

Diagnosing Early Keratoconus

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Epithelial Thickness Mapping with the Optovue is helping ophthalmologists identify the first signs of this condition.

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It had been speculated for many years that in keratoconus, the corneal epithelium responds to the thinning and ectasia of the cornea in a vivid way. We now know that corneal thinning prompts the epithelium to grow thinner as well. But in the area adjacent to the corneal thinning, the epithelium becomes thicker, as nature attempts to cover the irregularity and reduce the symptoms.

High-frequency ultrasound has been able to show these phenomena for some time. Today, the Optovue Avanti Widefield OCT can show these activities quickly and easily via its Epithelial Thickness Mapping (ETM) software, which produces a color-coded map of the epithelial thickness across the central 6 mm of the cornea.

The Clinical Importance of ETM

In healthy eyes, epithelial thickness is universal (approximately 53 μm in all eyes), regardless of age and other factors. A rare variation in that thickness could indicate a problem such as early keratoconus.

The early detection of keratoconus has gained importance since the advent of corneal cross-linking (CXL). Instead of prescribing glasses and corrective contact lenses or performing a transplant for keratoconic patients, we can actually help slow or halt the disease's progression.

To detect keratoconus as early as possible, we must learn more about its signs and routinely screen eyes for the condition. I use ETM to map the corneal epithelium of every patient in my practice. It is an indispensable tool for me to diagnose keratoconus and assess its progression.

To identify early epithelial changes in keratoconic eyes, we start with what we know. We know about the compensatory nature of epithelial distribution in response to anterior stromal surface irregularities. Specifically, the epithelium is thinner over the steeper, conic area in a keratoconic eye and thicker over the flatter areas. This compensation can prevent us from seeing topographical changes in the early stages of the disease.

My colleagues and I wanted to better understand this phenomenon, so we conducted a study of normal corneas, untreated ectatic corneas, and ectatic corneas previously treated with CXL to determine if their overall epithelial thickness would reveal a very early ectasia prognostic factor for keratoconus.¹ We found that a keratoconic condition causes an overall increase in epithelial thickness, particularly in younger patients. This "reactive" epithelial hypertrophy may precede any of the standard findings on corneal topography or tomography.

High-frequency ultrasonic biomicroscopy showed that (1) cross-

linked corneas have lower elasticity and a thinner epithelium than normal corneas; (2) keratoconic corneas have a much thicker epithelium overall; and (3) keratoconus suspects have a thicker epithelium as well.

These findings may help us develop guiding parameters to detect early, subtle cases of keratoconus. By using Optovue's ETM routinely, in addition to when we suspect keratoconus, we may find corneal epithelia that are remodeling and becoming thicker. It is an easy process—the ETM scan takes a few seconds for an undilated test, instead of 30 to 45 minutes with a water bath for high-frequency ultrasound. The ETM evaluation produces a color-coded map of the epithelium that makes it simple to identify problem areas, such as early signs of epithelial asymmetry (Figure 1).

Additional Applications For ETM

In addition to mapping the thickness of ocular tissues, ETM also helps us detect the peculiar epithelial distribution of dry eye disease. Thus, ETM offers a uniquely definitive test for the disorder and a means to categorize cases. Additionally, the technology is crucial for evaluating corneas for their candidacy for refractive and cataract surgery.

My staff and I are currently testing ETM software that with a 9-mm zone test zone. We will also continue our efforts to determine the earliest signs of keratoconus. ■

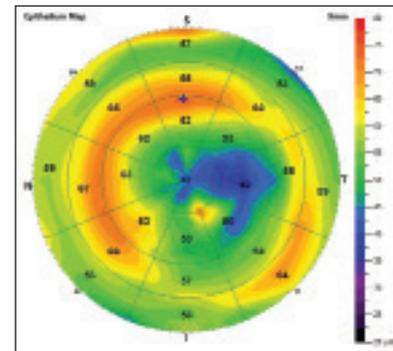


Figure 1. ETM provides an efficient way to quantify epithelial thickness and to track change between visits.

1. Kanellopoulos AJ, Aslanides IM, Asimellis G. Correlation between epithelial thickness in normal corneas, untreated ectatic corneas, and ectatic corneas previously treated with CXL; is overall epithelial thickness a very early ectasia prognostic factor? *Clin Ophthalmol*. 2012;6:789-800.

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