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Streamlining the Steps of Cataract Surgery

From clinical intake to surgical outcomes, clinicians describe their experiences with the ZEISS Cataract Workflow.

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At the May 2023 ASCRS annual meeting in San Diego, ZEISS convened a panel of expert cataract and glaucoma surgeons to discuss how the ZEISS Cataract Workflow helps optimize their surgical planning and performance. Herein, they discuss their clinical experiences with the IOLMaster® 700, the VERACITY® Surgical Planning Software, the CALLISTO® eye system, the QUATERA® 700 phaco system with the ARTEVO® 800 digital microscope, and the CT LUCIA® aspheric monofocal IOLs.

INTEGRATED CATARACT WORKFLOW IN MY OR | BY SRI GANESH, MD, MBBS, MS, DNB, FRCS

I founded the chain of Nethradhama Superspecialty Eye Hospitals in Bangalore, India, where my team and I perform about 10,000 cataract surgeries each year. We use the ZEISS Integrated Cataract Workflow in four of our operating rooms (Figure 1), which improves efficiency in and out of the OR. Patient workup and surgery with the ZEISS Cataract Workflow are based on the following key concepts: assess, educate, plan, treat, and check. Figure 2 illustrates the steps in my process.

I begin each patient's workup by taking ocular measurements with the IOLMaster 700 swept-source OCT (ZEISS), which is extremely precise, with an SS-OCT for measuring axial length and telecentric keratometry. With the touch of a button, I export the data from the IOLMaster 700 to ZEISS' FORUM ophthalmology software (in the United States, it would be the ZEISS VERACITY Surgery Planner software). This connects to the ZEISS EQ Workplace software, which I use to plan the surgery, including selecting the IOL and the IOL formula I will use.

Next, I transfer these data to the CALLISTO eye (ZEISS) in the OR; it will use the data to create overlays in the eyepiece. The CALLISTO eye's screen shows me the day's list of surgeries, from which I select the data for the next patient to be treated, including the IOL I've selected and the axis of alignment if it's a toric IOL. The CALLISTO offers a markerless alignment system for toric IOLs, Z Align, that projects digital axis markers onto the surgical field for precise placement of the IOL. The system also provides guidance for creating capsulorhexes and LRIs.

THE QUATERA 700 PHACO MACHINE

The new ZEISS phaco device, the QUATERA 700, connects to its ARTEVO 800 digital microscope, which has an integrated 3D

Figure 1. Dr. Ganesh's surgical cockpit contains the QUATERA 700, the CALLISTO, and the ARTEVO 800 (ZEISS).

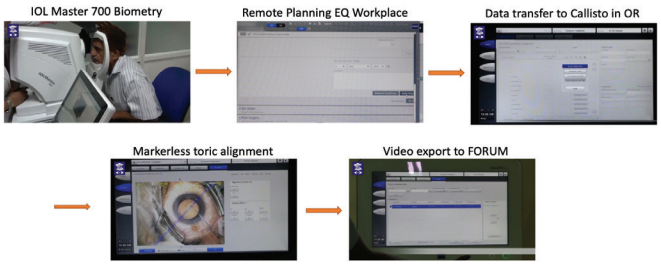

Figure 2. Dr. Ganesh's use of the ZEISS integrated Cataract Workflow, from biometry through the completion of surgery.

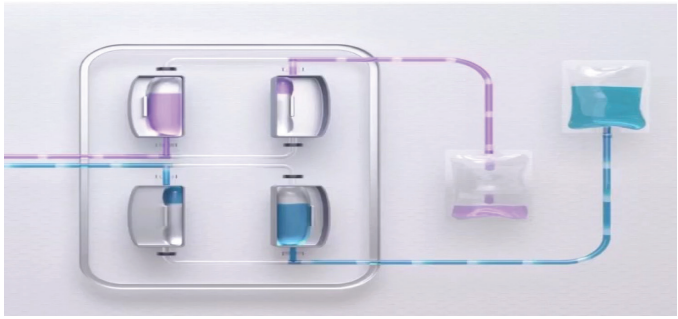

Figure 3. The mechanism of the QUATERA pump. The QUATERA 700 is designed with four pumps, two for irrigation (blue) and two for aspiration (purple).

heads-up display. The details of each case are displayed on the screen of the QUATERA 700, which is very convenient, and my OR technician can watch the procedure on the phaco screen to anticipate the next step.

I am very familiar with the QUATERA 700 phaco system, because I was involved in developing it. One of its main features is its QUATTRO pump, a patented system of four pumps—two for irrigation and two for aspiration (Figure 3). Unlike peristaltic or venturi phaco systems, these 4 syringe-like chambers continuously exchange infusion and aspiration in a synchronized and reciprocal manner. Meanwhile, an irrigation sensor measures the fluid volume and detects any incisional leaks, compensating accordingly to sustain the preset IOP. This system, the QUATTRO pump plus the irrigation sensor, ensures an extremely stable chamber. Surgeons may use the QUATERA 700 phaco system in either vacuum mode or flow mode, to mimic a venturi pump or a peristaltic pump, although it is neither. This capability enhances the machine's safety and efficiency without any compromise.

To test the performance of the QUATERA 700, I conducted a single-surgeon study (unpublished data) to compare its chamber stability and other parameters against two popular phaco machines. I randomized 90 eyes with dense cataracts and 90 eyes with soft cataracts to receive surgery with one of the three phaco systems. In the eyes with grade 3+ cataracts treated with the QUATERA 700, I noticed the pupils contracting and expanding, an indication of chamber stability. Even with the vacuum set at 700 mmHg (the highest setting), the QUATERA 700 provided excellent tissue grab and followability.

My patients are brought into the OR on trolleys and can be oriented in a way that I don't have to change my position or the screens. With this setup and the Cataract Workflow in my OR cockpit, my surgeries are comfortable and efficient. ■

The ZEISS Cataract Workflow Brings Calm and Efficiency to the OR | I. PAUL SINGH, MD

I want to enter the OR relaxed and make the surgical experience as calm and efficient as possible for myself, my team, and my patients. This means taking all my measurements ahead of time, so I can just perform the surgery and leave. To achieve that, I use the ZEISS Cataract Workflow, because it streamlines my preoperative planning and intraoperative calculations for smooth and easy surgery.

THE IOLMASTER 700

How do we surgeons obtain reliable preoperative measurements and take them to the OR? It all starts with good data. I feel that the IOLMaster 700 is a key component of surgery. Not only does it obtain preoperative measurements efficiently, but I think it is user-friendly for us and our technicians. The device employs something called *telecentric keratometry*, which ensures accurate measurements of the eye, no matter the pupil's size. The IOLMaster 700 also scans the macula to ensure alignment, and its swept-source OCT can help us detect ocular pathology, such as vitreomacular traction, epiretinal membranes, and edema.

PREOPERATIVE PLANNING

After we've taken preoperative calculations, we want to choose an IOL for a patient. The ZEISS VERACITY Surgery Planner is software that synthesizes all the diagnostic data—from the IOLMaster, topography, and any other imaging device—and allows us to run calculations with different IOL powers. The VERACITY software can be used on any device, which allows you to plan surgeries from anywhere.

IN THE SURGICAL COCKPIT

The data from VERACITY then go straight into the CALLISTO eye software in the OR, which transfers the calculations to the ZEISS ARTEVO 800 digital microscope with 3D heads-up display. With the press of a button, the CALLISTO eye automatically takes my preoperative IOLMaster scans and references them with a live scope scan. Thus, I can reference all the blood vessels and mark where 180° is on the eye. Because these measurements are centered on the visual axis (a plus sign indicates the center), I can create the capsulotomy on the visual axis as well. This assistance with centration is especially useful in eyes with small

pupils, iris defects, or other irregularities. The CALLISTO eye can maintain these markings even if the patient's eye moves during surgery. The software also provides alignment marks for implanting toric IOLs and creating limbal relaxing incisions.

PHACOEMULSIFICATION & FLUIDICS

For cataract surgery, I use the QUATERA 700 phaco machine. My technicians love its phaco screen, which shows them the live video of the surgery, so they can see what I am doing in real time. During surgery, the CALLISTO eye's overlay on the ARTEVO 800's 3D headset shows me the strength of my vacuum and how much fluid I'm using. The QUATERA 700 phaco machine has great vacuum—I'm a huge fan of vacuum-based systems, because fragments come to the tip easily. Although you do not need occlusion to build vacuum, the QUATERA 700 provides independent control of fluidics, which creates very stable chambers. I can leave my phaco tip in the middle of the eye and let those nuclear pieces come to me without using a second instrument. It's not enough to have fast vacuum during surgery; we want it to be safe at the same time.

SUMMARY

What I like about the ZEISS Cataract Workflow is that it simplifies the steps of preoperative assessment and surgery, and then it allows me to have all the pertinent data at my fingertips in the OR for surgical efficiency and precision. When I think about how accurate we want to be, with IOLs being positioned to a specific degree, doing manual calculations no longer makes sense to me. I want my surgeries to be as accurate as possible. Finally, the ZEISS platforms work beautifully. I have a large screen with amazing depth perception, my staff appreciate the surgical view so that they can proactively anticipate what I need next, and these features keep us on time. ■

The CT LUCIA 621P: Bringing ZEISS Optic Into the Eye | BY SETH PANTANELLI, MD, MS

Many surgeons might think that a monofocal IOL is a commodity, but to me, it is not. As technology improves, we become more capable of discerning the differences between them.

The human eye is not a perfect optical system; we see evidence of this when pictures from the IOLMaster 700 show an eye whose optical axis is not aligned with its visual axis, or when the pupil is misaligned with the visual axis or optical axis. Often, the lens inside the eye is decentered from the optical axis, and/or it may be tilted. To date, we don't have a way of compensating for these misalignments, although there are many studies that show how impactful they can be on image quality.

One study from Rosales et al published in 2010 showed that the average IOL tilt inside the eyes is pretty small—1° to 2.5°—but it is possible for a lens to be tilted up to 5° in healthy eyes.[1] Most of the time, the lens is well centered, with less than 0.35 D of decentration. However, a significant number of eyes, perhaps up to 20%, experience more than 0.50 mm of IOL decentration.[2]

DECENTRATION WITH ASPHERIC OPTICS

Most surgeons have moved on from spherical IOLs to aspheric IOLs, because aspheric optics are supposed to produce better retinal image quality. That's true, when everything's perfect; but again, the average eye is not perfect. Decentration quickly degrades image quality for aspheric IOLs. What if we could find a way to work in the middle, where we could maximize the benefits of an aspheric lens when decentration doesn't matter (like when a pupil is really small), and then try to mitigate the effects of decentration when it does matter (in large pupils). That's the idea behind the optical profile of the ZEISS CT LUCIA IOLs.

THE CT LUCIA 621P IOL

The central optic zone of the CT LUCIA IOL is a hydrophobic acrylic monofocal with variable asphericity. The CT LUCIA 621P has a unique, patented, aspheric ZEISS Optic (ZO) in which the central optical zone has negative spherical aberration to balance positive corneal aberration. Closer to the periphery, the optic transitions gradually from negative asphericity to positive asphericity, which simulates a neutral effect and is less susceptible to decentration. When the pupil is small, the optic of the CT LUCIA 621P performs like a negative aspheric, but as the pupil enlarges, and especially in cases in which it is not centered over the visual axis, it acts more like a neutral aspheric.

In 2022, Borkenstein et al published the results of a study in which they measured the optical performance of 3 IOLs: the Sensar 1-Piece Monofocal (Johnson & Johnson Vision); the Tecnis Monofocal (Johnson & Johnson Vision); and the ZEISS CT LUCIA 621P.[3] In MTF measurements, all the lenses performed well when the pupil was small (3 mm) and the IOL was well-centered. When the pupil was small and the IOL was decentered by 1 mm, the performance of all the lenses began to drop, but the CT LUCIA 621P still performed pretty well, especially compared to the negative aspheric IOL. Most impressively, the study showed that when the pupil size was large (4.5 mm), the CT LUCIA 621P demonstrated a high tolerance to decentration and consistent optical performance, having the highest MTF when being decentered while outperforming the spherical IOL when centered (Figure 1). This is how we might expect the lens to perform in the real world—providing optimized visual outcomes for a wide range of cataract patients.

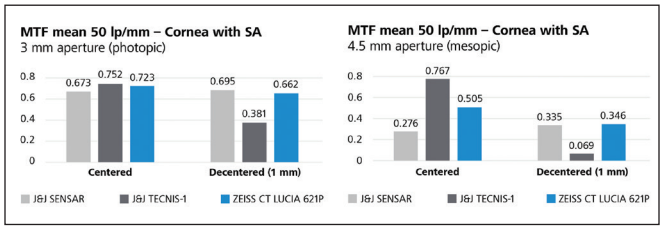

Figure 1. When the pupil was large and the IOL decentered, the CT LUCIA 621P IOL performed the best. (Adapted from Borkenstein AF et al, *Ophthalmic Res*, 2022[3]).

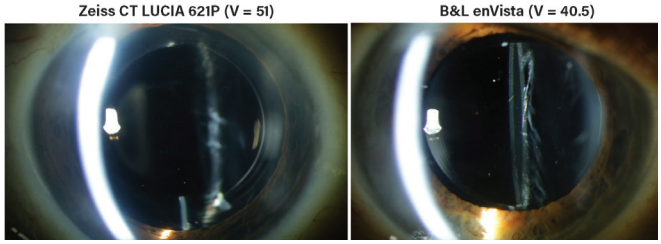

Figure 2. The CT LUCIA 621P: A high Abbe number equals fewer visual symptoms from chromatic aberration. Left: ZEISS CT LUCIA 621P (V = 51). Right: Bausch + Lomb's enVista hydrophobic acrylic IOL (V = 40.5).

CLARITY OF THE CT LUCIA IOL

To me, the most impressive thing about this IOL is its clarity. That is what I notice at the slit lamp. An IOL's clarity really comes down to the purity of its material, refractive index, and in turn, it's Abbe number (a measure of chromatic aberration). The Abbe number is inversely proportional to the refractive index. Preferably, the refractive index should be higher, because higher refractive indices give us thinner IOLs. But the higher the refractive index, the lower the Abbe number, the more chromatic aberration, and the more scattering of light. If we lower the refractive index just enough, so that it can still get through a 2.0- to 2.4-mm incision, we raise the Abbe number and get less chromatic aberration.

When I look at the CT LUCIA 621P IOLs at the slit lamp, I often can't see them at all. Other than the light reflex from the cornea and from the anterior hyaloid or the posterior capsule, the front and back surface of this lens is nearly invisible (Figure 2). I implant this lens through a 2.4-mm incision using a wound-assist technique, so I don't usually put the injector all the way into the anterior chamber. Then I use either a Kuglen Hook or I/A to deposit it in the bag.

RESULTS FROM THE CT LUCIA 611P IDE REGISTRATION TRIAL

I participated in the clinical trial from which the CT LUCIA 611P received FDA approval in the US (and then the 621 was approved via an amendment).[4] In the clinical trial, the 611P lens showed a very low rate of PCO: 3% at 1 year and 8.5% at 2 years. Only three patients in the entire study reported mild positive dysphotopsias. It's an extremely clear lens. It has no glistenings, no haze, and no surface damage noted in a single case across the whole series. Its diopter range is zero to 34.00 D in half-diopter increments.

DR. GANESH ON THE CT LUCIA 621P IOL

ZEISS' new IOL, the CT LUCIA 621P, is a hydrophobic, single-piece, acrylic IOL that features the aspheric Z0 optic design. It has a step-vaulted C-loop haptic, designed for maximum contact with the posterior capsule and with the periphery, and a reinforced optic-haptic junction for refractive stability (Figure 1). The CT LUCIA 621P IOL is implanted with a preloaded injector, which is easy to load and simple to use (Figure 2). The surgeon simply instills viscoelastic over the lens, folds the IOL's wings, and clicks the IOL into place.

Colleagues and I published the results of a study in which we compared the CT LUCIA 611P IOL with the TECNIS-1 ZCB00.[1] Although the outcomes were similar, the TECNIS IOL took significantly longer to unfold in the eye (35 seconds)—almost 3 times that of the CT LUCIA (12.93 seconds). Due to these outcomes with the 611P model, and for its unique aspheric optic design, the CT LUCIA 621P is the preferred monofocal IOL in my practice for routine and difficult cases. The preloaded injector enhances the efficacy, and I get excellent visual outcomes postoperatively.

1. Brar S, Ganesh S, Sute SS, Chidre S. Comparison of clinical results, contrast sensitivity and optical quality following the implantation of CT LUCIA 611P and TECNIS-1ZCB00 monofocal IOLs - 12 month outcomes. *Open J OPhthalmol*. 2022:16.

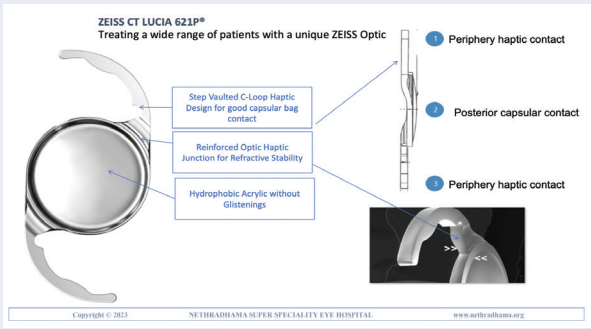

Figure 1. The ZEISS CT LUCIA 621P IOL features a unique hydrophobic acrylic optic and step-vaulted C-loop haptics.

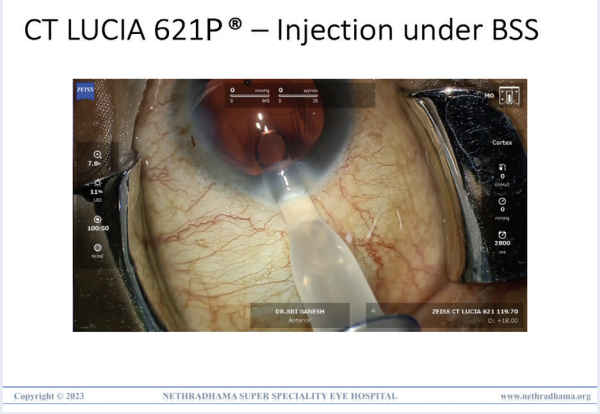

Figure 2. The CT LUCIA 621P IOL exits its injector.

SUMMARY

The CT LUCIA IOLs are hydrophobic acrylic monofocal lenses with a unique aspheric profile that maximizes visual performance based upon our understanding of real eyes (which all have some level of IOL tilt and decentration). The platform has a high Abbe number and low chromatic aberrations. It's the most invisible lens that I've implanted to date. It's glistening-free* and has a low rate of PCO and dysphotopsias. ■

1. Rosales PP, De Castro A, Jiménez-Alfaro I, Marcos S. Intraocular lens alignment from purkinje and Scheimpflug imaging. *Clin Exp Optom*. 2010;93(6):400-408.
2. Wang X, Dong J, Wang X, Wu Q. IOL tilt and decentration estimation from 3 dimensional reconstruction of OCT image. *PLoS One*. 2013;8(3):e59109.
3. Borkenstein AF, Borkenstein EM, Luedtke H, Schmid R. Impact of decentration and tilt on spherical, aberration correcting, and specific aspherical intraocular lenses: an optical bench analysis. *Ophthalmic Res*. 2022;65(4):425-436.
4. Schallhorn SC, Bonilla M, Pantanelli SM. Outcomes of a multicenter U.S. clinical trial of a new monofocal single-piece hydrophobic acrylic IOL. *J Cataract Refrac Surg*. 2022:1;48(10):1126-1133.

The New ZEISS CT LUCIA 621P IOL | BY WILLIAM F. WILEY, MD

We cataract surgeons might not think of a monofocal IOL as a premium lens, but with its high Abbe number, the ZEISS LUCIA 621P IOL truly is a premium monofocal product. Here, I am going to review two clinical cases in which I've implanted this lens.

CASE 1: A 2+ DENSE CATARACT

I began this surgery using the ZEISS miLoop lens fragmentation device in a carousel technique: shrinking the miLoop, opening it, spinning the lens, and repeating. When I was ready to implant the lens, I used the preloaded injector. I pulled the plunger back slightly and then advanced it forward, creating a wave of viscoelastic that pushed the lens into the bag. The IOL unfolded slowly enough that I could slip the I/A instrument behind it to extract the viscoelastic, but fast enough that by the end of the case, it was fully open and well-centered.

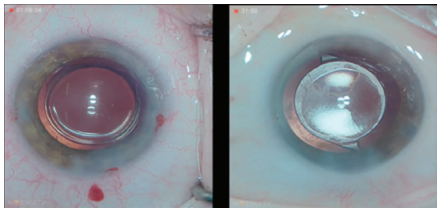

Figure 1. The CT LUCIA 621P IOL (A) and the Alcon Clareon IOL (B), both +21.00 D lenses, were implanted on the same day, using the same instruments, minutes apart. The same microscope light intensity was used in both pictures. The reflection seen from the Clareon IOL demonstrates that a high refractive index equals high reflectance.

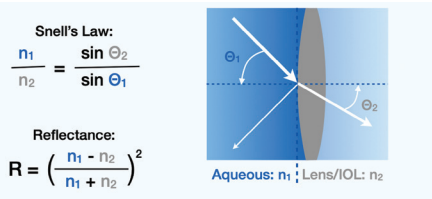

Figure 2. For IOLs, refractive index has tradeoffs. The greater the n^2, the thinner the lens, the more the light bends, and the greater the reflectance.

Material	Index (n)
Water	1.33
Cornea/Aqueous/Vitreous	1.38
Human crystalline lens	1.40
Zeiss CT LUCIA	**1.49**
Alcon (Acrysof) acrylic	1.55

Table 1. Refractive Index.

At the slit lamp, I noticed how clear the CT LUCIA 621P IOL looked after implantation, so I thought to review the recordings of some of the other lenses I implanted that same surgical day using the same scope. There was a noticeable difference in the amount of reflection I saw between the CT LUCIA 621P and the same-powered lens from a different manufacturer (Figure 1). The CT LUCIA 621P IOL was crystal-clear. Until you see them side by side, it's hard to really appreciate the difference between the clarity of lenses that we use. A high refractive index results in a high reflectance (Figure 2); the refractive index of the CT LUCIA 621P is 1.49 (Table 1). Also, high refractive index makes an optic thinner, and a thinner optic is at greater risk of shifting within the capsular bag.

CASE 2: DENSE CATARACT

In the case of a dense, grade 3-4 cataract, I again used the miLoop and carousel technique to dissect the cataract into four pieces. Sometimes with dense lenses, once half the fragments are out of the capsular bag, the bag starts getting a little floppy. So, I'll perform what I call a *scaffold technique*: I inject more viscoelastic, insert the IOL inside the bag, and use it to support the capsule before I remove those last pieces. To do this, I need a lens I trust to unfold controllably. This lens slips behind those nuclear fragments beautifully (Figure 3). It starts off small; both haptics are folded onto the optic.

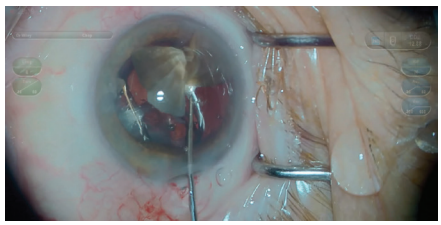

Figure 3. In the scaffold technique, Dr. Wiley inserts the CT LUCIA 621P IOL underneath remaining lens fragments to support the capsule during the final extractions.

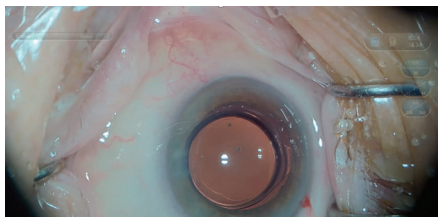

Figure 4. The CT LUCIA 621P IOL rests in the capsular bag after Dr. Wiley removed a dense cataract.

Once the IOL has opened in the bag, I can phacoemulsify the rest of the fragments out posteriorly, right above the optic, to save some endothelial cells. This allows for a very safe and controlled cataract extraction, especially in those tough cases. At the end of this case, the optic sat beautifully well-centered inside the eye (Figure 4).

To conclude, I have been impressed with how easy the CT LUCIA 621P IOL is to use and how clear its optics are. ■

*Clinical Study in US with CT LUCIA 611P of same material did not show any glistenings at 12 months.

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