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Introduction to Elevation-Based Topography

Placido-disk topography has been the standard methodology used for describing the curvature and power of the corneal surface. Placido-disk topography is based on a two dimensional image, however, and is not capable of accurately describing corneal shape. In order to accurately determine corneal shape, a measurement of the Z coordinate, or elevation, is required.

Several systems have been developed over the years to measure the X, Y, and Z coordinates of the cornea in an attempt to determine corneal shape. Of the systems currently available for use, the Pentcam (OCULUS Optikgeräte GmbH) is the most commonly encountered. Due to the advantages that elevation-based topography and tomography hold over placido-disk topography, the Pentacam is rapidly becoming the standard for corneal imaging, particularly when screening candidates for refractive surgery. Due to its popularity we chose to include it in this book, and its images comprise the majority of the images we describe.

The Pentacam uses the Scheimpflug imaging principle, which extends the depth of focus to effectively image the entire anterior segment. The trade-off to this depth of focus is distortion of the image, which the Pentacam corrects via software computation. The Pentacam is a rotating Scheimpflug camera that captures 25 to 50 images during a scan, yielding over 25,000 elevation points per corneal surface.

This technology has several advantages over traditional placido-disk technology. Placido-disk technology uses several assumptions inherent to power calculation. Placido-disk topographers are only capable of measuring the anterior surface, without any input from the posterior surface, thus are unable to measure true corneal power. To overcome this deficiency, placido-disk topographers assume that the posterior surface radius of curvature is 82% of the anterior surface radius of curvature, which leads to significant error particularly in eyes post refractive surgery. The Pentacam, in contrast, directly measures elevation data and therefore true power maps are attainable.

Placido-disk systems also create error by using paracentral measurements and derive peripheral measurements via assumptions. In many corneal conditions, such as prior refractive surgery, the variability of the central cornea relative to the periphery may be substantial.

To ease clinicians' transition from placido-disk topographers to elevation-based tomography, the Pentacam includes an axial power map that is designed to replicate what a placido-disk topographer would measure. This map is derived from the directly measured elevation data, and therefore is prone to the same errors in assumption that occur with any derived maps.

Elevations maps, and the concept of a reference plane, are covered in more detail in Chapter 4.

Pachymetric Maps

The remaining map on the typical Pentacam four-map view is called the topometric map, or pachymetric map. This map not only determines the central or paracentral corneal thickness, as has been traditionally determined

Wang M, Kugler LJ. *Atlas and Clinical Reference Guide for Corneal Topography (pp 5-6).*