
# LENSTAR LS 900
## Improving outcomes

**Tradition and Innovation –** Since 1858, visionary thinking and a fascination with technology have guided us to develop innovative products of outstanding reliability: Anticipating trends to improve the quality of life.

HAAG-STREIT DIAGNOSTICS

# LENSTAR
# Outstanding optic measurement results

While the introduction of optical biometry revolutionized cataract surgery in the late 1990s, Haag-Streit is writing the latest chapter in biometry history with its Lenstar LS 900.

The Lenstar provides highly accurate laser optic measurements for every section of the eye – from the cornea to the retina – and is the first optical biometer on the market that can measure the thickness of the crystalline lens. With its integrated Olsen[1] formula, one of the latest generation multivariable IOL calculation methods, the Lenstar provides the user with the best possible IOL prediction.

Dual zone keratometry, with 32 measurement locations or topography measurement with the optional T-Cone, provides reliable and precise measurements for the K values, axis, and astigmatism that are essential to the sophisticated planning of toric lenses[2,3]. The Lenstar LS 900 offers the optimal planning platform for superior refractive outcomes in cataract surgery, both now and in the future.


## Measured lens thickness – improved refractive outcomes[4]

With its integrated Olsen[1] IOL calculation formula and the Lenstar's unique measurement of the lens thickness, accurate prediction of the IOL position is provided for every type of eye. To improve refractive outcomes, the Lenstar is the optimal choice.

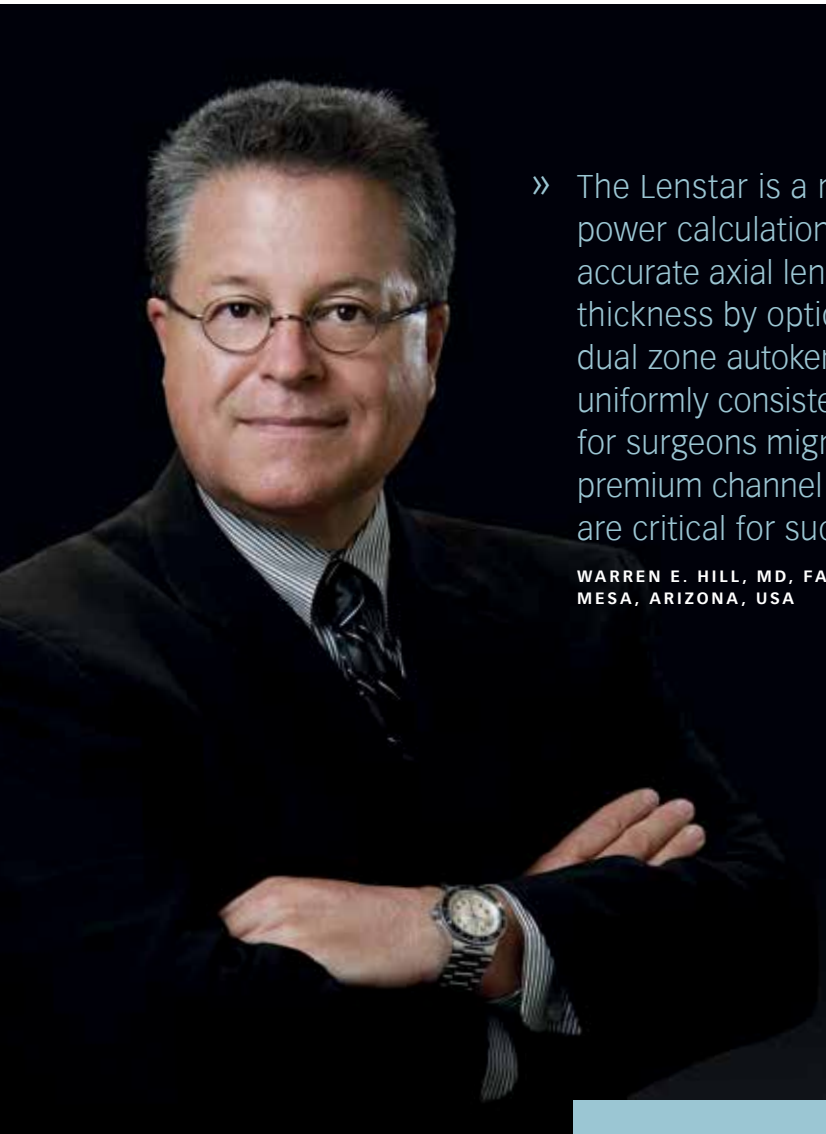
## Perfect K values – best toric results

The Lenstar features dual zone keratometry or T-Cone topography for precise astigmatism and axis measurement[2,3], as well as an on-board toric IOL calculator for sophisticated operation planning.

## For post-refractive cases – quick and reliable

Shammas and Masket IOL calculation methodologies can be used for post-refractive patients even without any clinical history available[5,6].

# LENSTAR
# an excellent choice for toric and premium channel IOL



» The Lenstar is a remarkably easy to use all-in-one IOL power calculation tool that delivers exceptionally accurate axial length, anterior chamber depth and lens thickness by optical biometry. At the same time, its dual zone autokeratometry feature is precise and uniformly consistent. The Lenstar is an excellent choice for surgeons migrating towards torics and other premium channel IOLs where highly accurate outcomes are critical for success. «

**WARREN E. HILL, MD, FACS**
**MESA, ARIZONA, USA**

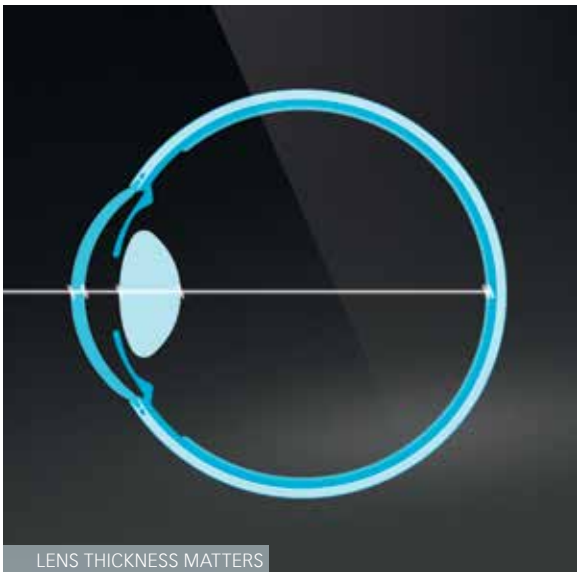
LENS THICKNESS MATTERS

## Improve your refractive outcomes with measured lens thickness.

Precise measurement of the entire eye – from cornea to retina – is key to achieving optimal IOL prediction accuracy in surgery.

The Lenstar is the first optical coherence biometer to provide the surgeon with all the measurements necessary to take full advantage of the latest IOL prediction methods, such as the Holladay 2 and Olsen[1] formulae, now integral to the Lenstar. Furthermore, it is ready to meet your requirements for future multi-variable formulae.

Lenstar measurements include central corneal thickness, anterior chamber depth, lens thickness, axial length, keratometry, white-to-white distance and pupil diameter.


LENS THICKNESS MATTERS

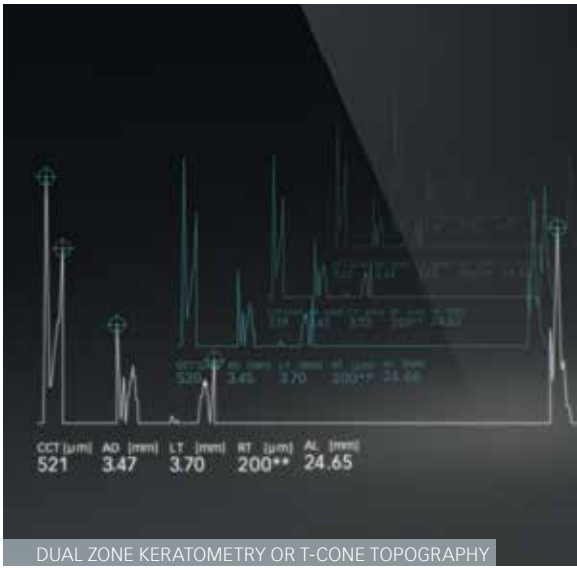
DUAL ZONE KERATOMETRY OR T-CONE TOPOGRAPHY

## Precise measurements and intuitive planning – best toric results.

Lenstar's unique dual zone keratometry provides measurement of the axis and astigmatism, equivalent to the "Gold Standard" manual keratometry[2,3] recommended for toric IOL by manufacturers.

The closely spaced 32 measurement point pattern improves precision, both delivering more data and minimizing the need for software data interpolation.

Optionally, the Lenstar can be equipped with the T-Cone topography add-on. That feature not only enables axis and astigmatism measurement but also offers a full topography map of the central 6 mm optical zone. In addition to topography, EyeSuite IOL also now features a toric IOL planning platform that is included with the T-Cone.



DUAL ZONE KERATOMETRY OR T-CONE TOPOGRAPHY

QUICK AND RELIABLE ALSO IN POST-REFRACTIVE CASES

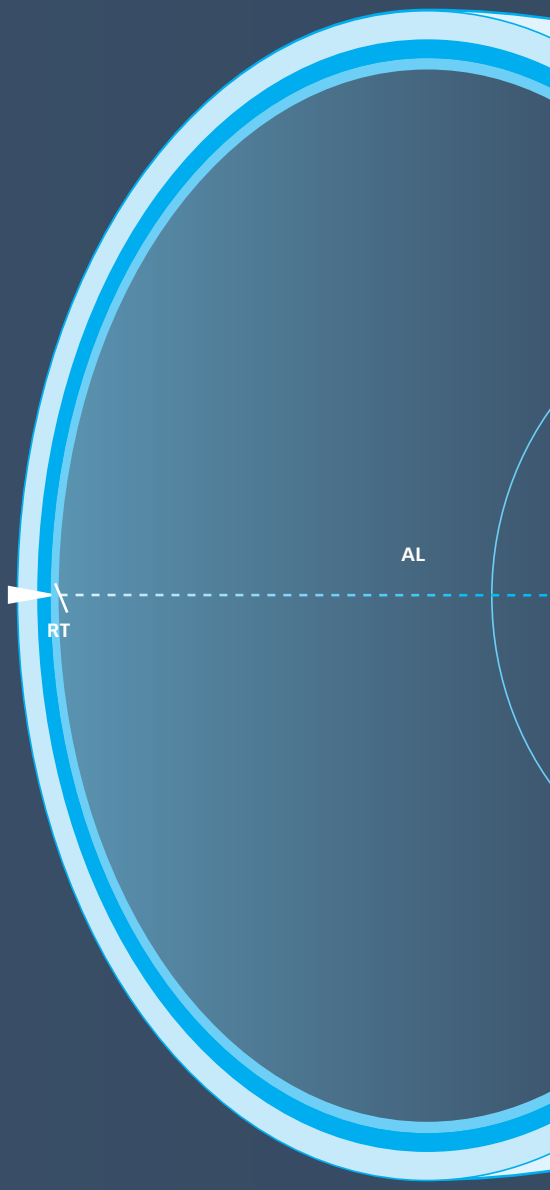
## Fast, precise and comprehensive for better refractive results.

The measurement process of the Lenstar is fast and optimized to ensure maximum patient comfort – users report five scans of both eyes in three minutes or less. Patient blinking and loss of fixation is detected and the Dens Cataract Measurement (DCM) Mode ensures state-of-the-art cataract penetration. Each of the measurements can be validated for efficacy and adjusted, if necessary, to ensure complete biometry accuracy.

In addition to the Olsen and standard IOL calculation formulae, EyeSuite IOL provides the user with a set of premium IOL calculation formulae for post-keratorefractive patients. The Shammas No-History and Masket formulae have both proven their efficacy in several peer-reviewed studies and may be regarded as best-in-class[5,6].


QUICK AND RELIABLE ALSO IN POST-REFRACTIVE CASES

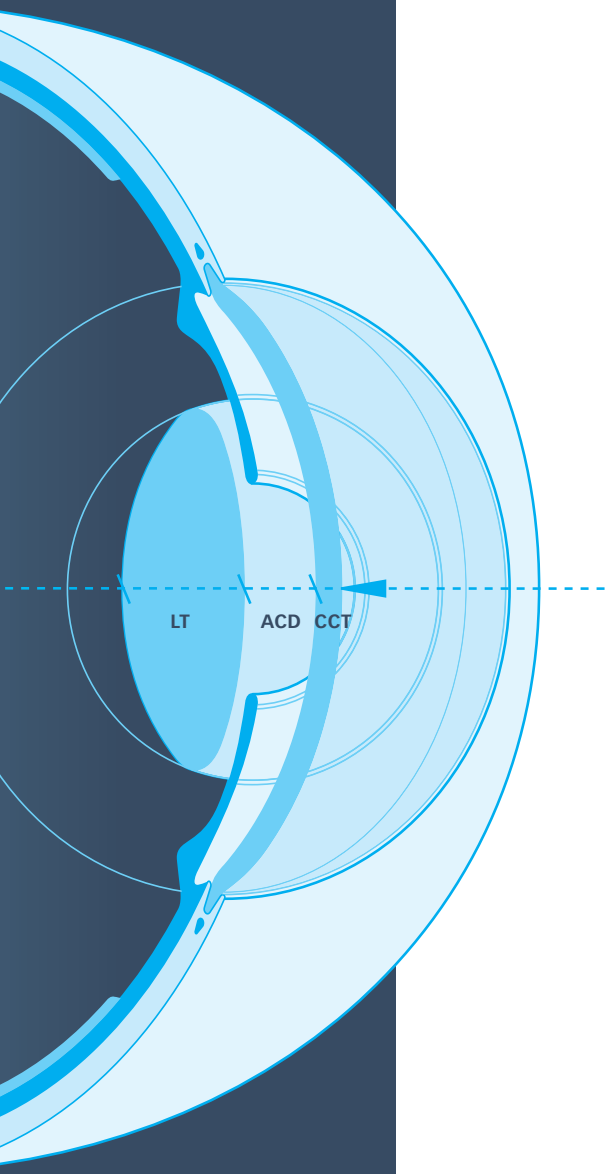
# Complete optical biometry
# **The all-in-one optical biometer and IOL planning platform**




Optical coherence biometry has revolutionized cataract surgery. Featuring OLCR technology, Lenstar is redefining optical coherence biometry.

Cutting edge, multivariable IOL calculation formulae, such as the Olsen or Holladay 2 formula for sophisticated IOL calculation, demand more than just the axial length and keratometry measurement. Lenstar provides all the key biometric parameters simultaneously.

In a single measurement scan and using optical low coherence reflectometry (OLCR), Lenstar captures axial dimensions of all of the human eye's optical structures. Additionally, Lenstar measures corneal curvature, white-to-white and more.




## Central Corneal Thickness[CCT]

As for every other Lenstar axial measurement, optical coherence biometry is used to measure CCT with stunning reproducibility of ±2 µm. CCT is a key parameter in glaucoma diagnosis, and is also used for laser refractive surgery and/or to differentiate prior myopic or hyperopic LASIK procedures when there is no patient history.

## Keratometry[K] / Topography[Topo]

Lenstar's unique dual zone keratometry, featuring 32 marker points, provides perfect spherical equivalent[7], magnitude of astigmatism and axis position[2,3], making it the biometer of choice for toric IOL's. With the optional T-Cone topography add-on, Lenstar provides full topography maps of the central 6 mm optical zone that are crucial to cataract planning.

## White-to-white[WTW]

Based on high-resolution color photography of the eye, every white-to-white measurement can be reviewed and adjusted by the user if necessary. As such, it is fully reliable for use with anterior chamber and sulcus-fixated phakic IOLs. It can also be used to determine advanced IOL calculation formulae.

## Pupillometry[PD]

Measurement of the pupil diameter in ambient light conditions can be used as an indicator for the patient's suitability for apodized premium IOLs, as well as for laser refractive procedures.

## Lens thickness[LT]

Accurate measurement of the lens thickness is key to optimal IOL prediction accuracy when using the latest IOL calculation formulae, Olsen or Holladay 2. Measuring the lens thickness with Lenstar significantly improves the IOL prediction accuracy of Holladay 2 and leads to a different IOL power selection in 30% of cases[4].

## Anterior chamber depth[ACD]

Like all axial dimensions captured by the Lenstar, ACD is measured by optical coherence biometry, providing more precision and reproducibility[7]. This allows ACD to be measured on phakic as well as on pseudophakic eyes[8]. Additionally, Lenstar is able to display the anatomical anterior chamber depth (endothelium to anterior lens surface).

## Axial length[AL]

OLCR technology, using a superluminescent diode as the laser source, enables measurement of the axial length of the patient's eye, precisely on the patient's visual axis and in the presence of dense media.

The user can review and move all of the measuring gate positions on the A-scan if necessary.

The Lenstar A-scan appears very similar to an immersion ultrasound scan, for easy user interpretation. The advanced digital signal processing used with the Dens Cataract Measurement (DCM) mode provides cutting-edge performance with respect to penetration rates.

## Special eye conditions

All of the described measurements are available for use on the normal eye, as well as for aphakic, pseudoaphakic and silicone oil-filled eyes. In case of error, users may even change the selected eye condition after completion of the measurement procedure.

# Intuitive and efficient
# **The ultimate platform for toric IOL planning**

Lenstar features a unique dual zone keratometer with a total of 32 marker points on two concentric rings of 1.65 and 2.3 mm in diameter for improved refractive outcomes with toric lenses[2,3]. It has now been complemented with an optional T-Cone topography add-on and an optional toric surgery planning platform. The T-Cone enables the Lenstar to provide true Placido topography of the central 6 mm optical zone. The toric surgery planning platform allows planning and optimization of the surgical procedure based on high-resolution and true color eye images taken with the Lenstar, either in combination with the T-Cone, or simply based on the dual zone keratometry of the standard unit. The toric planner shows the implantation axis, the incision location and user-defined guiding meridians in the real patient image.

Incision optimization tools allow for precise placement of the incision to minimize the residual astigmatism based on the surgically induced astigmatism. Alternatively, the incision location is fixed and the optimal toric IOL – based on available manufacturer data – is provided.

Planning of the operation on real eye images allows the user to define recognizable, additional guiding lines to anatomical landmarks in the intraoperative view. They either serve as a base line point for the intraoperative orientation or as a fallback strategy if external marking is not successful. The planning sketch can easily be printed and hung near the microscope.

T-CONE

## Topography for torics – match the axis

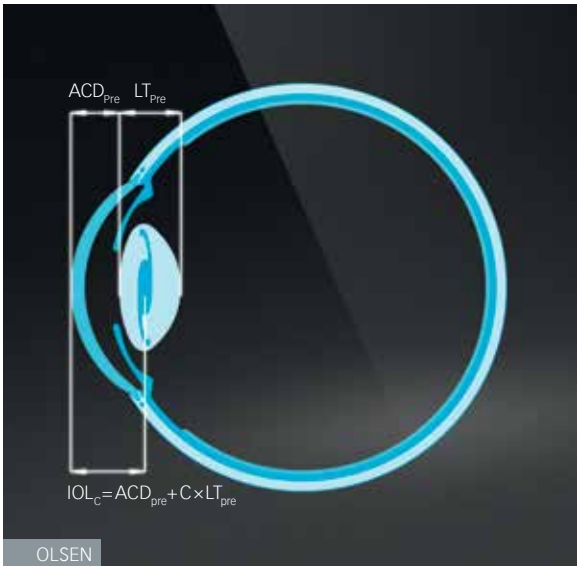
With the T-Cone optional topography add-on, the axis and astigmatism measurement of Lenstar is extended with true 11-ring Placido topography. This additional data improves the efficacy and safety of toric IOL surgery, eliminating the risk of irregularities and allowing the user to double check the axis location on the topography maps. The T-Cone is combined with the toric surgery planner for optimal planning of the intervention.


T-CONE

OLSEN

## Get the IOL position right – every time

Estimating the postoperative IOL position is the key aim, but also the proverbial Achilles heel, of any IOL calculation formula. With its unique concept of the C-Constant, the Olsen formula calculates the postoperative lens position as a fraction of the crystalline lens thickness and the ACD. This approach allows accurate calculation of the lens position independent of the corneal status of the eye. The lens position is then used to calculate the IOL power based on ray tracing, the same technology that physicists use to design telescopes and camera lenses.

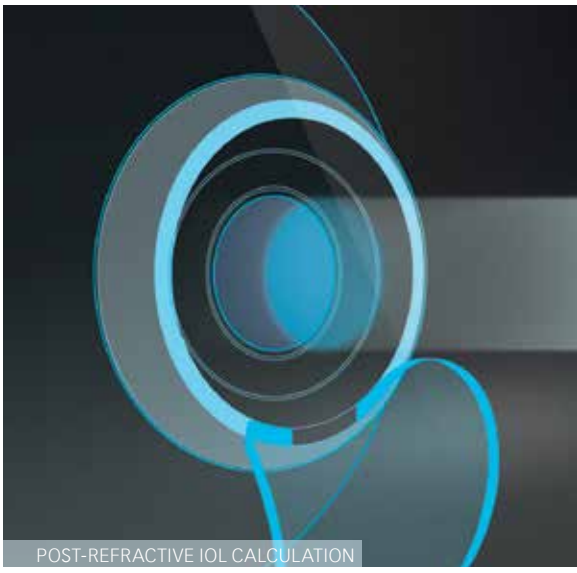


OLSEN

POST-REFRACTIVE IOL CALCULATION

## Shammas No-History and Masket – for premium results

The Lenstar EyeSuite software provides the user with a comprehensive set of cutting-edge IOL calculation formulae for normal eyes. IOL Power calculation in patients with prior LASIK or PRK, presenting with no history, is easily achieved with the on-board Shammas No-History method.[5,6] If the change in refraction is known, then the Masket and modified Masket formulae[5] may also be used.


POST-REFRACTIVE IOL CALCULATION

# Connectivity is key
# **Open data and intuitive user interfaces for optimal workflow**

The EyeSuite software is designed for optimal patient flow in busy practices. Paired with Lenstar's one scan – get all measurements technology biometry acquisition is fast and easy; users report completion of five scans on both eyes in three minutes or less.

Sophisticated capture and analysis algorithms – as well as the possibility to review the raw data of every parameter in detail to ensure correct measurement – result in full transparency and confidence that the biometry is accurate and precise.

With EyeSuite software, Lenstar is fully networkable, and allows full real-time access to all data in a practice. Surgeons can check their biometry results or recalculate an IOL even in the OR.

Further, the EyeSuite Script Language or standardized interfaces, such as GDT or DICOM, connect easily to almost any electronic medical record system. And EyeSuite's open data interface, combined with Lenstar's separate computer, allows auto-population of the data fields in the latest fourth generation calculation formulae – such as Holladay 2, the Holladay toric calculator (Holladay IOL Consultant) and Olsen (PhacoOptics). These not only save valuable staff time, they also eliminate the risk of transcription errors.

# Technical specifications
# **Lenstar LS 900®**

## Measured variables and modes

### Corneal thickness CT

| | |
|---|---|
| Measurement range | 300 – 800 µm |
| Display resolution | 1 µm |
| In-vivo repeatability | (1.σ-) ±2 µm |

### Anterior chamber depth ACD

| | |
|---|---|
| Measurement range | 1.5 – 5.5 mm |
| Display resolution | 0.01 mm |
| In-vivo repeatability | (1.σ-) ±40 µm |

### Lens thickness LT

| | |
|---|---|
| Measurement range | 0.5 – 6.5 mm |
| Display resolution | 0.01 mm |
| In-vivo repeatability | (1.σ-) ±80 µm |

### Axial length AL

| | |
|---|---|
| Measurement range | 14 – 32 mm |
| Display resolution | 0.01 mm |
| In-vivo repeatability | (1.σ-) ±35 µm |

### White-to-white distance WTW

| | |
|---|---|
| Measurement range | 7 – 16 mm |
| Display resolution | 0.01 mm |
| In-vivo repeatability | (1.σ-) ±0.04 mm |

### Keratometry K

| | |
|---|---|
| Measurement range for radius | 5 – 10.5 mm |
| Display resolution | 0.01 mm |
| In-vivo repeatability | (1.σ-) ±30 µm |
| Measurement range for axis angle | 0 – 180° |
| Display resolution | 1° |
| In-vivo repeatability | (1.σ-) ±11° |

### Pupillometry PD

| | |
|---|---|
| Measurement range | 2 – 13 mm |
| Display resolution | 0.01 mm |

### Retinal thickness

| | |
|---|---|
| Manually assessed | |
| Display resolution | 1 µm |

### Measurement modes

'Normal' eye
Aphakic eye
Pseudophakic eye
Silicone-filled eye
Combination of the above

### Laser safety

Class 1 laser product

### Onboard IOL calculation formulae

Haigis, HofferQ, Holladay 1, Olsen, SRK/T, SRK II, Masket, Modified Masket, Shammas No-History

### IOL calculation data interfaces

- Holladay IOL Consultant Professional Edition (Holladay 2 formula and Holladay toric calculator)[9]
- PhacoOptics (Olsen formula)[10]
- Okulix (Ray-Tracing by Prof. Preussner)[11]

### Electronic medical record system interfaces

- DICOM (SCU)
- EyeSuite Script Language
- GDT
- EyeSuite command line interface

The above-mentioned measurement ranges are based on the standard settings of the device for automatic measurement and analysis.

## LENSTAR LS 900® Optical Biometer Indications for Use

The Lenstar LS 900 Biometer is a non-invasive, non-contact OLCR (Optical Low Coherence Reflectometry) device. It is used for obtaining ocular measurements and performing calculations to assist in the determination of the appropriate power and type of IOL (intraocular lens) for implantation after removal of the natural crystalline lens following cataract removal.

## The LENSTAR LS 900® measures:

- Axial eye length
- Corneal thickness
- Anterior chamber depth
- Aqueous depth
- Lens thickness
- Radii of curvature of flat and steep meridian
- Axis of the flat meridian
- White-to-white distance
- Pupil diameter

## Sources

**1** Olsen T. Improving IOL power Calculation by measurement of the lens thickness with the Lenstar LS900 presented at the ESCRS in Paris 2010. **2** Hill W, Osher R, Cooke D, Solomon K, Sandoval H, Salas-Cervantes R, Potvin R. Simulation of toric intraocular lens results: manual keratometry versus dual zone automated keratometry from an integrated biometer. J Cataract Refract Surg. 2011 Dec; 37(12): 2181-7. **3** Gundersen KG, Potvin R. Prospective study of toric IOL outcomes based on the Lenstar LS 900® dual zone automated keratometer. BMC Ophthalmol. 2012 Jul 16; 12:21. **4** Lam S. Comparison of Age-derived Lens Thickness to Optically Measured Lens Thickness in IOL power Calculation: A Clinical Study. J Refract Surg. 2012 Feb; 28(2): 154-5. **5** Wang L, Hill WE, Koch DD. Evaluation of intraocular lens power prediction methods using the American Society of Cataract and Refractive Surgeons Post-keratorefractive Intraocular Lens power Calculator. J Cataract Refract Surg. 2010 Sep; 36(9): 1466-73. **6** McCarthy M, Gavanski GM, Paton KE, Holland SP. Intraocular lens power calculations after myopic laser refractive surgery: a comparison of methods in 173 eyes. Ophthalmology. 2011 May; 118(5): 940-4. **7** Buckhurst PJ, Wolffsohn JS, Shah S, Naroo SA, Davies LN, Berrow EJ. A new optical low coherence reflectometry device for ocular biometry in cataract patients. Br J Ophthalmol. 2009 Jul; 93(7): 949-53. **8** Olsen T. Use of fellow eye data in the calculation of intraocular lens power for the second eye. Ophthalmology. 2011 Sep; 118(9): 1710-5. **9** http://www.hicsoap.com/ accessed August 27, 2013 **10** http://www.phacooptics.com/ accessed August 27, 2013 **11** http://okulix.de/ accessed August 27, 2013

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**HAAG-STREIT AG**
Gartenstadtstrasse 10
3098 Koeniz
Switzerland
Phone +41 31 978 01 11
Fax +41 31 978 02 82
info@haag-streit.com
www.haag-streit.com

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