

WHAT IS THE VALUE OF SWEEP SOURCE OCT TECHNOLOGY IN BIOMETRY?

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During the ESCRS 2016 in Copenhagen, a group of experts met at the Bella Congress Center to share their clinical experience with the IOLMaster 700. The meeting focused on the versatility of the new biometer, including macular scans, the success rate of measurements in normal and challenging cases, the integration into the clinical workflow and special features such as IOL tilt prediction and fixation check.

Cataract Penetration Ability of the IOLMaster 700

The IOLMaster 700 from ZEISS is the first biometer with SWEPT Source Biometry®. This technology allows an OCT scan through the entire length of the eye, from the cornea to the fovea. With its 22 µm resolution in tissue, the 44 mm depth and 6 mm width on the cornea and a 1 mm

fixation scan width on the retina, the full-length B-scan performs fast and reliable boundary checks in phakic, aphakic and pseudophakic eyes. The longer wavelength of the Swept Source OCT technology facilitates tissue penetration, minimizing the scattering of light in extremely dense

cataracts. Axial length (AL) measurements through mild or moderate cataracts is usually not a challenge with modern optical biometers. The system's benchmark performance and measuring capability are underscored by its ability to penetrate dense or extreme cataracts.

“Reduce the number of unsuccessful scans in dense cataracts by more than 50%”

“His success rate in AL measurements increased substantially, with 9 times more successful scans”

“Cataract penetration rate increased to more than 99%”

In his role as Chairman of the Ultrasound Department of the National Eye Institute (INO) and Director of the DLT Diagnostic Ophthalmic Center in Lima, Peru, Mario de La Torre, MD has a high level of experience with “extreme” cataracts as about 6500 cataracts are operated on and approximately 8000 biometry procedures are performed annually at both centers. “Extreme” cataract is a common definition in Latin America for very dense nuclei, including brunescens, rubra, nigra and white cataracts. Since he started to work with the IOLMaster 700, it has been possible to reduce the number of unsuccessful scans in dense cataracts by more than 50%, which means a significant benefit with regard to the workflow in the clinic. According to de La Torre, an important feature of the IOLMaster 700 is that one can verify visually what structures have been measured, as all calipers are shown on the full-length OCT image (Figure 1). De La Torre also appreciated the flexibility of the new technology, allowing him to perform successful measurements in various situations, such as dyscoria, congenital cataract, anterior vitreous and dense cataracts in Marfan syndrome (Figure 2).



Figure 1. Full length B-Scan of the entire eye obtained with the IOLMaster 700.

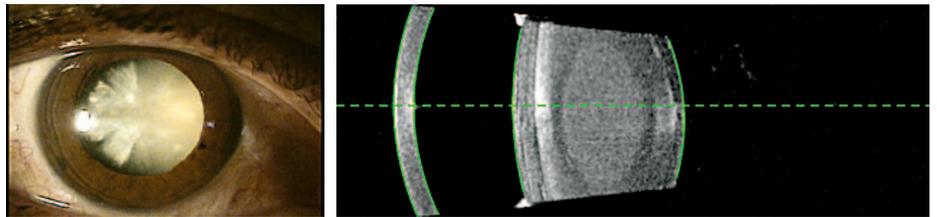


Figure 2. White intumescent cataract grade 4+: slit lamp image (left) and ZEISS IOLMaster 700 OCT image with measurement calipers; Image courtesy of Prof Mario de La Torre

Sabong Srivannaboon, MD, Professor of Ophthalmology at the Siriraj Hospital, Mahidol University, Bangkok, Thailand, confirmed the South American experience in Asian eyes where he is faced with rather dense cataracts and difficulties measuring AL with traditional biometers. With the IOLMaster 700 his success rate in AL measurements increased substantially, with 9 times more successful scans. In Srivannaboon’s opinion, not only the Swept Source OCT technology, but also the measurement in 6 meridians contributes considerably to the penetration ability of the biometer.

Nino Hirschall, MD, from the Vienna Institute for Research in Ocular Surgery at the Hanusch Hospital reported on the results of their scan study in which they compared the success rate of biometers in more than 1200 patients. With the IOLMaster 700 the successful cataract penetration rate increased to more than 99%.

“Macular holes, macular edema and epiretinal membranes with traction could be identified well with the IOLMaster 700.”

Getting indications for macular pathologies

The Swept Source OCT scanning of the IOLMaster 700 makes it possible not only to measure biometric data but also to perform a small scan of the central macula. Besides controlling the proper fixation of the patient, this function is useful to get indication for macular pathologies even though findings always need to be verified and diagnosed with a dedicated retina OCT as the ZEISS IOLMaster 700 is clearly not intended to be used for diagnostics.

Hirnschall reported on a study performed at the VIROS institute, which compared the macular scans of the IOLMaster 700 with a typical retinal SD-OCT device (RTVue, OptoVue, USA), both measurements being performed on the same day. The scans of 125 patients were assessed for sensitivity and specificity of macular diseases by two experienced retinal specialists and one ophthalmology resident. The scans were re-analyzed by one experienced examiner 3 weeks later. From the 120 evaluable scans 55 revealed healthy eyes and 65 cases with macular pathologies. The false negative rate was significantly higher than the false positive rate for all examiners. Compared to the SD-OCT, the IOLMaster 700 SS-OCT had a sensitivity of 42–68% and a specificity of 89–98%, depending on the examiner. Macular holes, macular edema and epiretinal membranes with traction could be identified well with the IOLMaster 700 (Figure 3). Geographic atrophy was less likely to be detected, which might be partly due to the rather small scan zone of 1.0 mm. According to Hirnschall, it is important for cataract surgeons to know if intraretinal fluid is present, and this was detected in 90% of the cases in the study.

Hirnschall concluded that the IOLMaster 700 provided useful information concerning the macula, especially for intraretinal fluid and macular holes. However, it is not meant to and should not replace a macular OCT device.¹

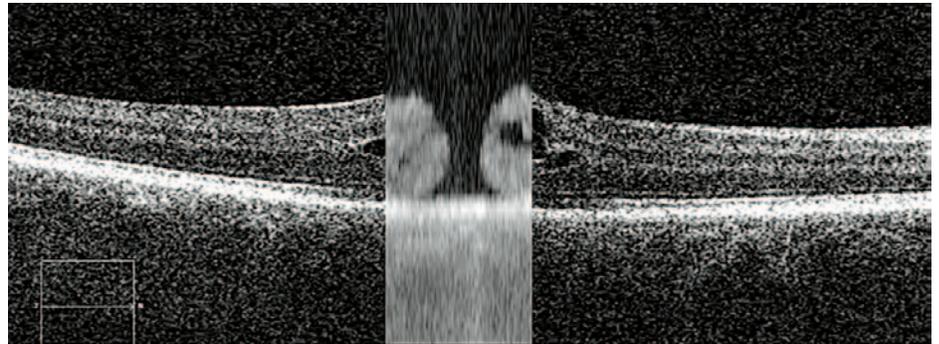


Figure 3. Macular hole: Fixation Check image combined with CIRRUS HD-OCT from ZEISS macula scan (via photo editor program; diagnosed via macular OCT scan) ; image courtesy Prof. W. Sekundo, Philipps University Hospital Marburg, Germany

“The average time for a measurement in his clinic is around 1 minute for beginners and less than 1 minute for trained personnel.”

“Preoperative preparation time, intraoperative IOL-alignment and overall surgery time were significantly shorter with the ZEISS Cataract Suite markerless.”

Efficiency and Workflow

Another important consideration regarding the clinical benefit of a new technology is how well it contributes to improving the clinical workflow. According to de La Torre, unsuccessful scans with a biometer mean a break in the workflow. Faster measurements and better penetration through dense cataracts make the overall clinical workflow more efficient. For him, the high speed of the IOLMaster 700 simplifies the workflow and shortens the measurement process. The average time for a measurement in his clinic is around 1 minute for beginners and less than 1 minute for trained personnel. Srivannaboon compared the time required for measurements between the IOLMaster 500 and 700 and found that the IOLMaster 700 was significantly faster.

Talking about workflow efficiency, it is important that the devices used for surgery work well together. The IOLMaster 700 is a core component of the ZEISS Cataract Suite markerless, an integrated workflow solution for toric IOL surgery. The keratometry measurement of the IOLMaster 700 is accompanied by a reference image of the eye. It uses small blood vessels on the sclera as landmarks and shows the patient’s astigmatic axis relative to the position of the eyeball. The biometric data are automatically transferred to the FORUM data management. Finally, the reference image is matched by CALLISTO eye for alignment to the patient’s eye (Figure 4). The system continuously tracks the image to provide overlays which assist the surgeon in the alignment of the toric IOL. The target axis is displayed as an overlay on the live image seen through a ZEISS OPMI LUMERA microscope. This markerless and precise² alignment facilitates the implantation of toric IOLs and avoids the manual pre- and intra-operative marking steps. Wolfgang Mayer, MD, Center for Refractive Therapy, LMU Munich, Germany, reported on the results of their efficiency study in which a comparison was made between the time required for toric IOL implantation with the ZEISS Cataract Suite markerless and manual ink marking. The IOLMaster 700 was used for reference imaging. Preoperative preparation time, intraoperative IOL-alignment and overall surgery time were significantly shorter with the ZEISS Cataract Suite markerless.



Figure 4. IOLMaster 700 integrated in the ZEISS Cataract Suite markerless

“A prediction of postoperative tilt would be helpful to avoid refractive surprises.”

“The Fixation Check [...] reduces the risk of refractive surprises as a consequence of undetected poor fixation”

Predicting IOL Tilt with the IOLMaster 700

Recent advancements in IOL technology have led to improved visual outcomes and increased expectations of surgeons and patients. Especially in high technology lenses such as aspheric, multifocal and toric IOLs, a significant postoperative tilt might impact the visual outcome and even require explanation and replacement of the IOL. Therefore, a prediction of postoperative tilt would be helpful to avoid refractive surprises. The postoperative IOL tilt is correlated to the preoperative tilt of the crystalline lens.

Some surgeons are already evaluating the potential of the imaging capabilities of IOLMaster 700 to find out if, in the future, it might be possible to consider tilt and decentration in IOL power calculation. A study of the VIROS group revealed that if the predicted tilt is incorporated in the calculation and alignment of the toric IOL, results were significantly improved. Hirnschall recommends recalculating toric IOLs if the predicted tilt is 8° or more. He pointed out that this recommendation is based on theoretical calculations and not on clinical data.

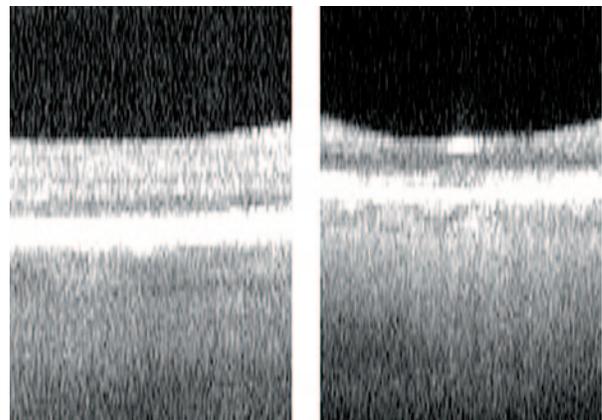
Damien Gatinel from the Anterior Segment and Refractive Surgery Department at the Rothschild Foundation, Paris, has performed optical bench tests. He has successfully demonstrated that tilt induces coma and that the impact of tilt on the visual outcome increases with IOL power.

Fewer Refractive Surprises with the Fixation Check

A unique feature of the IOLMaster 700 is the Fixation Check, which reduces the risk of refractive surprises as a consequence of undetected poor fixation of the patient. This scan with a width of approximately 1 mm on the retina allows surgeons to verify proper patient fixation during the scan (Figure 5). Good visibility of the foveal pit in the image indicates proper fixation of the patient during the measurement. If the foveal pit cannot be seen clearly, the measurement should be repeated and the patient instructed to fixate better on the target light. This is of particular importance in cases where macular pathologies or dense cataracts impede the patient's fixation.

Hirnschall presented some cases to demonstrate the impact of patient fixation on the reliability of biometric measurements. In a case with poor patient fixation the foveal pit was not visible. Discrepancies between measurements were significant with 190 µm difference in AL and 0.5 D difference in keratometry. In another case with good patient fixation the foveal pit was visible. Differences between measurements were very small, with 10 µm for AL and 0.02 D for keratometry.

Figure 5. Fixation Check with the IOLMaster 700. Poor fixation (left); correct fixation (right)



Conclusion and Glance at the Future

The clinical experience and study results of the expert groups underline the performance and versatility of the IOLMaster 700. The Swept Source OCT technology allows fast and reliable biometric measurements, even in dense cataracts. Unique functions like the Fixation Check increase reliability and minimize potential sources of error. The Fixation Check providing a scan of the macula can help to identify macular pathologies even though findings always need to be verified with a dedicated OCT scanner. The IOLMaster 700 is also part of the ZEISS Cataract Suite markerless, offering a seamless toric workflow. The discussion about the management of tilt underlines the potential of Swept Source OCT technology for areas that have not yet been addressed appropriately.

References

1. As the ZEISS IOLMaster 700 is clearly not intended to be used for diagnostics, findings need to be verified and pathologies diagnosed with a dedicated retina OCT.
2. Clinical data of Prof. Findl/Dr. Hirsnschall presented at ESCRS 2013—technically verified pre-/intraoperative matching precision $\pm 1.0^\circ$ in mean

For More Information

Product website: www.zeiss.com/iolmaster700

Clinical cases, videos and more: cataract-community.zeiss.com