ESCRS 2010: The Editors' Picks

The Chief Medical Editors of *CRST Europe* choose highlights of the meeting in Paris.

The XXVIII Congress of the European Society of Cataract and Refractive Surgeons (ESCRS), held last month in Paris, offered updates on the latest advances for anterior segment surgeons. Every year, the meeting is a must-attend event for those who want to keep abreast of the state of the art in their field.

This year, in advance of the meeting, we reviewed the program and chose a number of presentations we thought would be important to our readers. Topics included the correction of presbyopia, recent improvements in IOL power calculation and anterior segment imaging, and endophthalmitis prophylaxis.

We contacted the presenters and asked them to contribute a few words summarizing their talks in advance of the meeting. On the following pages are the results of this effort.

Obviously these few choices reflect our own personal interests and are not meant to disparage the many other excellent papers and posters presented at the meeting. We hope our readers find this feature valuable, and we look forward to bringing you the best of the ESCRS for many years to come.

—Sheraz M. Daya, MD, FACP, FACS, FRCS(Ed), FRCOphth; Erik L. Mertens, MD, FEBOphth; and Khiun F. Tjia, MD
CRST Europe *Chief Medical Editors*

Objective Testing of Near Vision

By Oliver Findl, MD, MBA

With the aging of the population, there is increasing interest among cataract and refractive surgeons in the subject of presbyopia correction. In order to assess the success of presbyopia-correcting devices and procedures, it would be beneficial to objectively measure our patients' near vision.

In measuring near vision, however, we are assessing visual performance, which by nature is subjective. Despite this, it may be possible to standardize measurements to the degree that we can at least agree upon what we have measured. This paper reviews the current status of near-vision assessment and makes some suggestions for use in future research.

STANDARDIZATION

Recent trials assessing accommodating or multifocal IOLs measure near vision with some type of near chart. The problem is that these charts, and the way they are used, vary greatly.

First, in assessing near vision, we must differentiate between near acuity and reading performance. Near acuity measures the resolution of the patient's visual system. Optotypes such as Landolt rings allow us to assess optical factors like image quality.

Reading performance, on the other hand, is an assessment of visual function, rather than simply optical resolution. We perform functional vision testing to see what patients can do with their vision.

For measuring distance vision, the current standard is a logarithmic chart, such as the Early Treatment Diabetic Retinopathy Study chart. These types of charts are available for testing near acuity as well, but in most papers currently being presented on presbyopia-correcting or accommodating devices, a host of other charts, such as the Jaeger chart, are used.

Jaeger is an old notation, and there is great variation among Jaeger charts. The J1 on my chart may not equal the J1 on another surgeon's. Another notation, usually called N, is dependent on the font used. Some use Arial, some use Roman, and some use other fonts, and there are different print sizes depending on the font used.

For the sake of standardization, all near-vision testing should be done using logMAR charts, as we do for distance. This will help to make comparisons between and among presbyopia-correcting modalities more valid.

READING CONDITIONS

Psychophysical testing of near vision is affected by many factors:

• **Luminance** may vary from examination room to examination room, as well as from center to center in a multicenter trial.

• We typically test using high **contrast**—100% difference between black type and white background. In the real world, however, newsprint typically has only 70% contrast.

• Reading **distance** can be measured with a tape measure, but often it is not. Even when it is measured, there is fluctuation because the patient may change position while reading.

• Reading speed can be affected by **cognitive function** and other patient factors. Elderly patients may have good visual acuity and good visual function but cannot read quickly. Someone who reads four books a week may be faster than someone who read his last book 25 years ago.

• The presence or absence of **age-related macular degeneration** may be the most important factor in testing reading speed. Minute scotomata from the disease can reduce reading speed.

The SRD allows the examiner to vary luminance and contrast levels to simulate real-world conditions. It is standardized so that investigators can compare between centers in a multicenter trial.

EFFECTS ON READING ASSESSMENT

We assessed repeatability and the effect of patient motivation by the examiner using five near vision charts.[1] In 60 eyes of 60 pseudophakic patients who underwent standard cataract surgery with standard monofocal IOLs, distance-corrected near visual acuity was assessed with the Holladay, Rosenbaum, Nieden, Jaeger, and Radner charts. We tried to control for some of the factors listed above. Lighting conditions were optimized and constant distance was assured with the use of a chin rest.

We found that the charts were poorly correlated; the correlation never reached above 74%, and some correlations were barely above 50%. Repeatability was also poor; the same test administered twice, 20 minutes apart, could yield quite different results.

Patient motivation by the examiner was very important. We had the patient read once, and then the examiner prompted the patient before a second attempt, with words of encouragement such as, “Try a little harder.” Patients did about 1 line (5 optotypes) better after being motivated.

Finally, there was an influence of pseudoaccommodation. These patients had good distance vision, but we were testing their near acuity without near correction. There was a lot of scatter and no correlation between BCVA and near vision performance. The difference is probably due to pupil size, multifocality of the cornea, and other factors that influence depth of focus.

SALZBURG READING DESK

We would like to have an accurate and repeatable way of measuring reading function or near visual acuity—something examiner-independent and standardized so that we can compare results across centers.

We assessed the reliability of the Salzburg Reading Desk (SRD),[2] from the laboratory of Gunther Grabner, MD, in a cross-sectional prospective study.[1] In patients after standard cataract surgery with standard monofocal IOLs, we measured reading acuity and reading speed with distance correction in three situations: high contrast/high luminance; low contrast/high luminance (eg, bad newspaper print); and low contrast/low luminance (eg, a menu in a dark restaurant). We also compared the desk to the printed version of the reading chart.

Between the printed chart and the SRD, there was no difference between the smallest print that could be read and no difference in reading distance. However, we found that for elderly pseudophakic patients, reading speed was faster with the SRD than the paper version.

The SRD allows the examiner to vary luminance and contrast levels to simulate real-world conditions. It is standardized so that investigators can compare between centers in a multicenter trial. For multifocal IOL testing, the low contrast/low luminance setting of the SRD may be of interest because of the loss of contrast sensitivity with multifocal IOLs.

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OCT in Anterior Segment Diagnostics and Imaging

By Jaime Aramberri, MD

Technologies for optical coherence tomography (OCT) of the anterior segment have rapidly become indispensable for refractive surgeons. The first technology to enter the market was a time-domain system, the Visante OCT (Carl Zeiss Meditec, Jena, Germany). More recently, several Fourier-domain OCT systems have become available, including the Cirrus (Carl Zeiss Meditec), the 3D OCT-2000 (Topcon Corp., Tokyo), and the RTVue (Optovue Inc., Fremont, California). I am familiar with all three of these Fourier-domain units, having used the RTVue for 2 years and the Cirrus and 3D OCT-2000 for 4 to 5 months.

Time-domain OCT offered a large field of view but relatively low resolution, making it useful to image and measure large anterior segment features. The newer Fourier-domain instruments offer higher resolution, making them better suited to image and measure smaller features. However, they are restricted to a smaller field of view, limiting the extent of exploration to approximately 2.5 mm depth and 6 mm width.

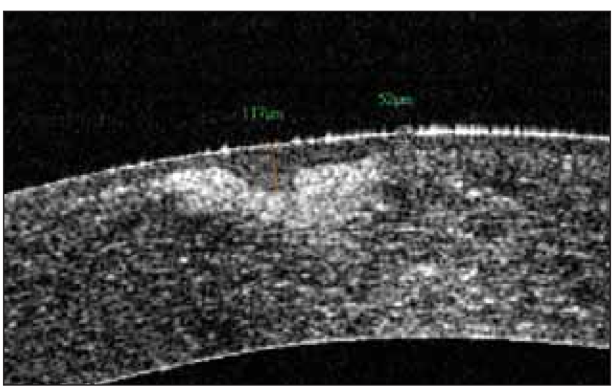

Figure 1. Corneal scar filled with epithelium. Transepithelial PTK to a depth of 115 µm was performed.

Despite their limitations, these instruments have rapidly been substituted some older technologies, such as ultrasound or Scheimpflug imaging for pachymetry and postoperative evaluation after refractive surgery. But, more important, these instruments now allow the performance of diagnostic evaluations that would not have been possible with previously available technologies.

For instance, OCT allows the examination of the stromal interface in eyes with suboptimal outcomes after LASIK. Problems such as epithelial ingrowth or fluid in the interface that could not be detected at the slit lamp or with topography can be seen and measured with OCT.

OCT is also useful in planning the treatment of corneal scars with transepithelial phototherapeutic keratectomy (PTK) and PRK (Figure 1). Previously, the surgeon did not know how deep to make a therapeutic ablation until the scar was eliminated, meaning the compensatory refractive portion of the ablation had to be calculated in real time. OCT now permits measuring the depth of stromal scars and epithelium, allowing the planning of therapeutic and compensatory refractive ablation depths preoperatively.

The technology can also be used to monitor the healing of corneal infections that occur as complications of refractive procedures. Improvement in the patient's condition with the application of antibiotics can be tracked as a decrease in the extent and depth of stromal infiltration on OCT (Figures 2 and 3).

Other applications for OCT include assessing the position of intrastromal corneal ring segments in the stroma (Figures 4 and 5) or phakic IOLs in relation to the cornea and crystalline lens.

Anterior segment Fourier-domain OCT now allows us to measure anything we can see at the slit lamp. With the ability to quantitatively assess features that we could previously assess only qualitatively, our diag-

Figure 2. Corneal infection 3 days after PRK. Stromal infiltration and peripheral thinning can be seen.

Figure 3. Same eye as Figure 2, but 5 days later. Positive response to topical antibiotic treatment with decrease in stromal infiltration. Epithelial defect can be seen.

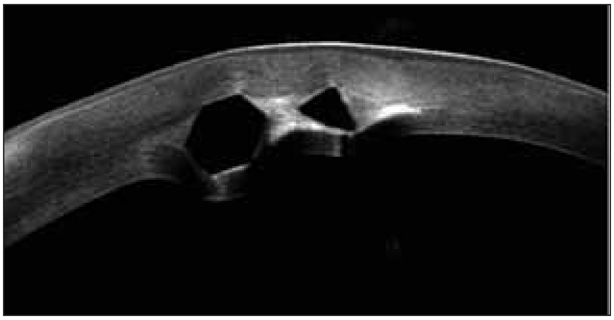

Figure 4. Unusual case with Intacs and Keraring in the same keratoconic cornea. Typical stromal deposit between both segments and medial to the Keraring. Compensatory changes of epithelial thickness can be seen.

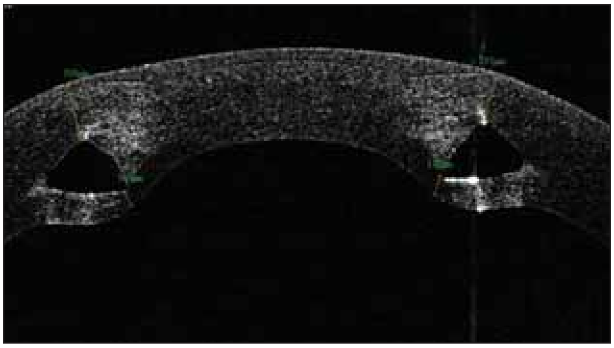

Figure 5. Keraring for post-LASIK ectasia. Correct deep location of the segment can be assessed and measured.

nostic ability improves, and this has a direct effect on our therapeutic decisions. These devices have rapidly become essential tools for the modern refractive surgeon.

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Cost-Effectiveness of Intracameral Cefuroxime

By Ayman Naseri, MD

Postoperative endophthalmitis is one of the most feared complications of cataract surgery. There is now persuasive evidence that direct injection of antibiotics lowers the risk of endophthalmitis after cataract surgery, including the multicenter prospective study of the effectiveness of intracameral cefuroxime sponsored by the ESCRS.[1]

Despite this evidence, there is still considerable variability in the methods of prophylaxis used throughout the world. In the United States, for example, most surgeons favor topical antibiotics, most often one of the fourth-generation fluoroquinolones.[2]

We performed a study to determine the differences in cost-effectiveness among several common antibiotic choices for endophthalmitis prophylaxis. We wanted to determine the levels of cost and efficacy necessary to match the cost-effectiveness of intracameral cefuroxime.[3]

Cost is relatively easy to discern, but effectiveness requires rigorous evidence, preferably level 1 evidence. For intracameral cefuroxime, we can calculate cost and effectiveness using fairly rigorous data, such as that from the ESCRS study and others, but for the comparison drugs it is more difficult.

There are two ways to make a comparison when efficacy data are lacking. One is to calculate the cost of the comparator drug and then assume 100% efficacy for that drug. The other is to assume that the cost-effectiveness of the two drugs is equivalent, and then ask the question, "How effective must the comparator drug be to achieve equivalence to cefuroxime?"

In our study we asked three questions: (1) What is the cost-effectiveness of intracameral cefuroxime for prevention of endophthalmitis? (2) How cost effective are alternative antibiotics, assuming 100% efficacy? and (3) How effective would these other options have to be to achieve cost-effective equivalence to intracameral cefuroxime?

We calculated the answers for several topical fluoroquinolones, for topical and subconjunctival generic antibiotics, and for intracameral moxifloxacin. In calculating costs, we used average wholesale prices in 2007 US dollars (USD). For intracameral and subconjunctival drugs, we also calculated additional costs such as the cost of preparation as well as nondurable items such as saline solution and syringes.

Using these methods, a dose of intracameral cefuroxime cost $2.83. (All numbers herein are in 2007 USD.) By comparison, intracameral moxifloxacin was $13.81 per dose, and topical fourth-generation fluoroquinolones were more than $50 per bottle.

For effectiveness measurements in this study, we used the large (225,000 patients) prospective study by Lundstrom and colleagues.[4] The rate of endophthalmitis in that study was 0.045%.

QUESTIONS

Question 1: What is the cost-effectiveness of intracameral

cefuroxime for the prevention of endophthalmitis? Using these calculations, a health care system would pay $1,403 to prevent one case of endophthalmitis. But if a case is prevented, there is also a cost savings because no treatment is needed for that prevented infection. The cost of treating a case of endophthalmitis, based on US Medicare claims data, is $3,793. Therefore, in a hypothetical cohort of 100,000 eyes, the use of intracameral cefuroxime leads to a cost savings of $480,000.

Question 2: How cost effective are alternative antibiotics, assuming 100% efficacy? Other drugs were also cost saving, except for topical fluoroquinolones. In a hypothetical cohort of 100,000 eyes, topical moxifloxacin would cost $4.5 million and topical gatifloxacin $4.8 million.

Question 3: How effective would other options have to be to achieve cost-effective equivalence to intracameral cefuroxime? The generic antibiotic polymixin would have to be 4.4 times more effective than intracameral cefuroxime to have equivalent cost-effectiveness. The fourth-generation fluoroquinolones would have to be almost 20 times more effective than cefuroxime to achieve cost-effective equivalence.

It is safe to say that intracameral cefuroxime is a highly cost-effective measure for the prophylaxis of endophthalmitis, and other more expensive antibiotics are less likely to be cost-effective, even under optimistic assumptions regarding their effectiveness.

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Improved IOL Power Calculation Using Lenstar Measurements

By Thomas Olsen, MD

For many years, the greatest source of error in IOL power calculation was the accuracy of ultrasound for the measurement of axial length. Since the introduction of optical partial coherence interferometry (PCI) for the measurement of axial length with the IOLMaster (Carl Zeiss Meditec), this has changed. The tenfold higher accuracy of PCI compared with ultrasound has greatly improved the refractive accuracy of lens surgery.

Today, the major source of error in the calculation of IOL power is no longer axial length but rather the error associated with the estimation of the effective lens position (ELP) or the postoperative anterior chamber depth (ACD) after IOL implantation.

Estimation of ACD remains a truly empirical element of any IOL power calculation formula, as it is hard to predict from theoretical considerations alone. In the past, no widespread effort was made to predict the ACD; most old formulas called for only a keratometry (K) reading and axial length as input variables. Personalized surgeon factors were used to fit theory with practice.

The clinical environment has changed since those earlier days. Surgeons now use small incisions and place the IOL in the capsular bag through the capsulorrhexis. Therefore the need for personalized factors to describe the position of the IOL may be reduced. It is a logical assumption that anterior segment anatomy and the dimensions and position of the preoperative capsular bag may be predictive of the postoperative position of the IOL. This was shown in a series of 6,698 cases[1] in which we found a highly significant association of preoperative ACD and lens thickness with the postoperative ACD.

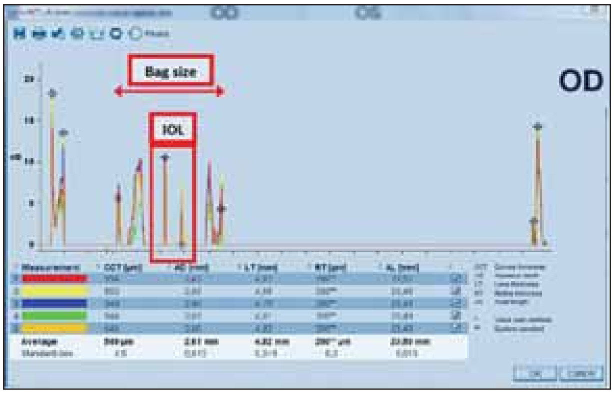

Figure 6. Lenstar LS900 scan of an eye before surgery allows the measurement of corneal thickness (CCT), anterior chamber depth (AD), lens thickness (LT), and axial length (AL) using PCI. The postoperative scan of the eye documents the position of the IOL, which has been implanted in the bag.

BIOMETRY AND POWER CALCULATION

The Lenstar LS900 (Haag-Streit, Koeniz, Switzerland) optical biometer measures corneal thickness, ACD,

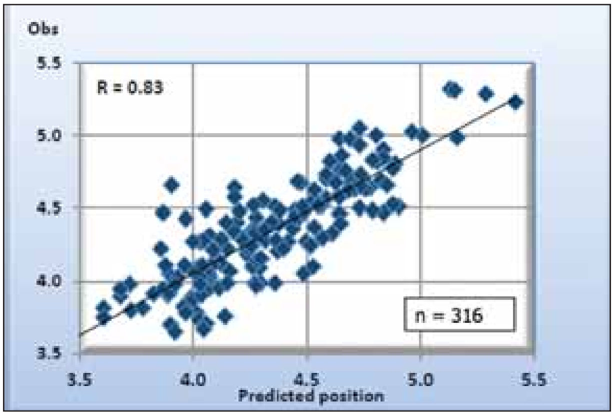

Figure 7. Prediction of the postoperative position of the IOL in a series of 300 cases using the Lenstar LS900 measurement of CCT, AD, LT, and AL. The formula-predicted position is plotted against the measured position also measured by the Lenstar.

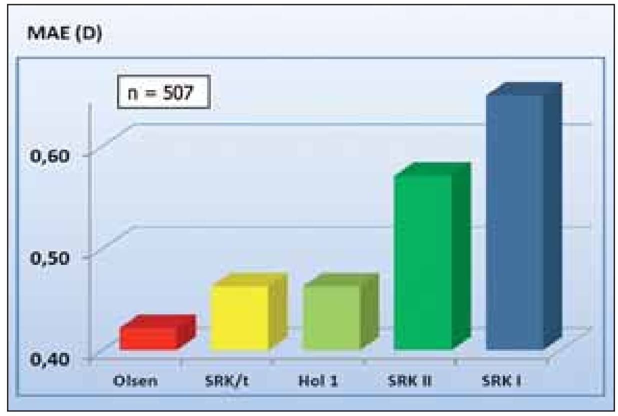

Figure 8. The mean absolute prediction error (MAE) with the Olsen formula as compared with other IOL power formulas in a series of 350 consecutive routine cases having uncomplicated lens surgery (*P* < .01).

Figure 9. The percentage of cases within 1.00 D with the new method as compared with other IOL power formulas in a series of 350 consecutive routine cases having uncomplicated lens surgery (*P* < .01).

lens thickness, and total axial length in a single scan. In pseudophakic eyes, it is often possible to measure the exact position and thickness of the implant. Comparing scans pre- and postoperatively, we can document the position of the implant relative to the preoperative bag size and study the relationship with the anterior segment anatomy (Figure 6). This information may be of great value for IOL power calculation.

I have developed an IOL power calculation formula[2] that eliminates the need for fudge factors. We obtained good results with this formula using Lenstar measurements of ACD and lens thickness for the prediction of the postoperative ACD (Figure 7).[3] The ACD prediction uses a four-variable regression equation, with ACD, lens thickness, corneal radius, and axial length as input parameters.

The [Olsen] ACD prediction uses a four-variable regression equation, with ACD, lens thickness, corneal radius, and axial length as input parameters.

Using Lenstar measurements with our formula, we found a significant reduction of the mean absolute error in refractive prediction compared with conventional IOL power formulas (SRK I and II, SRK/T, and Holladay 1) in a series of 350 consecutive routine eyes undergoing uncomplicated lens surgery due to cataract or refractive errors (Figure 8).[3] Eyes with poor visual acuity (less than 20/40), post-LASIK eyes, and those with poor quality of axial length reading or with astigmatism greater than 4.00 D, were excluded. More than 95% of eyes were within 1.00 D with our method, significantly better than with the other methods (Figure 9). ■

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