ADVANCEMENTS IN OCT AID EARLY GLAUCOMA DETECTION

How NIDEK's new RS-1 Glauvas may give practitioners more diagnostic confidence in treating glaucoma in highly myopic eyes.

By Jocelyn Chua, MD, FRCSEd, FAMS

I practice at the Singapore National Eye Centre, a public health institution, where I am a full-time clinician. As a glaucoma specialist, most of my patient population either have glaucoma or are glaucoma suspects. Whilst adults form the majority of this population, I also see children who either were born with glaucoma or developed the disease at a very young age. Children make up 5% of my practice.

Many of my patients are myopic. Myopic eyes (with elongated axial lengths) tend to have an increased cup-to-disc ratio and tilted, saucerised optic nerve heads (ONH) with significant peripapillary atrophy, and so many fall into the category of glaucoma suspects. Recently, I had trialed the RS-1, the first 250-kHz spectral domain OCT device, which also features a deep learning (DL) algorithm on its new OCT Viewer (Figure 1), alongside the utility of its unique Long Axial Length Normative Database (LAL-NDB) for Asian eyes and standard Normative Database (NDB) for Asian and White eyes (Table 1).

Figure 1. The RS-1 Glauvas with OCT Viewer.

TABLE 1. TWO DATABASES ON THE OCT VIEWER

	NDB	LAL-NDB
Axial Length	Less than 26 mm	26 mm to less than 29 mm
Age	20 years to under 80 years	20 years to under 60 years
Race (Data n)	Asian (130 individuals), White (90 individuals)	Asian (112 individuals)
Scan Pattern	Macula map, disc map, retina map	Macula map, disc map, retina map

BENEFITS OF THE LAL-NDB AND STANDARD NDB

Regardless of race, myopic eyes tend to have a thinner retinal nerve fiber layer (RNFL) at baseline, and the higher the myopia, the thinner the baseline values. NIDEK has developed an LAL-NDB using data collected from healthy myopic eyes in Hong Kong, Japan, and Singapore. Nakanishi et al[1] had observed that the LAL-NDB reduced false-positive diagnoses of glaucoma with a specificity of 90.5% in highly myopic eyes with axial lengths exceeding 26 mm, while maintaining a good sensitivity of 92.3% (when compared to a standard NDB with a 47.6% specificity and 96.2% sensitivity).

During image acquisition, the RS-1 acquires the axial length value* (*see the asterisk in the Figure 2 caption*), and if it exceeds 26 mm, the software automatically applies the LAL-NDB for comparison. Eyes with axial lengths shorter than 26 mm get compared to the standard NDB (Figure 2). I appreciate having access to the LAL-NDB, as it reduces the risk of over-diagnosis and unnecessary treatment in highly myopic eyes.

It is also important to recognize that there are differences in the RNFL among healthy eyes across racial groups. Existing OCT studies have shown that people of Hispanic and Asian descent have thicker RNFL overall compared to Whites, and

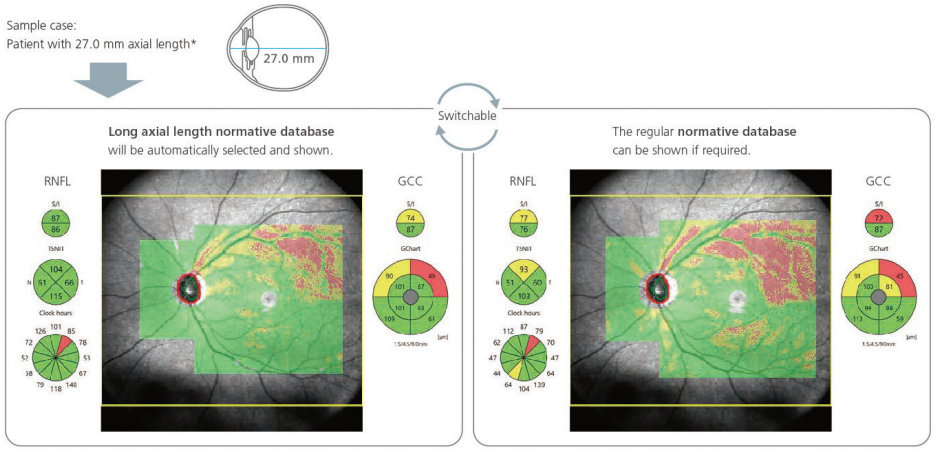

Figure 2. The OCT Viewer automatically compares eyes against either the standard NDB or the LAL-NDB, depending on whether the axial length value is less than or greater than 26 mm. (*The value of the axial length is obtained based on the results of the OCT image capture and differs from the actual measured value of the axial length).

those of African descent have the thinnest RNFL, on average.[2-7] These racial/ethnic differences in RNFL thickness remain after adjusting for age and gender. The availability of the standard NDB allows for a more reliable assessment of the patients in my practice, thereby affording a like-for-like comparison with what's a normal baseline within a racial group. That being said, the practitioner is also able to access an Asian or White NDB according to the patient profile. I find this feature very useful if one has a multiracial clinical practice.

THE ROLE OF THE GCC IN EARLY GLAUCOMA DIAGNOSIS AND MONITORING FOR PROGRESSION

The RS-1 captures the ganglion cell complex (GCC) with macular scans, which consists of the macular RNFL, the ganglion cell layer (GCL), and the inner plexiform layer (IPL). The GCC analysis is useful in detecting early glaucoma changes due to the presence of a high concentration of cell bodies (>50%) and its synapses within the parafoveal region. The OCT Viewer provides a comparison between the superior and the inferior GCC hemifields as well as a segmented GCC analysis. Several studies have shown that asymmetry in the GCC thickness across the horizontal raphe is very effective in discriminating pre-perimetric glaucoma or early glaucoma from normals.[8-10] The segmented representation of the parafoveal and perimacular GCC thickness also allows for better spatial assessment of the severity of glaucoma and monitoring for progression (Figure 3).

Glaucomatous eyes can have macular abnormalities as well, and the most common of these is the presence of an epiretinal membrane (ERM). Presence of macular disease can confound the practitioner's analysis of the GCC. Before performing a macular GCC analysis, it is always important to first look at the macular layers and make sure that there are no confounding factors that could render the GCC analysis unreliable.

The excellent capturing capability of the RS-1 combined with its DL-based B-scan denoising and segmentation algorithm on OCT Viewer allows for very detailed macular images. The segmentation algorithm offers a Structural Normality Map (SN Map) that shows structural abnormalities layer by layer in the retina with a heat map. It can thus help the practitioner detect minute abnormalities at a glance (Figure 4).

PROVIDER AND PATIENT USER EXPERIENCE

During my trial use of the RS-1, I have asked several patients for their feedback, and most have found that this device takes less time to capture both ONH and macular images than other OCT devices. I like that the RS-1 can provide the central corneal thickness measurement at the same sitting, as well. These features are particularly useful in children with short attention spans, and with the very elderly who may find it challenging to hold fixation for long. The LAL-NDB and

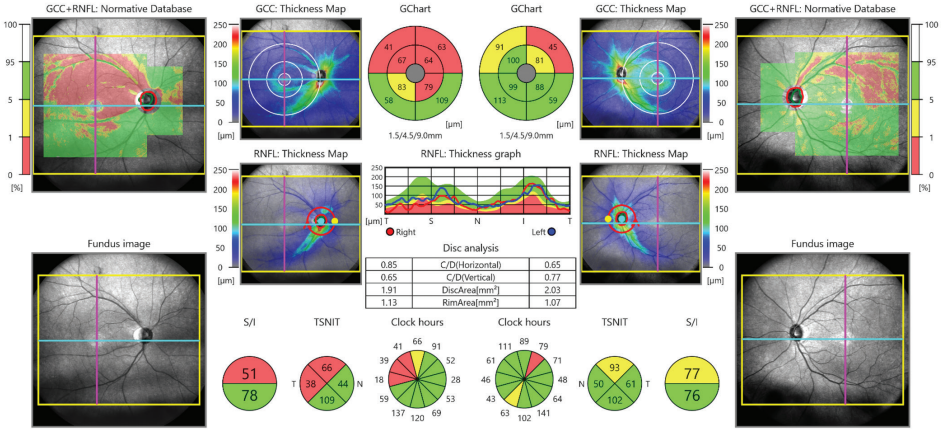

Figure 3. The 8-quadrant display of the RS-1 OCT data.

Epiretinal membrane (ERM)

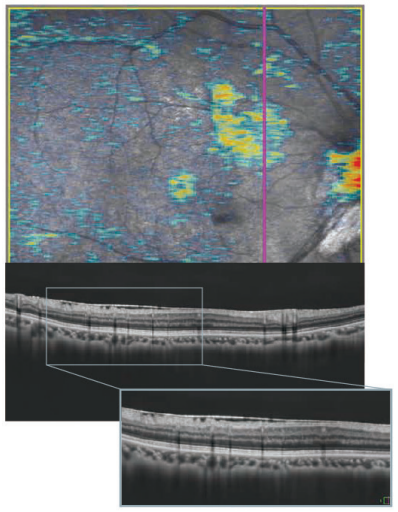

Figure 4. An SN Map of the ERM of the RS-1 OCT data. The structural abnormalities are highlighted as the colored area. In this case, how ERM spreads over retina can be detected at a glance.

standard NDB are also useful in contributing to the increased utility of OCT in the diagnosis of glaucoma for a specific subgroup of patients. I look forward to working more with the RS-1 in the future. ■

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