

# Topographic Interpretation of Keratoconus

Identifying patients at risk.

BY STEPHEN D. KLYCE, PHD

Careful screening with corneal topography is critical in refractive surgery to differentiate the normal cornea from the abnormal. There are two guiding principles for the practitioner. First, to ensure consistent interpretations, the topographer's color-coded contour map of surface powers should be set with a standard fixed scale, one that does not change its range with different corneas. Second, for routine use, powers should be presented with the axial power method, which is common to all topographers. With these basic guidelines in mind, refractive surgeons can review the features of corneal topography that help with the detection of keratoconus. (Figure 1).

between eyes are abnormal, similar to what occurs with unilateral keratoconus. To estimate the gradient, one can use the inferior power minus superior power calculation. When

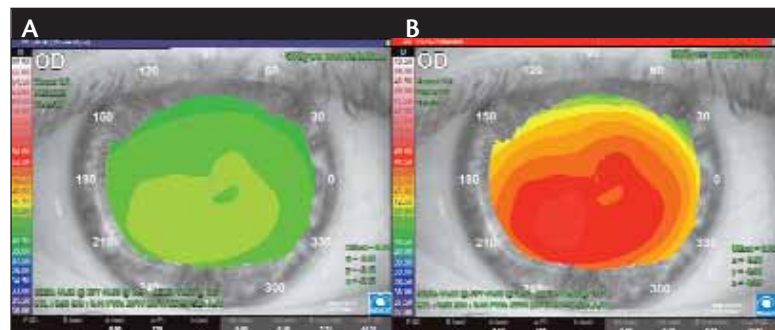


Figure 1. The topography of this patient's cornea is quiet and normal, using a fixed scale of 1.50 D (A). The same corneal topography using a 0.50 D scale tells a different story (B).

## TOPOGRAPHIC INTERPRETATION OF KERATOCONUS

### Normal Versus Abnormal

The hallmark of keratoconus is a localized region of generally inferior steepening seen with corneal topography. To draw a line between normal corneal asymmetry and keratoconus, one can measure the gradient in power along the steep axis and look for skewed radial axes. Other topographic abnormalities include significant differences between the patient's eyes in central and peripheral pachymetry, the axes of cylinder, and keratometric readings. Such differences

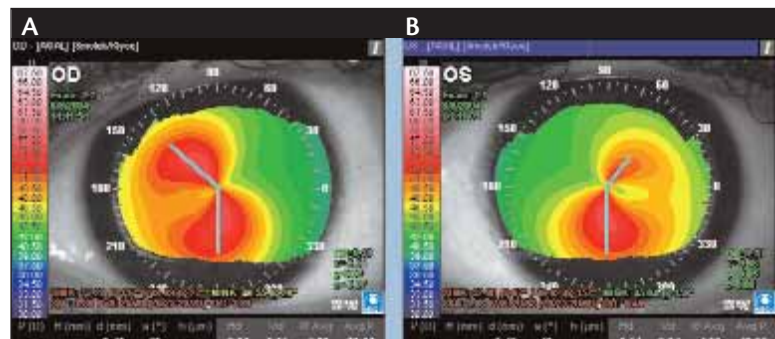


Figure 2. These keratoconic corneas show the lazy eight bow tie pattern with skewed radial axes marked by the blue lines (A and B). Only the left eye (B) shows asymmetry in the bow tie pattern.

the calculation is done by the computer, an average of five points 30° apart and 3 mm above and below are subtracted to find the difference. One can estimate this calculation with the computer's cursor by measuring the powers above and below and taking the difference. If the gradient is greater than 1.40 D, the topography is consistent with forme fruste or suspected keratoconus. If the gradient is greater than 1.90 D, then the topography can be interpreted as clinical keratoconus. A pattern I call *lazy eight* on topography indicates skewed radial axes, is a sure sign of corneal abnormality, and is usually due to keratoconus (Figure 2).

**Contact Lens History**

When screening patients for refractive surgery, always take a careful contact lens history, because contact lenses can warp their corneas. In such cases, ask the patients not to wear their contact lenses for several weeks until the topography is normal and their refraction is stable (Figure 3).

**Pellucid Marginal Degeneration**

Pellucid marginal degeneration is a definite contraindication for standard refractive surgery. One must look for a claw or "C" shape on topography (Figure 4) as well as against-the-rule cylinder.

**Interpretive Schemes**

Drawing the line between normal and abnormal

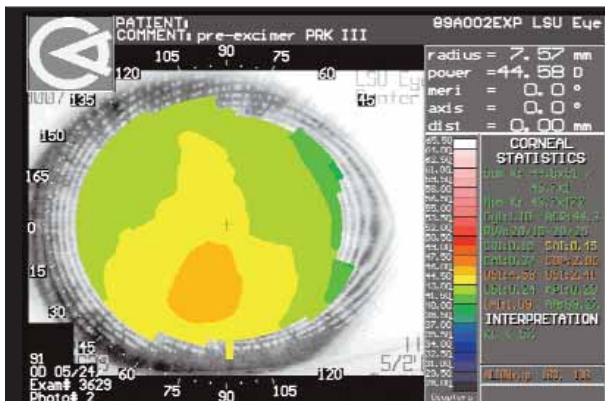


Figure 5. This cornea shows a mild amount of inferior steepening and is a good example of where a quantitative method is needed to classify an eye as normal or abnormal.

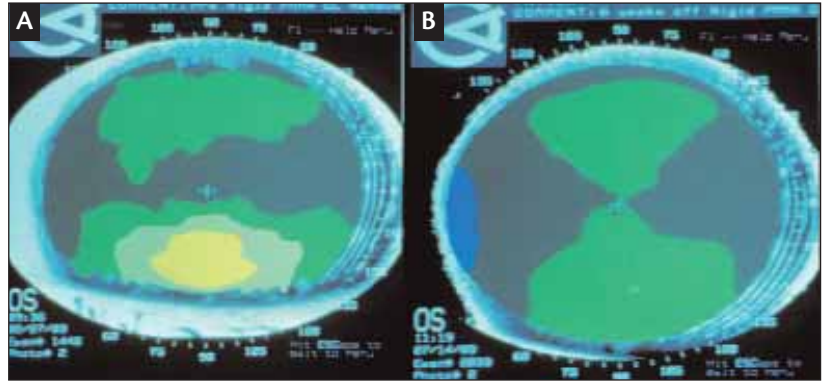


Figure 3. Contact lenses molded the cornea with a keratoconus-like inferior steepening (A). After 6 weeks of nonwear, corneal topography normalized with a symmetrical bow tie pattern (B).

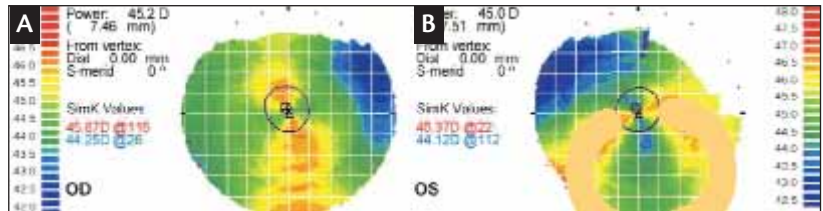


Figure 4. The right eye is abnormal with a truncated bow tie pattern (A). The left eye shows clear signs of pellucid marginal degeneration with the "C" shaped pattern (B).

topography is challenging (Figure 5). To help with this task, my colleagues and I have been working since 1994 to develop interpretive schemes based on the computer analysis of corneal topography.<sup>1</sup> These interpretive methods have been available commercially with the Tomey Keratoconus Screening software (Tomey Corporation, Nagoya, Japan) for some time, and we have since developed a system that categorizes topographies into several different classifications (Magellan Corneal Navigator, Nidek Technologies, Padua, Italy). The Nidek system



Figure 6. The Magellan Corneal Navigator's screen classifies this cornea as astigmatic, keratoconus suspect, and within the limits for clinical keratoconus.

identifies whether a cornea is normal, astigmatic, suspected keratoconus, pellucid marginal degeneration, and so on using neural networks. These systems also offer a number of statistical indices that help surgeons understand the difference between the normal and abnormal corneas (Figure 6).

“Careful screening and strict exclusion criteria will reduce the chance of ectasia and help build a plaintiff-free zone around your practice.”

### PREDICTING ECTASIA

A number of risk factors are associated with keratectasia after refractive surgery: ectatic disease; thin corneas pre- or postoperatively; high corrections; and thin residual stromal beds. It is important to understand that not every patient with known risk factors will develop keratectasia and that some with no known, recognized risk factors will develop the condition.

Even if all clinicians practice well above the standard of care, all complications will not be avoided. Careful screening and strict exclusion criteria, however, will reduce the chance of ectasia and help build a plaintiff-free zone around one's practice. ■

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1. Maeda N, Klyce SD, Smolek M, Thompson W. Automated keratoconus screening with corneal topography analysis. *Invest Ophthalmol Vis Sci.* 1994;35:2749-2757.

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