An Interesting Case of Data Gaps in Measurement of Corneal Curvature With Scheimpflug Tomography

To the Editor:

We present an interesting case of keratoconus, where the tomography data were mismatched between Scheimpflug imaging (Pentacam; Oculus Optikgeräte GmbH) and optical coherence tomography (OCT) (RTVue; Optovue). A 28-year-old woman visited the cornea outpatient department of Narayana Nethralaya Eye Hospital, Bangalore, India, in October 2019 for follow-up. Her earlier follow-up was in January 2017. She had bilateral keratoconus and was a regular user of piggy-back contact lenses (Bioinfinity soft lens; Cooper Vision) and rigid gas permeable lenses (Silver Line Laboratories Pvt. Ltd.). Scarring due to keratoconus was absent.

Figure 1 shows the 2017 and 2019 Scheimpflug imaging and OCT anterior axial curvature of the left eye.[1,2] On Scheimpflug imaging, the distribution changed from a regular astigmatism pattern (**Figure 1A**) to a generally symmetric central steepening (**Figure 1B**). However, OCT (**Figures 1D-1E**) continued to show the regular astigmatic pattern. Further, the root mean square of higher order aberrations increased from 2017 to 2019 in the OCT but not the Scheimpflug imaging anterior surface. This could explain the worsening of uncorrected distance visual acuity from 2017 to 2019 and a 1.25 diopters increase in spherical equivalent (**Table 1**). Thus, there was a discrepancy between the measurements from the two devices.

The Scheimpflug imaging scans of the left eye from 2019 showed a warning message of "data gaps," which normally implied edge detection inaccuracy in the mid and peripheral cornea. Despite repeat Scheimpflug imaging (three consecutive measurements in the same visit) of the left eye in 2019, the data gaps message remained. No data gaps warning message was displayed by Scheimpflug imaging for the right eye. **Figure 1C** shows a sample of edge detection along the anterior edge of the Scheimpflug imaging scan for the left eye. The 2019 scan of the left eye had an abnormal data gap in the central cornea (solid yellow line in **Figure 1C**). This gap was seen in all 25 cross-sectional images of the cornea acquired by Scheimpflug imaging. However, no such data gap was noticed in any of the OCT B-scans irrespective of the time points (2017 and 2019) for the right eye because these curvatures were derived from offline processing of the OCT B-scans (**Figure 1F**).

Thus, these unusual missing edges in the central cornea of the left eye led to an incorrect assessment of anterior curvature and aberrations with Scheimpflug imaging in 2019. Further, Scheimpflug imaging interpolated the elevation in the central cornea of

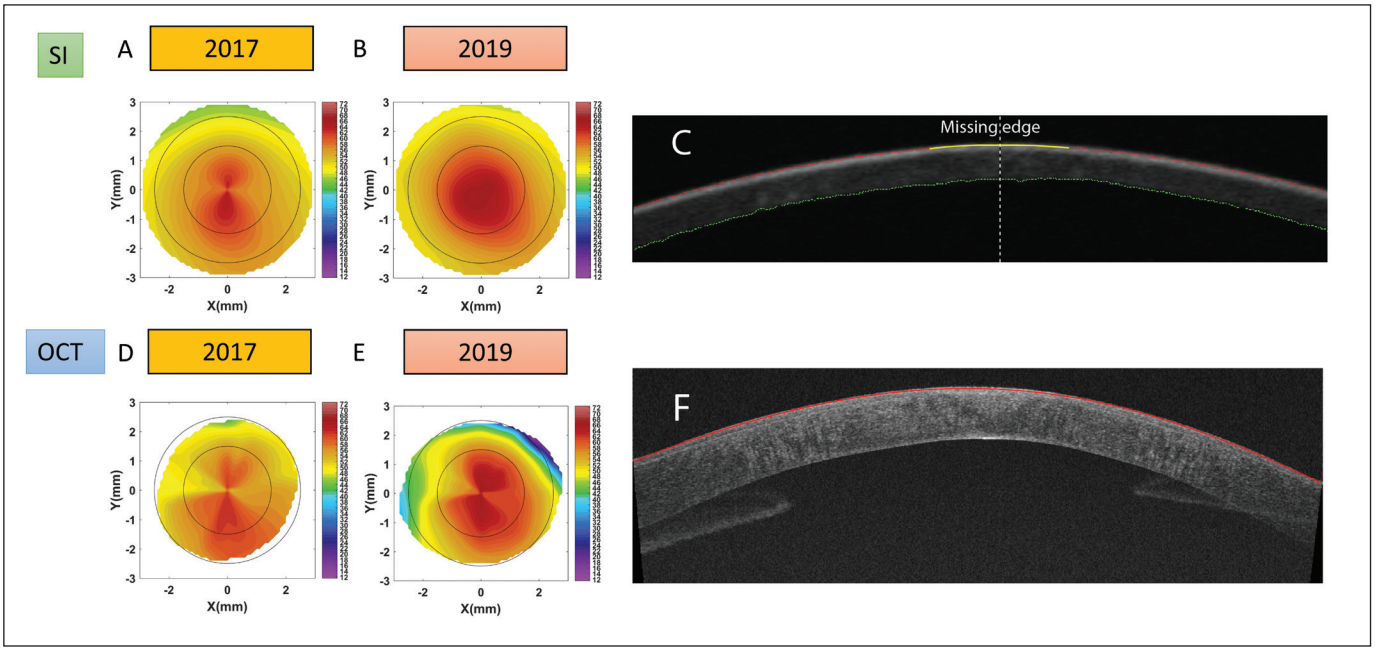

Figure 1. Scheimpflug imaging (SI) axial curvature of anterior surface of the left eye in (A) 2017 and (B) 2019, and optical coherence tomography (OCT) anterior surface curvature in (D) 2017 and (E) 2019. The color bar unit is diopters. The edge detection in a cross-sectional SI and OCT image of the left eye in shown in (C) and (F), respectively. Note the missing edge highlighted with the yellow line in (C).

Copyright © SLACK Incorporated

TABLE 1
Visual Acuity, Refractive Error, and Corneal Tomography of the Left Eye Measured in 2017 and 2019

Parameter	2017	2019
UDVA (Snellen)	20/60	20/200
CDVA (Snellen)	20/30	20/30
Sphere (D)	-9.00	-10.00
Cylinder (D)	-3.50	-4.00
Axis (°)	140	140
SI		
K1 (D)	60.60	61.60
K2 (D)	55.30	59.10
Kmax (D)	64.30	67.40
Axis (°)	90	127
RMS LOA (µm)	4.71	15.49
RMS HOA (µm)	3.17	2.9
OCT		
K1 (D)	61.40	61.70
K2 (D)	56.40	58.20
Kmax (D)	62.60	67.00
Axis (°)	75	105
RMS LOA (µm)	3.56	13.4
RMS HOA (µm)	3.05	5.1

UDVA = uncorrected distance visual acuity; CDVA = corrected distance visual acuity; D = diopters; SI = Scheimpflug imaging; K1 = flat axial curvature; K2 = steep axial curvature; Kmax = maximum axial curvature; RMS LOA = root mean square of lower order aberrations; RMS HOA = root mean square of higher order aberrations; OCT = optical coherence tomography

2019 measurement, which led to significant errors. The proprietary algorithms used for detection of edges differ between the devices. Hence, a retrospective evaluation of Scheimpflug imaging and OCT images should be pursued, particularly in highly aberrated corneas. As is generally known among the clinical fraternity, the data gaps in Scheimpflug imaging usually pertain to the mid and peripheral cornea. However, we were surprised to observe the data gap in the central corneal region (**Figure 1C**). Hence, a careful review of the central corneal edge detection in aberrated corneas with Scheimpflug imaging is recommended.

Himanshu Matalia, MD
Raghav Narasimhan, Mtech
Nandini Chinnappaiah, MD
Vikas Kumar, OD
Abhijit Sinha Roy, PhD
Bangalore, India

REFERENCES

1. Matalia H, Francis M, Gangil T, et al. Noncontact quantification of topography of anterior corneal surface and Bowman's layer with high-speed OCT. *J Refract Surg*. 2017;33(5):330-336. doi:10.3928/1081597X-20170201-01
2. Chandapura R, Salomão MQ, Ambrósio R Jr, Swarup R, Shetty R, Sinha Roy A. Bowman's topography for improved detection of early ectasia. *J Biophotonics*. 2019;12(10):e201900126. doi:10.1002/jbio.201900126

Drs. Matalia and Sinha Roy have a pending patent application on Bowman's topography through Narayana Nethralaya Foundation, Bangalore. The remaining authors have no financial or proprietary interest in the materials presented herein.

doi:10.3928/1081597X-20200325-02