Anterior segment OCT and phakic intraocular lenses: A perspective

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Perfect tolerance is expected when one implants a phakic intraocular lens (pIOL) in the anterior segment. Not only should the material be compatible, but the pIOL must respect the anatomy of the anterior chamber. Based on 3 years of experience using an anterior segment optical coherence tomographer (Visante OCT, Carl Zeiss Meditec), I have defined numerous safety criteria for pIOLs. The internal dimensions of the anterior chamber must be considered along different meridians. I propose an objective measurement of the iris dome, the crystalline lens rise (CLR), which is the distance between the anterior pole of the crystalline lens and a line joining the 2 opposite iridocorneal angles. In a series with the Artisan IOL (Ophtec), pigment dispersion syndrome appeared in 70% of cases in which the CLR was greater than 600 μm. Angle-supported IOLs must be placed relative to the anterior chamber's largest diameter; in the same series of cases, the anterior chamber was oval with a large vertical axis in 74% of cases. The posterior face of an angle-supported IOL must have a 700 μm vault to respect the physiological modifications of the crystalline lens. It is difficult to know the posterior chamber's exact diameter as it varies with the horizontal or vertical axis. It also undergoes constant modifications due to accommodation and aging.

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The evolution of corneal metrology in the areas of contact lenses and refractive surgery over the past 10 years is primarily due to the development of the excimer laser. In the 1970s and 1980s, the only measurement instruments available were the Placido disk, which estimated the regularity of astigmatism; the Javal instrument, which measured the amount of astigmatism and the central radius of curvature; and central pachymetry, which was evaluated optically with a slitlamp or A-scan ultrasounds. Thirty years later, it would be unthinkable to propose corneal surgery without knowing the anterior surface topography, pachymetric mapping of the various corneal zones, corneal radius of curvature, evaluation of posterior topographic curves, corneal diameters, and quantitative measurement of corneal symmetry.

The success of phakic intraocular lenses (pIOLs) that were recently approved by the U.S. Food and Drug Administration (FDA) is based on the eye's tolerance of a foreign body in the anterior segment. This means that fragile structures such as the corneal endothelium, iris, iridocorneal angle, and crystalline lens must be preserved. These procedures will be safe only when we have accurate measurements of the internal biometry of the anterior chamber. Imprecise measurements such as the white to white are no longer sufficient.

Until recently, the most advanced technology was based on the optical principles of the Scheimpflug method[1] or on the study of high- and very-high-ultrasound frequency scanning devices.[2] Optical coherence tomography, which was introduced about 15 years ago to study the posterior pole, is now essential for in-depth study of the macula and to measure the various retinal layers. It is now being used to analyze the anterior segment.[5–8] Over the past 3 years,[9–14] I have routinely used 3 versions of an anterior segment optical coherence tomographer and would like to share my experience and describe the criteria for selecting pIOLs that I have defined.

ANTERIOR CHAMBER OPTICAL COHERENCE TOMOGRAPHER

The OCT with its 820 nm wavelength is a well-known posterior segment imaging device.[3,4] In 1994, Izatt et al.[5] suggested using it for anterior segment imaging. However, it was not until 2001, when a high-speed anterior chamber

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OCT using a 1310 nm wavelength became available, that good quality, easy-to-interpret images were obtained.[6]

The image acquisition system of the first prototype provided a video image of the examined zone and stored the final 7 images, which were taken at a rate of 8 frames per second. At the end of the examination, the images were reviewed and the best shots retained. The chosen image was then interpreted with specific software that readjusted the dimensions of the image by eliminating the distortions induced by corneal optical transmission differences.

Today, with the commercial version of the Visante OCT (Carl Zeiss Meditec), a reconstructed image of the anterior chamber is obtained without going through the stages of reconstruction. All the required anterior chamber measurements (anterior chamber diameter, anterior chamber depth [ACD], corneal pachymetry, crystalline lens thickness, and iridocorneal angle opening) can be obtained from this image.

With standard software, axial resolution is approximately 18 μm and transverse resolution, 60 μm. With high-resolution corneal software, axial resolution can reach 8 μm (data provided by Carl Zeiss Meditec). The infrared light beam is stopped by the pigments; therefore, a satisfactory view of the structures situated behind the epithelial pigment layer of the iris or the anterior uvea is not possible except in eyes with few pigments.

Analysis of the eye is a noncontact procedure. The patient fixates on a target. The target's focus is adjustable with positive or negative lenses to compensate for the patient's spherical ametropia and obtain images in an unaccommodated situation. It is also possible to defocus the target with negative lenses to induce physiological accommodation in the examined eye. With this noncontact technique, there is no undue pressure on the anterior segment, image acquisition takes a few seconds, and only the eye under observation is stimulated and studied in physiological conditions.

I have conducted several studies with the Visante OCT; in particular, anterior segment measuring[10,14] and the relationship between pIOLs and anterior chamber structures.[11,13] After 17 years of experience with angle-supported IOLs and 8 years with iris-fixated IOLs, I would like to explain my reasons for using the Visante OCT and the results of the studies and compare these results with data available in the literature.

ROLE OF THE ANTERIOR CHAMBER OCT IN EVALUATING ANTERIOR CHAMBER IRIS-FIXATED LENSES

In his book on the Artisan IOL,[15] Budo lists the following criteria for implantation: The anterior chamber must have a minimum depth of 2.8 mm and a maximum depth of 3.5 mm (in the center). A European multicenter study required a minimum ACD of 3.0 mm. The FDA phase II study set the limit a little higher, 3.2 mm. Budo also recommends that the Artisan IOL be used only in eyes with irides that are not too convex.[15]

For the past 7 years, I have been using Artisan IOLs, following the recommendations in Europe as well as requiring the minimum 2.8 mm for ACD (corneal epithelium to crystalline lens anterior pole). The convex iris notion remains purely subjective as no way to objectively measure the iris dome has been described.

In one study,[13] 6% of eyes with Artisan hyperopic IOLs developed the pigment dispersion syndrome (PDS). A retrospective study of about 90 eyes with myopic and hyperopic Artisan IOLs found that PDS appeared only in eyes with a high iris–crystalline lens dome. To define the forward protrusion of the crystalline lens dome, the line joining the 2 iridocorneal angles along the horizontal corneal diameter (3 o'clock to 9 o'clock) was used as a fixed reference. The distance between the anterior pole of the crystalline lens and the median of this base line was considered the crystalline lens rise (CLR). This enabled us to define the convexity of the iris–crystalline lens dome objectively and quantitatively. Figure 1 shows the clinical aspect of PDS in a highly myopic patient. The pigment membrane developing on the pupil is perfectly visible (*a*), and on the horizontal cut of the same eye, the central part of the iris appears crushed and very thin compared with the peripheral part. The thin central part is very different from that of a normal iris observed with the same AC OCT and can be interpreted as flattening of the iris between the crystalline lens and the Artisan IOL. This flattening could be the result of a significant forward thrust of the crystalline lens (*b*). In this case, the CLR is 889 μm, which is considerably above the norm.

Figure 2 shows the anatomical measurements of the CLR in 89 myopic and hyperopic patients. The red squares represent cases of PDS; the yellow triangles, loosely fixated IOLs; and the blue squares, IOLs without complications. Pigment dispersion syndrome occurred only in patients with a high CLR, which was more frequent in the hyperopic patients than in the myopic patients. In the 9 cases of PDS, 8 cases occurred in patients with a CLR equal to or greater than 600 μm. There was no pigment dispersion when the CLR was less than 500 μm.

Anterior chamber depth is not constant,[9,10,16–18] and with age, there is an 18 to 20 μm forward thrust of the crystalline lens per year. This forward thrust, which is approximately 20 μm per year, enables us to calculate a safety time period. If one wishes to forecast a 15-year safety period, it is necessary to allow a 300 μm margin before the 600 μm limit is reached (Figure 3). It would therefore be possible to propose Artisan IOLs to patients with a CLR less than 300 μm.

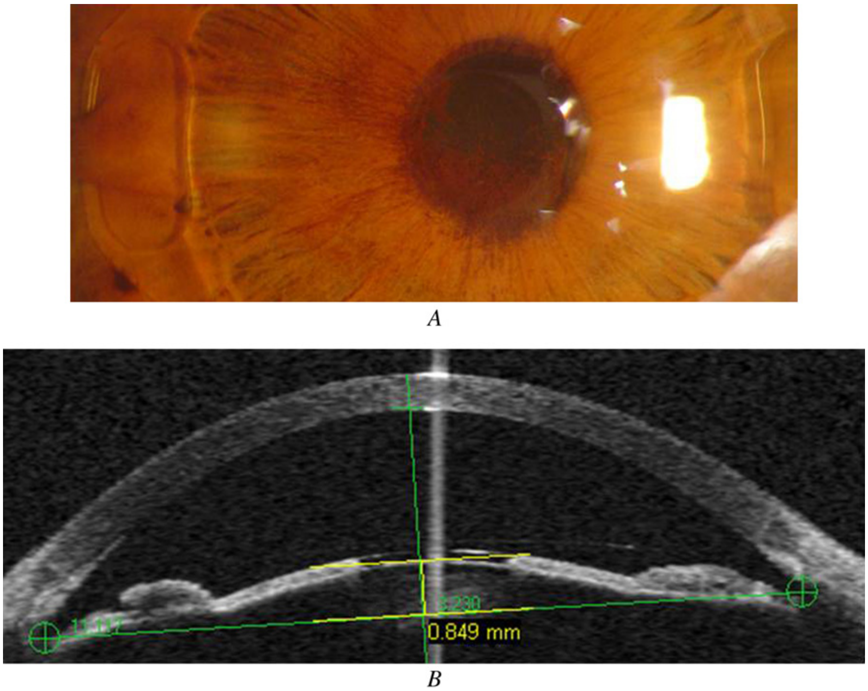

Figure 1. *A*: Clinical aspect of a pigment dispersion syndrome following implantation of an Artisan IOL. *B*: Optical coherence tomography of the same patient showing a high CLR.

Before surgery, the patient would have to be informed of this safety period and prepared to undergo regular yearly checkups to control the anatomical modifications of the anterior segment in the same way a yearly endothelial checkup with a specular microscope is essential.

The data are based on the technique used. With ultrasound equipment or in other centers, the safety limits may be slightly different but the reasoning is the same. In our study,[13] 2 eyes did not develop PDS although their CLR was about 800 μm; in fact, the fixation of the IOLs was loose and the 2 IOLs were in front of the iris with no compression. It is important to know that the quality of Artisan or Verisyse IOL fixation is not necessarily the same from one procedure to the other, even in the hands of an experienced surgeon, but the safety rules that we have described should prevail.

ROLE OF THE ANTERIOR CHAMBER OCT IN EVALUATING ANTERIOR CHAMBER ANGLE-SUPPORTED LENSES

Angle-supported anterior chamber IOLs must respect 3 parameters—perfect adjustment to the internal diameter of the anterior chamber, minimum distance from the endothelium, and no contact with the iris and the crystalline lens.[11,13]

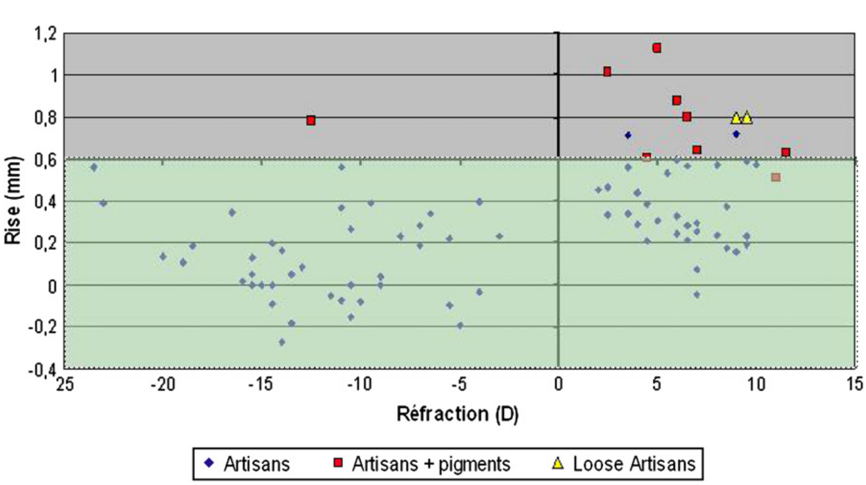

Figure 2. Study of 89 eyes with myopic and hyperopic Artisan IOLs. The red squares represent eyes with PDS. Note: In all cases, the CLR was equal to or greater than 600 μm. In the study, the mean CLR was 310 μm.

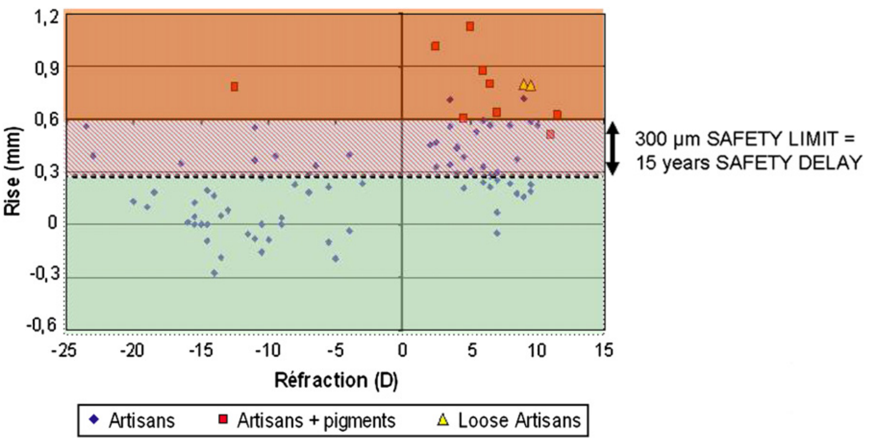

Figure 3. An Artisan IOL can be implanted in a patient with a 300 μm CLR because it will take 15 years for the CLR to reach 600 μm based on a forward movement of the crystalline lens at a rate of 20 μm per year.

Internal Diameter of the Anterior Chamber

To date, there are few published studies of the anterior chamber's internal diameter. Most authors rely on the white-to-white measurements. In a series of 14 eyes using the Artemis and the best-surface-fit technique, Rondeau et al.[19] found that the internal shape of the iridocorneal angle was a circle. However, the results were not consistent. With the same Artemis device, Werner studied 20 cadaver eyes (L. Werner, MD, et al., "Anterior Chamber and Ciliary Sulcus Diameter of Human Eyes Measured with Very-High Frequency Ultrasonography in Different Meridians," poster presented at the ASCRS Symposium on Cataract, IOL and Refractive Surgery, San Diego, California, USA, April 2004). The authors found that the vertical diameter of the anterior chamber (iridocorneal angle or sulcus) was generally larger than the horizontal diameter.

In an in vivo study of 107 normal eyes with the anterior chamber OCT,[14] we found that the internal vertical diameter of the anterior chamber was a mean of 310 μm larger than the internal horizontal diameter (Figure 4).

In an ultrasound study of normal eyes, Song et al. also found that the vertical diameter of the anterior segment was larger than the horizontal diameter (J.S. Song, MD, et al., "Measurement of Ciliary Sulcus Diameters Using High-Frequency Ultrasound Biometry," presented as a poster at the annual meeting of Association for Research in Vision and Ophthalmology, Fort Lauderdale, Florida, USA, May 2006). Of the 4 articles on this topic, 3 favored an oval shape with a large vertical axis and 1 favored a circle. This differs from the white-to-white evaluation, which generally assumes that the horizontal diameter is the larger diameter; however, one must remember that insertion of the conjunctiva at the cornea is different on the horizontal and vertical meridians.

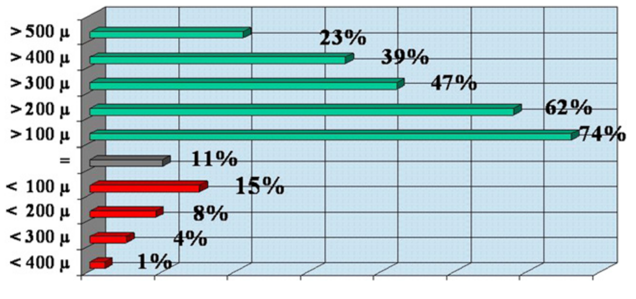

Figure 4. A statistical study of 89 normal nonoperated eyes showed that in 74% of cases, the vertical diameter was larger than the horizontal diameter by at least 100 μm.

Creating anterior chamber phakic IOLs with soft haptics has improved their adaptability to the anterior chamber diameter, but ovalization still occurs (Phillippe Sourdille, MD, personal communication, April 2006). Therefore, I recommend adapting angle-supported phakic IOLs to the largest internal diameter of the anterior chamber and inserting them along this axis to avoid the propeller effect, which occurs when the IOL is smaller than the axis on which it has been placed. When the IOL is perfectly adapted to the largest axis, it rests gently in the angle and does not move.

In my personal experience, most anterior chamber pupil ovalizations are due to an oversized IOL. However, careful placement of the footplates is another factor that should be considered and efforts should be made to create the best footplate shape.

Anterior Chamber Depth

The second aspect to be taken into account is sufficient ACD. Contrary to common practice, the measurement should be of the internal depth of the anterior chamber (crystalline lens to endothelium) rather than the ACD between the anterior pole of the crystalline lens and the epithelium. There are no epithelial dystrophies following phakic IOL implantations, but if there is not a minimum clearance between the endothelium and the edges of the IOL, there is a high risk for endothelial corneal dystrophy. Logically, the clearance between the IOL and the endothelium is not the distance from the center of the optic to the posterior face of the endothelium along the eye's axis but the shortest distance from the optic to the endothelium; ie, along an axis close to the cornea's radius. Pérez-Santonja et al.[20] and Ferreira de Souza et al.[21] clearly demonstrate that the minimum distance between the edge of the optic and the endothelium to prevent the risk for corneal dystrophy is 1.50 mm. I therefore suggest that the Visante OCT software include a safety rainbow indicating 3 distances from the endothelium: 0.50 mm, 1.0 mm, and 1.50 mm. With the Visante OCT software calipers, the safety distance between the IOL and the endothelium can be precisely measured and one knows whether the IOL is in the right position (Figure 5). If the edge of the optic is less than 1.50 mm from the endothelium, corneal distortions that occur during eye rubbing can give rise to endothelial alterations by contact with the edge of the IOL, which is dangerous. If the IOL is closer than 1.0 mm from the endothelium, explantation should be considered. This is also true for other types of phakic IOLs.

Implant Vaulting

The vault of angle-supported IOLs enables them to remain in front of and at a distance from the iris surface and the anterior pole of the crystalline lens when they move. The shape of the iris dome is conditioned by the forward protrusion of the anterior pole onto which the iris moulds itself. All angle-supported IOLs rest in the iridocorneal angle. The iridocorneal sinus is the only zone of the anterior uvea that remains fixed throughout a person's life and during accommodation. When the eye accommodates,[9,10] the ciliary body, iris, and crystalline lens move but the iridocorneal junction does not (Figure 6). The IOL, which is wedged in this zone, remains fixed; its relationship to the crystalline lens and iris will change but its relationship to the cornea will not.

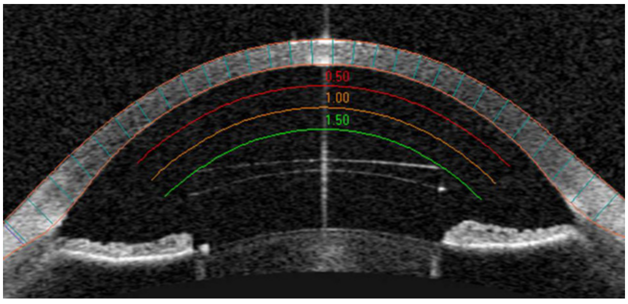

Figure 5. Safety distances from the endothelium.

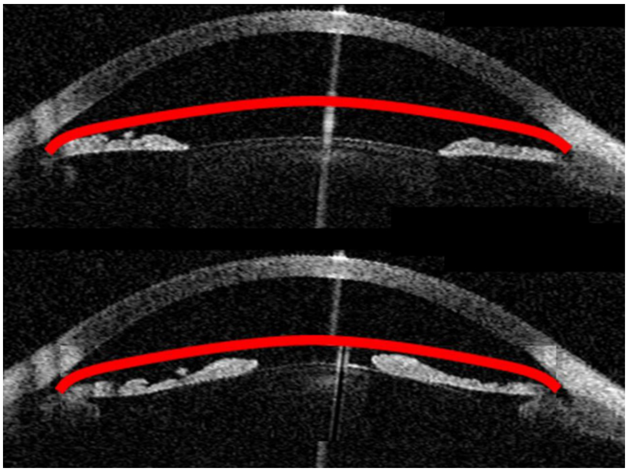

Figure 6. Study of 10 diopters of accommodation in a young adult. The angle-supported IOL is represented in red. Sufficient vaulting of the implant is essential to avoid contact between the iris and the crystalline lens during accommodation.

One should also consider the modifications of the crystalline lens' shape and volume. With every diopter of accommodation, the anterior pole of the crystalline lens moves forward 30 μm[9]; with age, the crystalline lens thickens, with an 18 to 20 μm forward movement of its anterior pole every year.[8] This means that after 20 years, the anterior pole of the crystalline lens has moved forward by 400 μm, which is quite a distance considering that in a young subject, the mean real ACD (endothelium to crystalline lens anterior pole) is 2800 μm.[10,16–18]

The vault of an angle-supported IOL has to be a compromise: sufficient clearance relative to the endothelium (minimum of 1.50 mm from the optic edge) and sufficient vaulting to be able to remain in front of the crystalline lens dome, respect the crystalline lens distortions during accommodation in a young subject, and anticipate a sufficient forward "growth margin" of the crystalline lens so contact between the lens and IOL will not occur for 15 to 20 years. The IOL must therefore be placed within a safety zone delimited at the front by a 1.5 mm distance from the endothelium and at the back by the theoretical 400 μm protrusion of the anterior pole of the crystalline lens with respect to the base line joining the 2 iridocorneal sinuses. This would allow forward movement of the anterior pole over 20 years as long as the iris dome was not too convex on the day of implantation. The mean crystalline lens height in a young subject is approximately 300 μm (Figure 2). This would mean a 700 μm safety vault (300 μm mean CLR + 400 μm mean 20 year safety delay = 700 μm) for phakic IOLs (Figure 7).

These remarks are based on mean measurements and will help to establish sufficient safety standards for

Figure 7. The "free zone" is the space in the anterior chamber where the optic of an anterior chamber IOL (angle supported or iris fixated) must be situated. The anterior angles of the optic must be at least 1.5 mm from the endothelium, the posterior face of the implant must be at least 700 µm from the base line joining the 2 opposite iridocorneal angle sinuses.

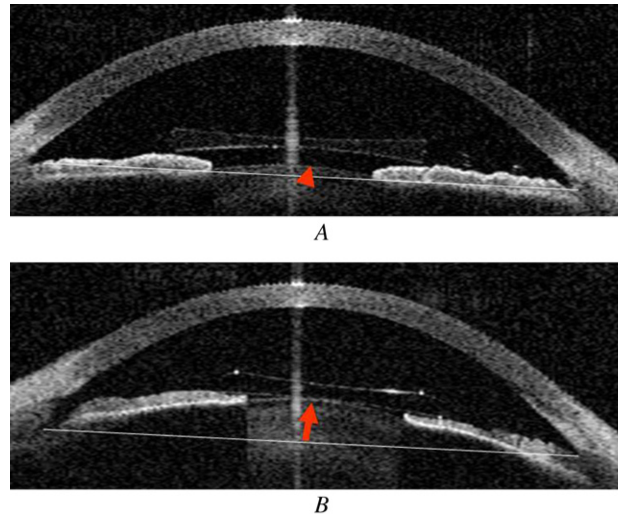

Figure 8. *A:* Measure of the CLR in a patient with a Nuvita IOL. The CLR is small and there is sufficient clearance between the anterior pole of the crystalline lens and the posterior face of the IOL. *B:* Another eye photographed 10 years after implantation of a ZB5M IOL The CLR has increased and the crystalline lens in now in contact with the posterior face of the IOL.

angle-supported anterior chamber IOLs while "customized" IOLs are being developed. With improvements of the Visante OCT software, it might be possible to simulate the exact situation of the IOL, even its relationship to the crystalline lens during its modifications.

Figure 8 shows situations with angle-supported IOLs. In Figure 8, *A*, the anterior chamber IOL is a correct distance from the crystalline lens and the iris; however, in Figure 8, *B*, the crystalline lens is in contact with the IOL. In the latter situation, there is a risk for cataract development. The eye was operated on 10 years earlier and at that time, there was no visible contact between the IOL and the crystalline lens. The present situation is the result of the CLR and the lens' physiological thickening with age.

ROLE OF THE ANTERIOR CHAMBER OCT IN EVALUATING POSTERIOR CHAMBER PHAKIC IOLs

While studying accommodation in an albino patient,[9] we found that the ciliary sulcus' horizontal diameter decreased by about 900 µm for 10 diopters of accommodation. In a study of 20 cadaver eyes using ultrasound biomicroscopy, Werner et al. demonstrated that the sulcus' vertical diameter was larger than the horizontal diameter in the same way that the anterior chamber's vertical internal diameter is larger than the horizontal diameter (L. Werner, MD, et al., "Anterior Chamber and Ciliary Sulcus Diameter of Human Eyes Measured with Very-High Frequency Ultrasonography in Different Meridians," presented as a poster at the ASCRS Symposium on Cataract, IOL and Refractive Surgery, San Diego, California, USA, April 2004). Song et al. found similar data in human living eyes with ultrasound biometry (J.S. Song, MD, et el., IOVS 2006; ARVO abstract 3296). This means that the ciliary body is not a fixed structure during accommodation or aging. Today, one of the limits of the anterior chamber OCT is that the wavelength and the powers used are blocked by the pigments. Under normal conditions, it is difficult to explore the posterior chamber behind the iris pigments.

In ultrasound studies, Garcia-Feijoó et al.[22,23] demonstrate that posterior chamber IOLs were rarely in the sulcus and often rested against the zonules, crystalline lens, or the ciliary body. Moreover, at each extremity, the position of the IOL's footplates were not necessarily symmetrical.

All these studies show that preoperatively it is difficult to predict the postoperative position of the IOL. To rest on the ciliary sulcus, the posterior curvature of an ICL posterior chamber IOL (Staar Surgical) must fit perfectly to the shape of the crystalline lens in the posterior chamber. From one subject to another, the size of the crystalline lens, its height or rise, and the anatomy of the posterior chamber behind the iris are different; in the same subject, the posterior chamber changes during accommodation in young subjects and its depth gradually decreases as the subject ages. Ideally, a posterior chamber IOL should remain at a safe distance from the crystalline lens and have a posterior face that adapts to the movements of the anterior curvature of the crystalline lens (relaxed, accommodated). Finally, it must be decided whether posterior chamber IOLs should float or rest on the posterior chamber structures.

Today, it is not possible to know the biometry of the posterior chamber with optical coherence tomography unless the iris is light colored with few pigments. It is possible to observe behind the iris with the Artemis, but we are not aware of any studies analyzing the exact biometry of the sulcus along its various diameters (horizontal, vertical oblique) and the relationship of posterior chamber phakic IOLs during accommodation and aging in a large series of posterior chamber phakic IOLs. We think it is difficult to choose the size of an IOL for implantation in a structure that is considerably more malleable than the anterior segment. New rules regarding posterior chamber phakic IOLs should be defined in the future by carrying out retrospective and prospective studies of their relationship with the posterior chamber and by calculating these parameters.

Case Reports

To illustrate posterior chamber problems, we report 2 cases. The first one was a hyperopic patient with a phakic PRL (Carl Zeiss Meditec). In both eyes, there appeared to be contact between the natural crystalline lens and the posterior face of the PRL. Two or 3 years after implantation, there was no cataract and the crystalline lens remained clear. Perhaps the constant contact explains the cataracts observed with ICL IOLs,[24] which seem to be frequent in patients older than 40 years (whose crystalline lens has moved forward by 400 μm compared with the position in a 20-year-old subject).

The other case was a patient with an ICL who developed a cataract. Because of complaints of halos, the ICL was explanted. Images of the position of the anterior edges of the optic showed they were well below the defined 1.5 mm minimum clearance between the IOL and the endothelium (Figure 9). Even a posterior chamber phakic IOL with a high vault does not necessarily avoid contact with the endothelium.

DISCUSSION

Today, various techniques based on ultrasound and optic procedures are available to evaluate the anterior chamber. Modern ultrasound equipment uses high and ultra-high frequencies (UBM, Artemis). The inconvenience of UBM is that it explores a very small zone and therefore the anterior segment has to be reconstructed by juxtaposing images. Figure 10 shows how difficult it is to reconstruct the anterior segment as 3 or 4 images are necessary and juxtaposing them is not simple; only the dimensions measured along the anterior/posterior axis of the eye seem satisfactory; the diameters and the oblique distances cannot be evaluated precisely as it is difficult to study the zones side by side. The quality of the work is not being criticized since at the time, it helped to specify the minimum anterior/posterior distances to be respected relative to the endothelium.

Ultrasound equipment has the advantage of being able to explore the posterior chamber behind the iris pigments. However, it is more difficult to use as there is a water or gel bath placed in front of the examined eye; the operator has to identify the axis under study on the control screen. Natural accommodation of the examined eye cannot be done directly; the fellow eye has to be accommodated (which is not easy) or artificial accommodation has to be induced with pilocarpine eyedrops. The probe or water bath can put unusual pressure on the anterior chamber and can modify its biometry. The variation in ultrasound acoustic transmissions are important depending on the matter and can produce shadowing behind the prosthesis or iris showing notches and repetition echoes (Figure 11).

The Scheimpflug technique provides good images of the anterior segment, but the optical cuts are oblique and require fairly complex reconstruction software as the distances observed on the images vary depending on the position in the anterior segment. Whichever equipment is used, the cornea–sclera junction zone is overexposed because the scleral tissue is extremely white and it is impossible to define the tip of the iridocorneal angle precisely and the real internal diameter of the anterior chamber; it might be

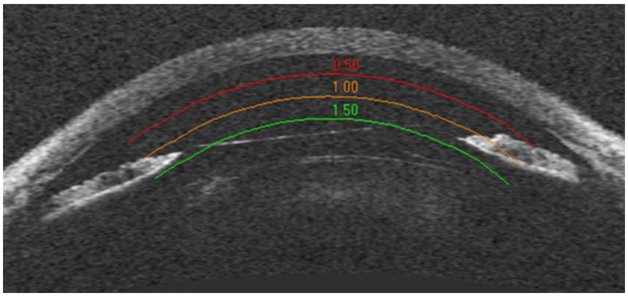

Figure 9. Optical coherence tomography of an ICL IOL. The edge is in front of the green safety line (safety distance not respected).

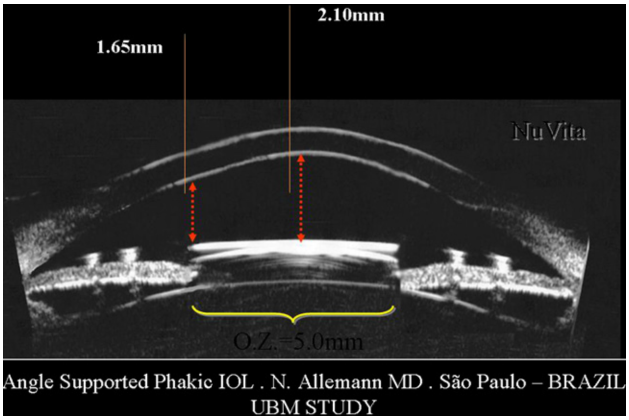

Figure 10. Three to 4 image reconstruction of the anterior chamber and a Nuvita IOL done with UBM (courtesy of N. Allemann, MD).

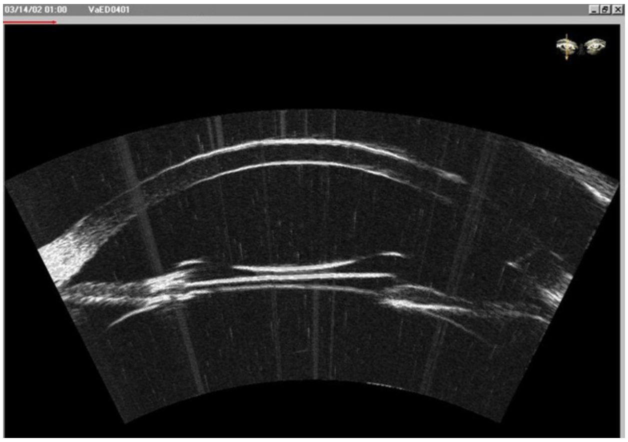

Figure 11. Angle-supported IOL photographed with the ultra-high-frequency Artemis.

necessary to extrapolate and the results will depend on the exposure of the iridocorneal zone. We were able to compare the same eye with the Scheimpflug and the OCT (Figure 12); as shown, the difference between the techniques could be as much as 1.5 mm, which is unacceptable for evaluation of an angle-supported IOL. Thus, without knowing the exact position of the iridocorneal angle, it is impossible to know the base line and the CLR cannot be measured. If the image capture system is not improved, the Scheimpflug technique will not be precise enough to define all the safety criteria essential to phakic IOLs.

CONCLUSIONS

Biometry of the internal dimensions of the anterior chamber has become essential as a result of modern technologies and the amount of safety we must be able to provide to patients. Today, a specialist in retinal surgery would never suggest macula surgery without an OCT study of the posterior pole; likewise, no refractive surgeon would propose corneal surgery without in-depth study of corneal topography. Progress in the field of phakic IOLs requires modern means of exploration and a full revision of anterior chamber biometry. Based on clinical results, it is simple to establish clear indication criteria and, by keeping to these rules, greatly reduce the number of complications. Therefore, with phakic IOLs, I believe it is essential to know the internal dimensions of the anterior chamber, the CLR or height, and the safety distance between the IOL and the endothelium. With this information, we will be able to preoperatively decide which type of IOL to choose (or exclude).

Modern surgery and medical imaging (cardiovascular exploration, neurosurgical exploration) are moving toward 3-dimensional (3-D) analysis of images or structures. Hence, with a team of 3-D imaging specialists from the University of Marseille and with data from the anterior segment OCT, we have begun to represent the anterior chamber and cornea in 3 dimensions. We hope to be able to develop software capable of automatically defining the surfaces and the junction zones to eliminate human error when taking measures. The study has just started, but the first results are very encouraging. Using different color scales, we can visualize the difference in light transmission in certain structures. However, further research is necessary in this area.

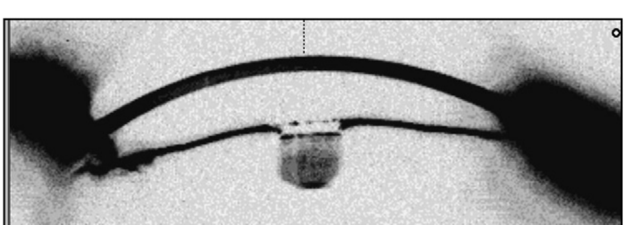

Figure 12. Negative Scheimpflug image with the Oculus Pentacam.

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