Measurement of the Crystalline Lens Radius With Artemis Very High Frequency Ultrasound Biomicroscopy for Implantable Collamer Lens Sizing

To the Editor:

In their recent article, Reinstein et al.\(^1\) described the use of the Artemis 2 very high frequency digital ultrasound (ArcScan, Inc., Morrison, CO) to calculate the fit of the Visian Implantable Collamer Lens (ICL). Another parameter previously proposed as influencing ICL vaulting is the crystalline lens anterior radius of curvature (ALR).\(^2\) The ALR has not yet been used in any previous studies that use ultrasonic measurement for predicting the ICL vault.\(^3\)-\(^5\)

Several assumptions are made in the formulas used to size the ICL and calculate the theoretical vault height of the ICL that would have been chosen by the white-to-white method: the sulcus-to-sulcus measurement is made at the iris base, which does not take into consideration sulcus peripheral widening at the ciliary processes. The “gap constant” assumes that the haptics rest on the zonules with “standard” compression (I have seen considerable variability in haptic compression when using the Artemis on postoperative cases). The crystalline lens height is a calculated value based on the previous two assumptions and is not an actual, measured value such as the aforementioned ALR measurement.

Anatomical differences that result in the compression of the haptics against the ciliary processes, or the ALR (“lens rise”), could account for variability in the ICL vault. The measurement of the ALR can easily and accurately be performed preoperatively with the Artemis device.

We have retrospectively looked at this parameter (ALR) in an earlier series of 82 consecutive ICLs, with a mean postoperative follow-up of 36.3 months. We used the Artemis base curve measuring device to calculate the ALR at a 7.0-mm optical zone in the preoperative undilated eye. In 29 eyes with an ICL vault of 150 mm or less, the mean ALR had an 8.70-mm base curve; for the 13 cases with ICL vault 300 mm or greater, the ALR was 12.08 mm. Thus, a steeper ALR may reduce the ICL vault. For the past 5 years, I have used the Artemis to measure the ALR as an aid in ICL sizing.

The ALR may be a confounding variable for the relationship of either white-to-white or sulcus-to-sulcus to the ICL vault, and may indeed be an independent factor for predicting ICL vault. Furthermore, both the length and the base curve of the ICL could be customized to the sulcus width and the crystalline lens curvature (“L” reading, corresponding to the corneal “K” reading), respectively, to optimize the vault in each individual patient, similar to contact lens fit. I encourage the authors to evaluate the ALR in their current preoperative database, and the relationship to achieved ICL vault.

I would like to point out an error in the article. In the Figure 6 text and graph, and “Results” paragraph 4, page 33 it is stated that the “achieved vault height was 0.9 mm.” This should be “0.09 mm.”

REFERENCES

2. Roholt PC. Artemis VHF ultrasound for sizing the Visian ICL. Paper presented at: American Cataract and Refractive Surgery Symposium; April 4-9, 2008; Chicago, IL.

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The author has no financial or proprietary interest in the materials presented herein.

Reply:

We would like to thank Dr. Roholt for his letter referring to our article regarding the use of sulcus diameter measurements for implantable collamer lens (ICL) sizing,\(^1\) because the letter has raised some important points related to this topic. We absolutely agree that the crystalline lens anterior radius of curvature (ALR) is an important factor that should be considered for optimal ICL sizing. Dr. Lovisolo has been using this radius as a parameter since 1997 and first included this in a paper presentation during the European Society of Cataract & Refractive Surgeons Winter Meeting in 1998.\(^2\) At that time, he was using the FABD echographic (Ellex, Adelaide, Australia) with which he could obtain an image of the anterior segment by pasting together two images. This information was included in the Fumagalli “sag” formula to calculate the lens implant overall length derived from the base of the radius of curvature of the anterior surface of the crystalline lens and the sulcus-to-sulcus diameter. This protocol and the results of his early experience with improving ICL sizing was published in his
1999 book and subsequently in a review article. Since then, Dr. Lovisolo developed custom software for ICL sizing and all four versions included ALR. The more recent Lovisolo ICL sizing software uses a more complete anatomic factor, which considers not only ALR, but also angle opening and anterior chamber volume. Haptics compression is highly predictable in the laboratory or with a computer using finite element analysis, provided that the correct parameters of the material are given. It was an oversight on our part to not include the ALR in the list of parameters incorporated in the ICL sizing algorithm. We could not agree more with Dr. Roholt and would encourage him to publish the interesting results described in his letter.

Dr. Roholt also points out that there were some assumptions made in the theoretical calculation of the ICL vault height that had the white-to-white diameter been used for sizing. This is correct and these are described as calculated or assumed constant values in the original article. Dr. Roholt also pointed out the potential for significant variation in lens haptic compression, particularly in cases with non-optimal lens sizes, and this variation has not been accounted for by the theoretical modelling in our article. However, by assuming that the haptics are in an ideal location, the model represents a best-case scenario, so if anything the results using the white-to-white sizing method may be worse than predicted by this model. Ideally, the study would have included a control group where the lenses were sized using white-to-white; however, this population was not available for study because we stopped using this method in 1998.

We thank Dr. Roholt for also pointing out the error in Figure 6. We appreciate him bringing up these points and emphasizing the importance of ICL sizing. We consider the highest standard of care in any phakic intraocular lens surgery to be a direct measurement of the implantation site for optimal sizing, combined with monitoring the lens position and anatomic relations immediately after surgery and on an on-going basis over time.

REFERENCES

3. Lovisolo CF, Pesando PM. The Implantable Contact Lens (ICL) and Other Phakic IOLs. Canelli, Italy: Fabiano Editore; 1999.

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Dr. Reinstein is a consultant for Carl Zeiss Meditec (Jena, Germany) and has a proprietary interest in the Artemis technology (ArcScan Inc, Morrison, Colorado) through patents administered by the Cornell Research Foundation, New York, New York. The remaining authors have no financial or proprietary interest in the materials presented herein.

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