The All-New Pentacam Cornea OCT Offers Synergy for the Future of Corneal Assessment

by Matt Herman

Pentacam® Cornea OCT

OCULUS' latest innovation, the Pentacam® Cornea OCT, made its highly anticipated debut at ESCRS 2024 in Barcelona—and some of the biggest names in ocular surgery believe it could forever alter the way that ophthalmologists approach corneal assessment.

The OCULUS Pentacam saw its latest evolution step onto the world stage in eye care at the 42nd Congress of the European Society of Cataract and Refractive Surgeons (ESCRS 2024) in the form of the Pentacam Cornea OCT. But does it deliver on its next-generation promises for corneal assessment in refractive surgery—and ophthalmic medicine in general?

Dr. Renato Ambrósio, Jr.

Experts like Prof. Damien Gatinel (France), Dr. Poojah Khamar (India), Dr. Riccardo Vinciguerra (Italy) and Dr. Renato Ambrósio, Jr. (Brazil) think so—and they stepped up to the podium at an ESCRS 2024 Day 2 lunch symposium to explain why.

Dr. Poojah Khamar

From the class-leading resolution (1.9 µm) and scanning radius (15mm) on its onboard OCT to simultaneous, fully integrated Scheimpflug imaging, these doctors believe that this next generation of Pentacam is a notable leap forward—and the implications for the way ophthalmologists practice medicine could be profound.

The power to perceive

"Eyes cannot find what the mind does not seek, nor see without the power to perceive." With this potent quotation, world-famous anterior segment surgeon Dr. Renato Ambrósio, Jr. outlined his vision on how the OCULUS

Pentacam Cornea OCT enables ophthalmic surgeons to imagine—and attain—new heights in their practice.

According to Dr. Ambrósio, there has been a paradigm shift in the way ophthalmologists are approaching corneal procedures: the simultaneous integration of a vast array of data, including corneal biomechanics from OCULUS' Corvis® ST, into preoperative corneal assessment.

"It's important to note that with the evolution of imaging, we must now use biomechanical properties as well," he said, citing a paper he co-authored with co-presenter Dr. Riccardo Vinciguerra (Italy).[1]

This paradigm shift has brought together a variety of tools to the surgeon for screening, diagnosing and treating patients with keratoconus and corneal ectasias. For Dr. Ambrósio, the Pentacam Cornea OCT represents the culmination of combining these tools into one central hub to gain new insights and analyses on the cornea not previously possible—in other words, synergism.

"Synergism is when one plus one equals more than two. When you only have OCT [imaging], that's a limiting factor. But we now also have [corneal] geometry because the Scheimpflug image is taken simultaneously with the OCT," he said.

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The result, for Dr. Ambrósio, is an unprecedented new way of looking at the cornea. "It's very impressive and you have a lot of data," he noted. "This synergism is important because you have a huge scan of the cornea. This leads to a high amount of data for things like power calculation."

The possibilities for such a massive amount of high granular data have not yet been fully realized, but there are current applications, such as epithelial mapping, that are already causing a sea change in corneal assessment.

Dr. Ambrósio believes not only in the power of these measurements, but also in their quality— setting a new standard in corneal assessment. "We found high repeatability and reproducibility," he said, summarizing an in-house OCULUS study that he participated in. "A small standard deviation of sub three microns makes it state-of-the-art in precision for epithelial thickness mapping.

Digging deeper into layers

Rising anterior segment star Dr. Pooja Khamar thinks that the future of corneal assessment for corneal surgery is in layers, and that the Pentacam Cornea OCT is uniquely positioned as the single device to get surgeons there.

Her presentation revolved around the Pentacam Cornea OCT's ability to visualize a cross-section of the cornea—and especially at the high resolution needed to analyze corneal structures like Bowman's and Dua's layers.

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Although topography and biomechanics are crucial in planning, Dr. Khamar thinks that there's another oft-overlooked piece of the puzzle—one that Pentacam Cornea OCT holds the key to. "Understanding epithelial patterns and the

dynamics of epithelial remodeling is becoming an essential skill for every refractive surgeon," she noted.

One example she gave of this involves analyzing Bowman's layer with Pentacam Cornea OCT and the use of Bowman's roughness index (BRI), a biomarker brought to the mainstream by research from Dr. Rohit Shetty that she had a hand in. [2,3]

"Because of the resolution of the OCT, you can very beautifully look at the condition of the patient's Bowman's layer," she said, giving examples of patients who underwent SMILE (ZEISS; Jena, Germany), KLEx procedures like SILK (Johnson & Johnson Vision; Irvine, USA) and SmartSight (Schwind eye-tech-solutions; Kleinostheim, Germany).

Dua's layer is another structure of interest, according to Dr. Khamar, and there's one area in particular that it helps with, thanks to the resolution—and novel scanning geometry—of the Pentacam Cornea OCT.

She highlighted this as she drew to the end of her presentation. "Sometimes, it's very difficult to image Dua's layer, because of the parallel [to the optical axis] structure of the rays of other OCTs," she said.

"But we are now able to image this layer—and that has a very important role when it comes to acutely high drops in keratoconus. You can now also see that [with Pentacam Cornea OCT], which is something we would have missed otherwise"

The evolution of refractive diagnostics

Influential cornea researcher Dr. Riccardo Vinciguerra echoed Dr. Khamar's comments and went a step further with his turn on the podium.

For Dr. Vinciguerra, the Pentacam Cornea OCT gives modern surgeons unprecedented access to what he believes is the new essential triangle of refractive diagnostics—Scheimpflug tomography, cornea OCT imaging and biomechanics.

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"In 2013, biomechanics was research," said Dr. Vinciguerra. But things have changed, and markers like stiffness parameters, the Corvis biomechanical index (CBI), and tomographic biomechanical index (TBI) are standard practice.

And now, according to Dr. Vinciguerra, corneal assessment is evolving again with the debut of Pentacam Cornea OCT and its full integration of this triangle. Dr. Vinciguerra's talk revolved around two topics that point to a new necessity for including OCT—ectasia detection and fixing complications in refractive surgery.

For detecting keratoconus, Dr. Vinciguerra pointed to OCT as a third essential component, in addition to tomography and biomechanical assessment. In the cycle of keratoconus, as he called it, Dr. Vinciguerra discussed the technology's indispensability.

"It's not possible to have a change in corneal curvature, thickness, epithelium and elevation without a previous trigger," he said. "Biomechanics must be the first to change, in addition to, potentially, tear film changes."

OCT, he noted, is a fundamental confirmation of the diagnosis.

> "You need it in pre-op, particularly for trans PK. You need it all the time in PTK. You need it in normal post-op to evaluate remodeling regression, and if you have an abnormal post-op, you need it to fix."
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Dr. Vinciguerra pointed out that it increases sensitivity by a significant degree—but there is one other key that pushes it over the edge. "We need OCT because it might improve the sensitivity of our device and thus the detection of keratoconus," he began, pointing to a recent study on the role of advanced biomarkers on keratoconus diagnosis.[4]


Dr. Riccardo Vinciguerra

"But what I believe is that, most of the time, it will also improve the specificity. It will tell you this looks like keratoconus, but the epithelium is thick in an area where it's not steep, for example, so it's not keratoconus."

After presenting some cases corroborating these observations, he turned his attention to what he sees as the critical role of corneal epithelial mapping in the modern corneal assessment paradigm for refractive surgery planning and ectasia detection. "When do you need an epithelial map? Always," he said.


Prof. Damien Gatinel

"You need it in pre-op, particularly for trans PK. You need it all the time in PTK. You need it in normal post-op to evaluate remodeling regression, and if you have an abnormal post-op, you need it to fix," he said.

Dr. Vinciguerra's final case presentation was an illuminating one. For those who question the need for Pentacam Cornea OCT's ultrafine 1.9 µm resolution, he showed just why that might cost some patient's vision—a hyperopic scar underneath a PRK flap. "In this case, it is really crucial to know how to retreat the patient," he said. And without the Pentacam Cornea OCT's resolution necessary to detect this scar, this case would have gone completely differently.

"Tomography is always mandatory," he said in conclusion. "Corneal biomechanics has been shown to help in many ways, and OCT with epithelial map is now a fundamental tool for screening, post-refractive surgery and fixing complications."

Tools, these doctors believe, whose natural synergy is realized for the first time on the OCULUS Pentacam Cornea OCT. ■

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Editor's Note

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MEDIA MICE

HQ Office: 6001 Beach Road, #09-09 Golden Mile Tower, Singapore 199589

Phone: +65 8186 7677

Satellite Office: 2 Nuoc Man 2 Street, Da Nang City, Vietnam 50506

Phone: +84 868 063 773

E-mail: enquiry@mediamice.com

Web: www.mediamice.com