Sponsored by
OCULUS

PENTACAM

WHY WE NEED A NEW KERATOCONUS STAGING SYSTEM

Physicians need to identify ectatic disease earlier, clearly classify disease severity, and track progression.

BY MICHAEL W. BELIN, MD

All patients are not created equal and should not be treated the same, which can happen when using outdated technology. A perfect example of this is the Amsler-Krumeich grading system for keratoconus, which is over 70 years old and, in my experience, no longer has clinical validity.

We need a new classification system because the Amsler-Krumeich grading system has limitations. Its staging system may be confusing and does not convey useful clinical information. Its stage 1 is a meaningless term, because half of the world's population has stage 1 "disease." The system predates topography/tomography, relies on apical thickness, and does not take posterior surface into account.

The global consensus on keratoconus and ectatic diseases published last year in *Cornea* concluded that we do not have an effective way to classify or stage keratoconus and document progression.[1] Surgeons need a new system that recognizes full anatomical changes, including those in anterior cornea and posterior cornea as well as corneal thickness. The new system should have simple parameters, be platform independent so that it can be used with any tomographic device, and make it easy to convey information. The new classification system should allow surgeons to effectively evaluate different treatment modalities—cross-linking, intracorneal rings, deep anterior lamellar keratoplasty, penetrating keratoplasty, or rigid gas permeable contact lenses—so that they can determine the most effective treatment for their patients.

The Pentacam (Oculus) has the ability to identify ectatic disease earlier than previously possible and can create a baseline to track progression. It does this automatically by using the new keratoconus classification system: the Belin ABCD keratoconus classification system. **A** is the Anterior radius of curvature, **B** is the posterior (Back) radius of curvature, **C** is the thinnest Corneal thickness reading; and **D** is the Distance visual acuity (Figure).

The Belin/Ambrosio (BAD) display is an efficient, easy-to-read, color-coded display used for screening presurgical patients. It evaluates anterior and posterior elevation using a standard best-fit sphere, an enhanced reference surface, and the difference in elevation between the two reference surfaces, as well as corneal thickness, including pachymetric progression and the cornea's thinnest point and thinnest displacement.

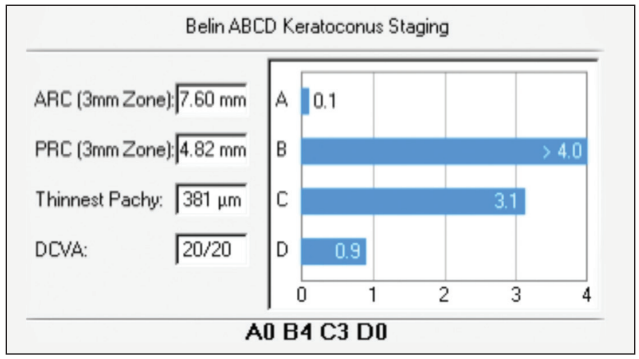

Figure. The Pentacam has the ability to identify ectatic disease earlier than previously possible and can create a baseline to track progression using the Belin ABCD classification system.

BAD III has a new regression analysis with new parameters, including elevation at the cornea's thinnest point, maximum keratometry, and Ambrosio Relational Thickness (ARTmax). It displays hyperopic data, has the option to turn off yellow/red for small d, and has improved AUROC. In the BAD display, the individual values are reported as standard deviation (SD) from the mean and will change color to yellow at 1.6 SD from the norm and red at 2.6 SD from the norm. In the improved BAD display, the final D is an overall reading of all the parameters based on a regression analysis. The individual D values have different weighting.

In summary, the Pentacam can screen for and detect keratoconus or corneal ectasia much earlier than previously possible.[2,3] ■

1. Gomes, JA, Tan D, Rapuano CJ, et al; Global Delphi Panel of Keratoconus and Ectatic Diseases. Global consensus on keratoconus and ectatic diseases. *Cornea.* 2015;34(4):359-369.
2. Villavicencio OF, Gilani F, Henriquez MA, et al. Independent population validation of the Belin/Ambrósio enhanced ectasia display: implications for keratoconus studies and screening. *Int J Kerat Ect Cor Dis.* 2014;3(1):1-8.
3. Belin MW, Villavicencio OF, Ambrósio Jr RR. Tomographic parameters for the detection of keratoconus: suggestions for screening and treatment parameters. *Eye Contact Lens.* 2014;40(6):326-330.

Michael W. Belin, MD
- professor of ophthalmology and vision science at the University of Arizona in Tucson
- mwbelin@aol.com
- financial disclosure: consultant to Oculus

PENTACAM-AXL

IMPROVING CATARACT SURGERY OUTCOMES

A total screening tool, the Pentacam-AXL allows physicians to preoperatively examine patients with one instrument instead of two.

BY H. JOHN SHAMMAS, MD

The Pentacam-AXL (Oculus) does everything the original Pentacam does with a couple of added features: it measures the axial length and accurately calculates IOL power, which is like having two units in one.

The Pentacam-AXL delivers precise AXL and keratometry (K) readings for accurate IOL power calculation (Shammas et al, unpublished data, 2016).[1] In addition, the IOL calculation software takes the conditions of the patient's eye—ie, posterior corneal astigmatism and prior refractive surgery—into account, and it uses customized formulas to calculate IOL power for post-radial keratotomy and post-LASIK eyes.

The Fast Screening Report alerts the surgeon about possible abnormalities in the patient's eye such as keratoconus, corneal opacities, and anterior chamber changes. It does this by comparing the patient's data to normative data from confirmed scientific studies. Patient data are presented all on one screen, making it easier to review.

Toric IOL calculations with the Pentacam-AXL, in my experience, are easier and more accurate, and are performed automatically without the need for additional calculators. An added benefit is the overview image and K overlay.

The Pentacam-AXL allows K reading measurement to be taken from three different maps: sagittal (axial) power map, true net power map, and total corneal refractive power map (Figure). These K readings can be measured at the 2-, 3-, 4-, and 5-mm rings or at the 2-, 3-, 4-, and 5-mm zones.

The Pentacam-AXL provides precise astigmatism calculations, which are critical to meet the high expectations of patients who pay out of pocket for procedures. All keratometers, including the IOLMaster (Zeiss) and the Lenstar (Haag-Streit), measure the K readings only from the anterior corneal surface. They do not take into account the astigmatism produced by the posterior corneal surface. The Pentacam-AXL calculates the total corneal astigmatism. The best way to measure total corneal astigmatism is through ray tracing, given by the total corneal refractive power map. Two studies by Koch et al and Tonn et al showed that the amount of astigmatism in the posterior corneal surface is important to the total corneal astigmatism calculation.[2,3] Therefore, surgeons owe it to their patients to calculate the total corneal astigmatism.

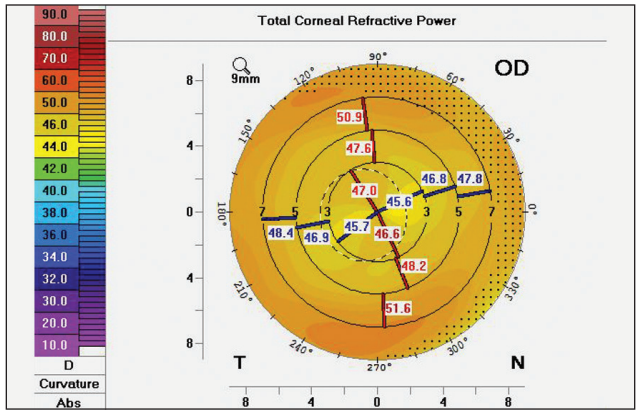

Figure. The Pentacam-AXL allows K reading measurement from three power maps: sagittal, true net, and total corneal refractive.

I especially like using the Pentacam-AXL in challenging cases because, in my experience, I get better K readings in patients who have had prior myopic or hyperopic LASIK. I use the wavefront analysis to determine which IOL to use. In patients who have had prior radial keratotomy, I obtain better central K readings for more accurate IOL power calculations. In patients with keratoconus, I confirm the K readings on the optical axis not on the corneal apex. I get a more accurate total astigmatism value and its axis from the total corneal refractive map for patients contemplating a toric IOL. For patients considering a bifocal IOL, I get a better assessment of the corneal optical quality with wavefront analysis.

In summary, the Pentacam-AXL offers all the advantages of the original Pentacam plus axial length measurement and a built-in IOL calculator. ■

1. Fityo S, Buhren J, Shajari M, Kohnen T. Keratometry versus total corneal refractive power: analysis of measurement repeatability with 5 different devices in normal eyes with low astigmatism. *J Cataract Refract Surg.* 2016;42(4):569-576.
2. Koch DD, Ali SF, Weikert MP, et al. Contribution of posterior corneal astigmatism to total corneal astigmatism. *J Cataract Refract Surg.* 2012;38(12):2080-2087.
3. Tonn B, Klaproth OK, Kohnen T. Anterior surface–based keratometry compared with Scheimpflug tomography–based total corneal astigmatism. *Invest Ophthalmol Vis Sci.* 2014;56 (1):291-298.

H. John Shammas, MD

- in private practice at the Shammas Eye Medical Center; clinical professor of ophthalmology at the Keck School of Medicine of the University of Southern California in Los Angeles
- hshammas@aol.com
- financial disclosure: speaker for Oculus