Parameters to Document Progression of Keratoconus

The ability to measure how a patient's disease changes is key.

BY MICHAEL BELIN, MD

PROGRESSIVE KERATOCONUS: CRITERIA AND CONSENSUS

The Keratoconus Expert Group, conceived and established by Jérôme C. Vryghem, MD, is a vibrant group of invited international corneal experts with special interest in keratoconus. Prior to the meeting of the European Society of Cataract and Refractive Surgeons (ESCRS) in October 2013, the group, in its fourth year, convened with a specific purpose to arrive at a consensus in three principal areas: (1) the criteria used to determine the progression of keratoconus, (2) when (and how) to perform corneal collagen crosslinking, and (3) the value of intrastromal corneal ring segments.

I had the privilege and rather challenging job of chairing the section on establishing criteria for measuring the progression of keratoconus. I say challenging because, as you will see from the articles in this bonus feature—particularly those by A. John Kanellopoulos, MD, and Michael Belin, MD—there are considerable differences in opinion on this subject.

Although there is general agreement about what should be considered *progression*, it is clear that more scientific study is required when it comes to measuring *subtle progression*. There are a number of variables at play, and each one is unique, with its own characteristics. Even data analysis using averages is fraught with problems, unless one has the luxury of access to 100% data in all eyes at all timeframes with similar criteria, including cessation of contact lens wear prior to evaluation. As Dr. Belin points out, most patients with keratoconus are dependent on hard contact lenses, and, as these lenses definitely affect anterior corneal shape, basing decisions mainly on anterior parameters carries risk of potential error. Requesting that patients with keratoconus keep their lenses out for 1 month in order to evaluate them properly is idealistic and probably overkill.

Often, when there is considerable controversy, simple approaches are best. Dr. Belin's approach is quite attractive: Corneal thickness and posterior elevation may be the best criteria to use, perhaps with the addition of corneal volumetric change. We may also need an alternative approach altogether, using a different method of diagrammatic presentation; Damien Gatinel, MD, has used a clever method in his Score software (Bausch + Lomb Technolas), which employs multiple variables to evaluate the risk of keratoconus in corneas prior to elective ablative refractive surgery.

Getting back to basics, evaluating markers for keratconus is likely the ultimate tool, and Jesús Merayo, MD, PhD, reports on some of his work in this area, which looks interesting and promising. We hope you enjoy these articles, and we expect that you have your own individual opinions. Please do not hesitate to contact us—we would love to have the opportunity to publish your views.

—Sheraz M. Daya, MD, FACP, FACS, FRCS(Ed), FRCOphth
Chief Medical Editor

When treating a patient with keratoconus, several aspects of care must be taken into consideration, including diagnosis, disease progression, and efficacy of treatment. It is difficult to isolate one of these factors from the totality of a patient's care. However, it is important for us to consistently evaluate our approach to each of the aforementioned aspects, as doing so will ultimately improve our management of keratoconus.

When we talk about measuring the progression of keratoconus, there is a difference between showing progression in moderate to advanced disease and
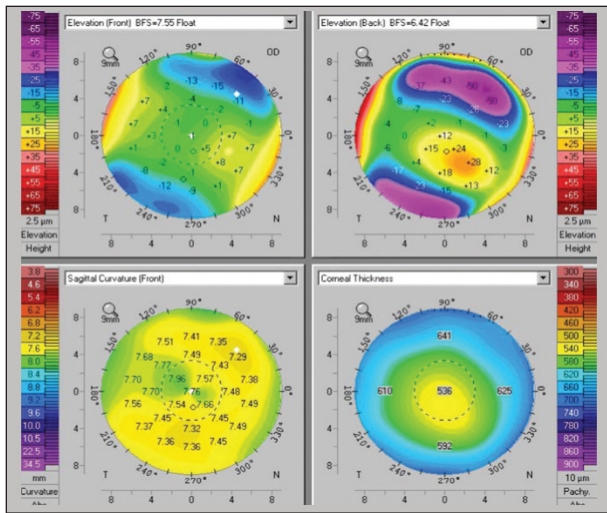
Figure 1. A four-map composite (anterior and posterior elevation, anterior curvature, and corneal thickness) on the Pentacam (Oculus Optikgeräte), showing a normal anterior surface but prominent posterior ectasia. There is a small displacement of the thinnest point in line with the posterior ectasia.

documenting progression in early or subclinical disease. It is key to be able to measure how a patient's disease changes, and five parameters are used to document this progression. These include the anterior and posterior corneal surfaces, epithelial thickness, BCVA, and corneal thickness. This article aims to identify the best parameter for documenting disease progression, highlighting the advantages and disadvantages of each measure.

FIVE PARAMETERS

Parameter No. 1: Anterior corneal surface. Patients with early clinical keratoconus are typically prescribed rigid contact lenses. The problem with using the anterior surface as a measure of progression is that it can be altered by these lenses. Additionally, curvature can change with the axis of measurement, so, as the disease changes, the measurement of total curvature—not just anterior curvature but posterior curvature—does not really mimic the change in the disease. Additionally, subclinical disease (ie, true ectasia with a normal anterior surface) will not show changes on the anterior surface until later in the disease process (Figure 1).

Parameter No. 2: Epithelial thickness. Readily available commercial methods for determining a patient's epithelial thickness are lacking, and, therefore, this measure cannot be used for screening patients. Although there has been some early work evaluating epithelial thickness in keratoconus, there is no published literature exploring the progression of disease with relation to epithelial thickness.
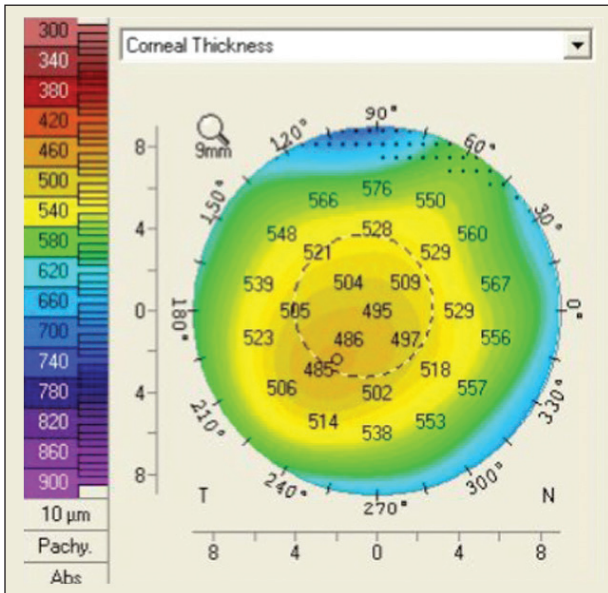
Figure 2. Full Pentacam corneal thickness map, showing displacement of the thinnest point inferiorly and temporally.
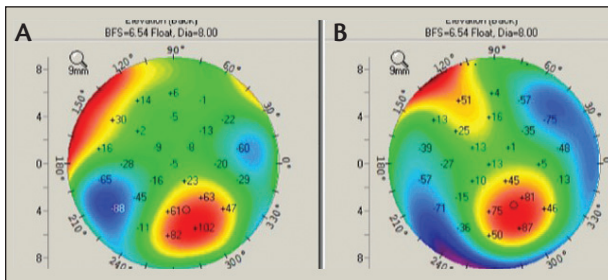

Figure 3. Two Pentacam posterior elevation maps taken over time. The most recent (A) shows 15 µm of elevation change (ie, increase). The best-fit sphere reference surface is kept constant in both exams (A, B).

TAKE-HOME MESSAGE

- Five parameters used to document the progression of keratoconus are the anterior and posterior corneal surfaces, epithelial thickness, BCVA, and corneal thickness.
- With a full-thickness corneal map, change in corneal thickness can be seen not just at a single point, but over the entire map.
- Of the parameters used to document keratoconus progression, the posterior surface is the least affected by outside forces.
- When elevation maps are used for following patients with keratoconus, one key is to keep the reference surface constant.

Parameter No. 3: BCVA. Patients with keratoconus have variable BCVA. It can change from day to day, depending on which part of the cornea is evaluated; it also changes dramatically depending on pupil size and varies with lighting. Due to this variability, BCVA is not a reliable measure of keratoconus progression.

Parameter No. 4: Corneal thickness. Single-point measurements of corneal thickness are also probably not suitable indicators of progression because, again, they can vary significantly with exam. A full corneal thickness map, however, does have good potential to document progression (Figure 2).

Parameter No. 5: Posterior surface. Of the parameters used to document keratoconus progression, the posterior surface is the least affected by outside forces. Some change in the posterior surface can be seen with contact lens wear, but not nearly as much as on the anterior surface. The posterior surface has strong potential for measuring disease progression (Figure 3).

SUMMARY

As we all know, patients with keratoconus may have changes in their visual axes and lines of sight as well as changes in their corneal curvature that do not mimic the shape of the cornea.

In my experience, the best parameters for documenting the progression of keratoconus are corneal thickness and the status of the posterior surface. With a full-thickness corneal surface map, the change in corneal thickness can be seen not just from a single point, but over the entire map. Posterior elevation maps are also effective for evaluating change.

When elevation maps are used for following patients with keratoconus, one key is to keep the reference surface constant. By convention, the preoperative or initial exam is usually used as a baseline.

In my opinion, full-thickness corneal surface maps and posterior elevation maps are the best ways to measure disease progression in patients with keratoconus. ■

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