Properties of Intraocular lens at body temperature

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Introduction

An intraocular lens (IOL) is an artificial plastic lens, which is surgically inserted into the eye during a cataract surgery. It replaces the cloudy natural crystalline lens, affected by the cataract. The surgery results in an immediate and dramatic improvement in patient's vision, and therefore has the highest self-reported patient satisfaction rates of all medical procedures. In addition, if the IOL is properly selected to correct a patient's long-standing refractive error, the patient will not require eyeglasses in most viewing conditions.

In selecting the proper IOL, surgeon must be aware that the refractive power of IOL depends on the temperature of the surrounding medium. The vast majority of modern IOL materials are soft and flexible, often described as gummy bear-like. Both physical and optical properties of such materials are very sensitive to the temperature. Normally, the thermal response of the IOL material is carefully quantified. Using this data, the room temperature optical measurements of the IOL are then converted into the optical properties within the patient's eye.

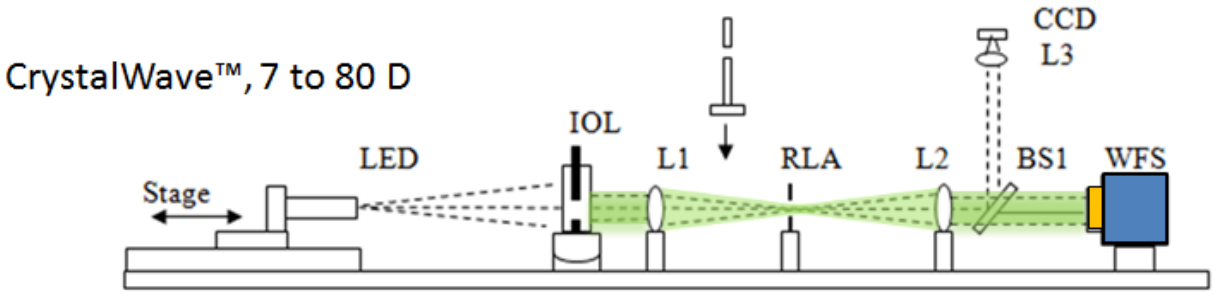
Lumetrics has developed a system for measuring the refractive power of the IOL at conditions similar to those encountered by IOL in the eye. These direct measurements eliminate the need for thermal response conversions, which can be inaccurate.

Method

Lumetrics has developed a temperature-controlled, low thermal mass, insulated optical cuvette for use in its flagship IOL evaluation system, the CrystalWave™. The cuvette is used to maintain the IOL within a saline solution at 35°C. This is an accepted standard for the temperature within human eye, which can be cooler than the typical human core temperature of 36.6°C.

Low thermal mass is needed to reach the temperature setpoint in relatively short amount of time. However, at the same time the temperature change should be sufficiently slow for the IOL material to adjust. The cuvette allows for simple temperature control to ensure proper

environment for different lenses.



The index of refraction of the aqueous humour is set to 1.336 by ISO 11979-2. In handling the saline solution, it is important to understand that salinity concentration affects the refractive index of the solution. As water evaporates from the solution, the concentration of the salts increases and the index of refraction increases as a result. Therefore, one must avoid solution evaporation for accurate measurements of the IOL. Lumetrics has implemented evaporation control via a combination of structural and procedural changes. The cuvette has a limited surface area of saline exposed to air.

During the measurement, the IOL sample must be stable and not under any stress. Stability is typically achieved by placing the sample into a tight holding fixture. At the same time, any force on the sample induces stresses that affect measurements. In the CrystalWave holding stress is actively monitored by evaluating lens aberrations, such as astigmatism and coma, in real-time.

3) Results

Table 1: 35 °C Intraocular lens test results				
Test radius 1.25 (mm) **Lens Test ID**	**Average Power SEQ (Diopters)**	**Std**	**Average Spherical Aberration (µm)**	**Std**
1	18.94	0.09	-0.011	0.001
2	18.96	0.03	-0.009	0.001
3	18.99	0.11	-0.005	0.001
4	19.02	0.02	-0.010	0.000
5	19.08	0.04	-0.016	0.005
6	21.26	0.05	-0.003	0.000
7	21.13	0.02	0.000	0.001
8	21.10	0.05	0.001	0.000
9	20.99	0.04	0.005	0.001
10	21.23	0.03	-0.001	0.001
11	24.18	0.07	-0.017	0.001
12	24.56	0.04	-0.016	0.000
13	24.36	0.04	0.000	0.001
14	24.28	0.02	-0.020	0.001
15	24.05	0.04	-0.020	0.001

Lumetrics recently provided IOL measurement services for a customer. Table 1 lists the IOLs test results for in-eye conditions.

4) Conclusion

Lumetrics offers services for IOL measurement in the conditions replicating in-eye use for contact lens and IOL performance certification (power, spherical aberration, etc). A commercial turn-key system is also available for deployment at customer's location.