenses demand optical biometry and advanced IOL formulas?

Dr. Hill: For the past 9 years, I have been optimizing outcomes databases for surgeons.* What we are finding is that, even after the removal of outliers, only about 78% to 82% are within ±0.50 D of intended correction. If you are implanting a premium lens and 18% of your patients are outside what may be considered an acceptable range, that is going to be a cause for at least some enhancements. In order to get the numbers up, you need to move to the next level of sophistication for IOL power calculation formulas.

Q: Have there been any data transfer problems with the Holladay 2 formula?

Dr. Hill: We have not experienced any problems. There is a bridge between the Holladay IOL Consultant Software and the LENSTAR EyeSuite software, so you just click a button and information moves in the direction of the Holladay 2 formula. Cases that were measured within a certain period will be automatically ported over.

Q: What is your experience with denser lenses?

Dr. Hill: Originally, we thought that the IOLMaster would be the champion, as it has a sophisticated digital signal-processing algorithm for dense cataracts. What we found, however, was that we can get through some cataracts with the LENSTAR LS 900 that we can't with the IOLMaster. In very dense cataracts, the IOLMaster may have an edge, but generally speaking, if you can get through it with the IOLMaster, you are going to have a pretty good chance of getting through it with the LENSTAR LS 900.

Q: How long after surgery do you wait to take your postoperative refraction value?

Dr. Hill: For us, it is 4 to 6 weeks, but the correct answer is whenever the refraction is stable.

Q: Is there an Aramberri double-K modified formula inside the LENSTAR LS 900 to calculate IOL power following keratorefractive surgery?

Dr. Hill: Not within the LENSTAR EyeSuite software. However, the most recent LENSTAR EyeSuite software (i.4000) does contain the Shammas No History Formula, which has about the same accuracy as Haigis-L. If the Holladay IOL Consultant software is resident on the LENSTAR computer, the Holladay 2 formula has the option of incorporating a double-K modification by selecting the option: Prior LASIK, RK, ALK, etc. However, for IOL power calculations following LASIK, PRK, or RK, I recommend the ASCRS online post-keratorefractive surgery calculator, because the many of the currently popular calculation methodologies are displayed side by side.

For example, let us say Mrs. Jones had LASIK for 6.00 D of myopia 5 or 6 years ago, and that you have her preoperative K values and refraction. You took her stable postoperative refraction at 6 months postoperatively, and you also have measurements from the IOLMaster or the LENSTAR. Experience has taught us that the historically based calculation methods in the left hand column are those least likely to be accurate. If you know the stable change in the manifest refraction, in the middle column, the Masket and modified Masket methods are the most likely to give the correct answer, with modified Masket having a slight advantage with the larger amounts of laser vision correction. If there is no prior refractive information available, Haigis-L and Shammas are very useful.

Use of a single formula lacks the broad overall insight that comes with doing these calculations with a tool such as the ASCRS calculator. ■

Warren E. Hill, MD, is in private practice at East Valley Ophthalmology in Mesa, Arizona. Dr. Hill states that he is a consultant to Haag-Streit. He may be reached at (480) 981-6130; hill@doctor-hill.com.

** Editor's Note: Dr. Hill's office offers a free lens constant optimization service to surgeons who submit 250 cases via a downloadable spreadsheet (available at http://www.doctor-hill.com/physicians/download.htm#two). The report shows the optimized Haigis, Holladay 1, Hoffer Q, and SRK/T lens constants.*