Samuel Boyd, MD

L. Felipe Vejarano, MD

Samuel Boyd, MD
Director, Laser Section
Associate Director, Retina & Vitreous Department,
Clinica Boyd - Ophthalmology Center
Panama, Rep. of Panama

L. Felipe Vejarano, MD
Vejarano Ophthalmological Foundation,
Department of Ophthalmology,
Cauca University,
Popayan, Cauca, Colombia

The Pentacam Application for Intrastromal Segment Ring

The intrastromal corneal segment ring is a device designed initially to correct mild-to-moderate myopia by flattening the anterior corneal curvature without encroaching on the visual axis. The device is a two types PMMA transparent ring, one with an outer diameter of 8.1 mm and an inner diameter of 6.8 mm. It is precision lathe-cut to ±0.01 mm as a hexagonal-shaped section of a cone called INTACTS® and the other with 6.3 mm of outer diameter and 5.7 mm of inner diameter in a piramidal shape called FERRARA RINGS®. Those are inserted through a peripheral radial incision made with a diamond knife at two-thirds corneal depth into a 360° peripheral intrastromal channel created with specially designed instruments.[1] Anterior corneal curvature is changed by using rings of different thickness. In order to offer the patient the most accurate correction in their ametropic defect we must evaluate corneal changes with advanced imaging modalities, many of which promise to deliver quantitative information and qualitative images of the cornea and anterior chamber. This equipments have a range of applications, including the diagnosis and tracking of pathology, the planning and monitoring of refractive surgery, and the study of accommodation.

Many surgeons including Carlos Verges, MD from Spain have switched the primary imaging system in their practice from scanning slit-topography (like ORBSCAN®) to the Pentacam® Comprehensive Eye Scanner (Oculus Optikgeräte GmbH, Wetzlar, Germany). The Pentacam® is a noncontact optical system designed specifically to image the anterior segment of the eye. Dr. Verges has recently upgraded his system to the high-resolution hardware package, which includes a 1.45 megapixel camera.[2] This improved camera offers several advantages, such as crisper images of phakic IOLs and the crystalline lens and a more precise presentation of corneal layers. With the recent released software it is possible to predict the precise position of any phakic IOL even through time, as well as to make a precise classification of the hardness of the cataract with the new densometry of the lens to plan your surgery. It also enhances the accuracy of corneal imaging via a fine scan that produces 100 images in less than 2 seconds.[2]

Corneal Layer Application

The different zones within pathologic corneal tissues are visible on Scheimpflug images due to their individual light scattering properties. The scattering observed with a slit lamp or Scheimpflug camera is known as backward scattering and must be distinguished from forward scattering toward the retina, which is much more important for vision. The intensity of the backward light scattering is strongly dependent on the angle of illumination and observation. Protein concentration, which varies within this abnormal tissue (ie, scar, epithelium, etc.), is an important parameter of light scatter. It is important to take all these factors into account when we read densitometry curves in corneal analysis.

Four-Image Application

According to Michael Belin, MD from New York, he uses the Pentacam's four-picture composite report (**Figure 1**), which includes anterior elevation, posterior elevation, pachymetry or corneal thickness, and sagittal curvature maps. He uses best-fit sphere and float for the elevation map setting. "My screening display for refractive surgery uses the ±75 µm elevation scale for all my refractive patients. I use the color scale called intuitive, which I developed for Oculus, Inc., when I screen elevation and pachymetry maps. I limit my display so that it shows only the central 9 mm zone of the eye". Although the machine defaults to 12 mm (it covers all the way out to the limbus), Dr. Belin found the central 9mm easier to look at clinically and for surgical screening. The placement of the different maps in the composite display does not matter, as long as it is consistent.[3,4,5]

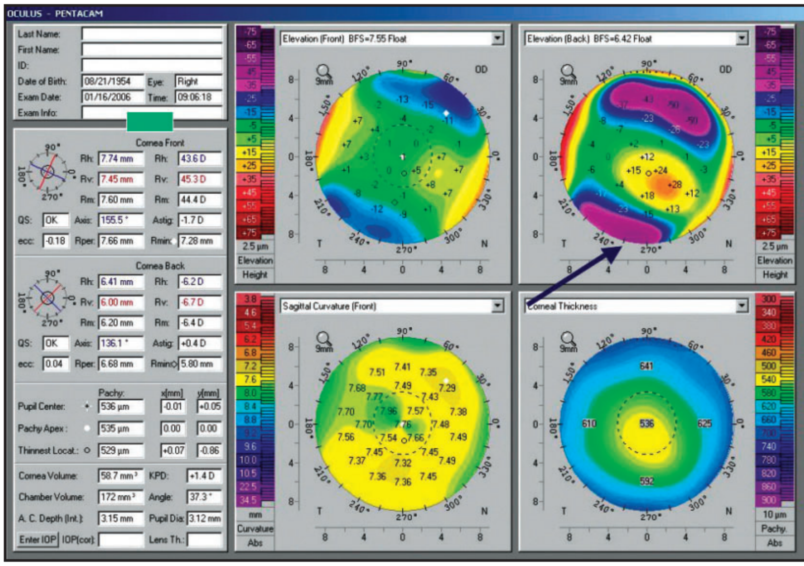


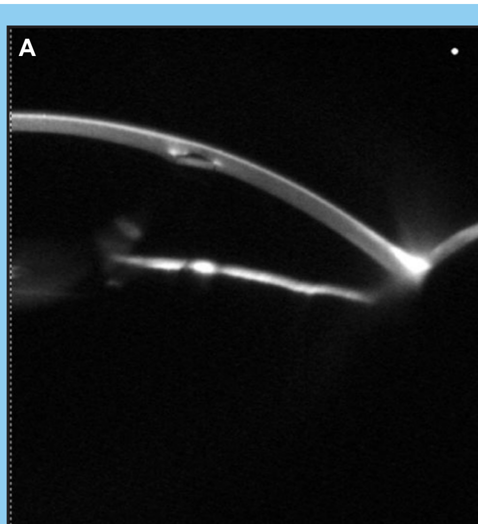
Figure 1. The four-map normal image in Pentacam. Anterior and posterior elevation, sagittal curvature and pachymentry maps are shown.

Importance of Posterior Elevation

Accurate posterior elevation data are a requisite for accurate pachymetry, because pachymetry is simply the difference between the anterior and posterior surfaces. Because what we look at is not the real elevation data, we use an approach that allows us to pick up subtle changes. We compare the elevation to a shape, the most common being a best-fit sphere. We do not look at the actual elevation, but rather a representation to make it obvious that a shape has undergone change.

Scheimpflug Technology

The Pentacam® uses a Scheimpflug camera to produce a three-dimensional analysis of the anterior segment (**Figure 2 A-C**). Other types of cameras capture a specific image and



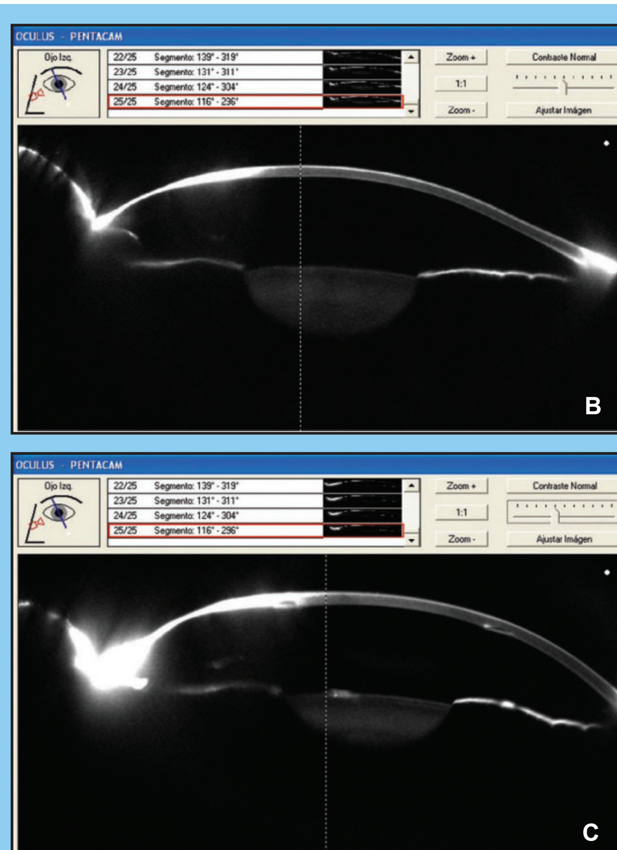


Figure 2 A-C: Pentacam® generated Scheimpflug image showing the placement of one intracorneal ring segment in the cornea **(Figure 2-A)**. The image is of sufficient quality to clearly see the exact shape of the insert and can be used to determine the depth of placement *(Courtesy of Paolo Ferrara, MD)*. You may also see a case with severe slimming of the superior cornea **(Figure 2-B)** causing severe irregular astigmatism and in the next image with the Ferrara Rings in place, **(Figure 2-C)** note the better contour of the central cornea *(Courtesy of L. Felipe Vejarano, MD)*

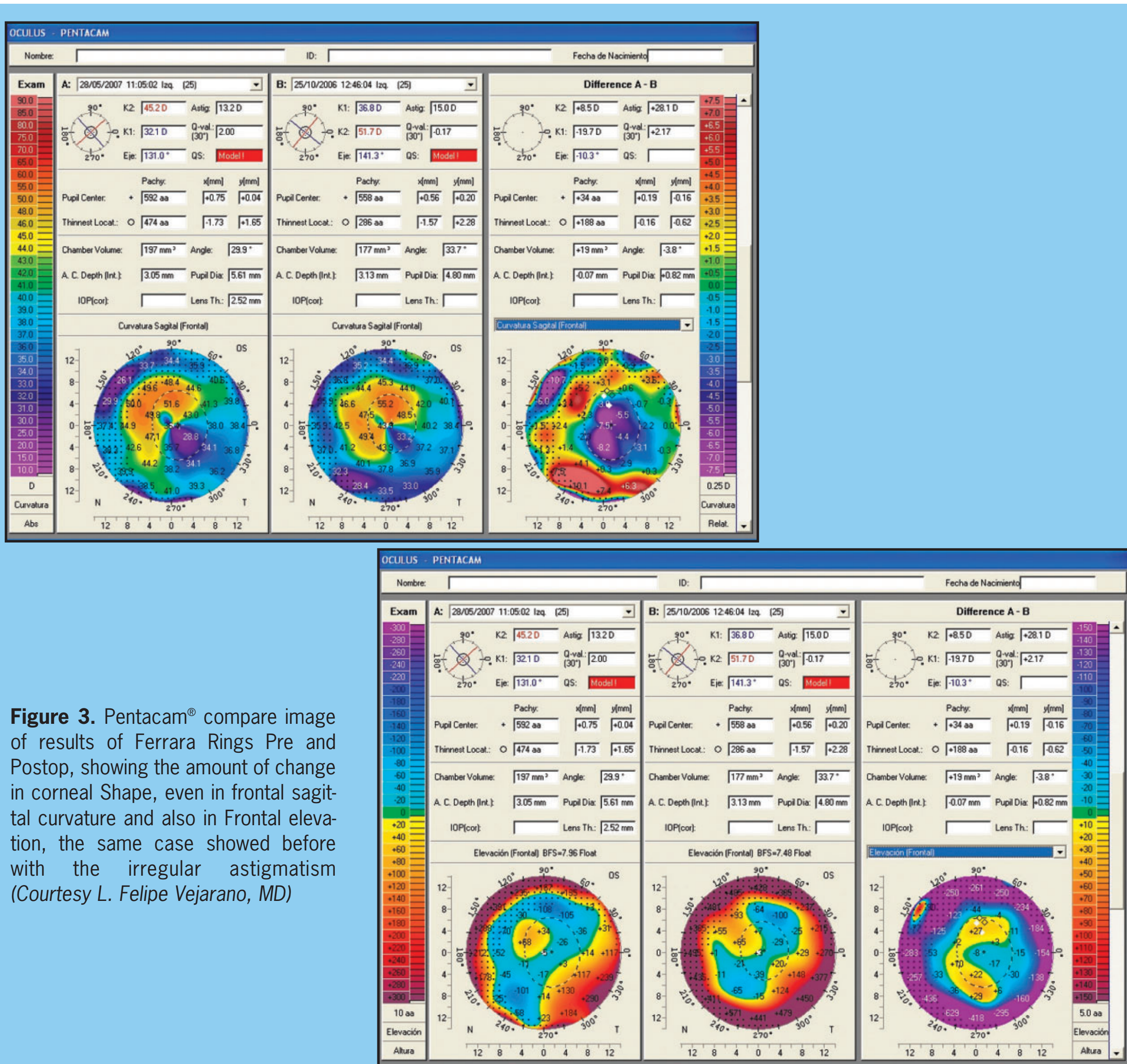


Figure 3. Pentacam® compare image of results of Ferrara Rings Pre and Postop, showing the amount of change in corneal Shape, even in frontal sagittal curvature and also in Frontal elevation, the same case showed before with the irregular astigmatism *(Courtesy L. Felipe Vejarano, MD)*

focus it on a plane, but this type of imaging lacks depth of focus. According to Stephen Pascucci, MD from Tampa, Florida, a Scheimpflug camera captures an image on three intersecting planes and focuses them on a single point, thereby creating a three-dimensional reproduction.[6] After the Pentacam® captures an image, it displays the information in a variety of ways. “You can click on various parts of the image, such as cross-sections of the cornea. For example, if you know the location of a corneal scar, then you can continue to click on the eye's Pentacam image until the scar comes into view. Thus, you can show the patient the scar within his cornea for the purposes of education and documentation”.

Conclusion

In conclusion, it is highly recommended to use the Pentacam® preoperatively in all patients as an indispensable exam for refractive surgery as well as in eyes that will receive phakic IOLs or cataract surgery where we need to examine the relationship of the implants to the structures in the front part of the eye. It can also be used in postop controls of these patients to compare the results (**Figure 3**). You may use it in selected cases, such as cataract patients, (even if you perform topography). For individuals with irregular astigmatism due to anterior basement membrane dystrophy, blepharitis, or dry eye, the Pentacam® offers similar advantage to the Placido-based units in detecting the amount of irregular astigmatism from their disease. Its multipurpose use and highly developed tools for topographical analysis make the Pentacam® a good all around unit for any kind of refractive surgical screening.

REFERENCES

For detailed and complete References, please visit “Journal Bibliography Section” at our webpage: www.thehighlights.com