We are the front line of defense in the battle against glaucoma. Early diagnosis, treatment, and detection of progression are critical to help save patients from irreversible vision loss.

EARLY GLAUCOMA SIGNS

It is often believed that structural loss precedes functional loss as identified on visual fields. However, the Ocular Hypertension Treatment Study (OHTS) showed that 55% of patients with glaucoma reached an endpoint based only on optic nerve head changes, 35% showed visual fields changes as the first sign, and 10% had both.\(^1\) If we use or depend excessively on one technology, we will miss many cases that may progress to cause significant vision loss. The retinal nerve fiber layer (RNFL) profile in individuals with early glaucoma is very similar to that of individuals with good ocular health due to the wide range of normality. This makes it very difficult to discriminate between the two.\(^2\) Therefore, we need to combine devices to obtain the benefits of available technologies.

DIAGNOSTIC TOOLS

If glaucoma is suspected, a threshold perimetry in the central 30° is performed, like 32, 24-2, or 30-2, or the Glaucoma (G) Protocol (Octopus, Haag-Streit) could be used. Although glaucoma is a peripheral disease, macular fibers are less protected than previously believed, as shown by OCT studies.\(^3\) Visual fields that have only a small portion of points dedicated to the macular region (e.g., 24-2 or 30-2) may not detect the damage. If one uses a protocol like the G Protocol, more points are located in the macular region, particularly for the papillo-macular bundle, and it is easier to identify macular or ganglion cell complex (GCC) damage. I use the G Protocol for all of my patients, and if a significant number of points close to the fixation show damage, a 10° protocol is warranted. Additionally, with the G Protocol, the points are spread in clusters that are very similar to the nerve fiber layer pattern that we know.

Octopus perimetry uses real-time eye-tracking, which readjusts itself if the eye moves and aligns with the pupil center, providing reliable data. If a patient blinks, it retests the spot, and if patients close their eyes, it pauses the test.

STRUCTURE-FUNCTION CORRELATION

In contrast to traditional beliefs, structural damage often correlates with functional damage.\(^4\) In very early disease, visual fields appear more normal, whereas the ganglion cell count decreases. However, once visual field changes are observed, visual field damage and retinal ganglion cell axon count tend to run parallel. In advanced glaucoma, we cannot measure RNFL beyond a certain limit with OCT, and visual field analysis is the only method that can be used. Therefore, discordance between structure and function is primarily in very early or very advanced cases.
We can use advanced techniques such as the Octopus Polar Analysis and Cluster Analysis to match OCT findings with locations on visual fields. The Polar Analysis shows where correlating damage can be expected on the OCT, allowing side-by-side comparisons with structural results.

The Octopus perimetry clusters points along nerve fiber bundles (e.g., arcuate bundles, macular bundles) and provides Cluster Analysis. The Cluster Analysis is more sensitive than looking at single points. It is based on an average, so fluctuations have less influence.

In a case with suspected central defects, shown in Figure 1, the Cluster Analysis showed an area that looked like a superior arcuate scotoma with a nasal step. The Polar Analysis showed long lines indicating inferior damage, confirmed by the RNFL, representing inferior loss and an arcuate-like defect on the GCC. The Bebie curve showed that it was a local defect.

There are additional ways to diagnose glaucoma early. Pulsar Perimetry shows a target with black and white circles. The white rings become black, and the black rings become white. If a patient has early defects that are not reaching the level of probability of damage, you may not be as sure with white-on-white perimetry, but Pulsar Perimetry can show a large defect. If a patient has visual field damage, white-on-white perimetry may be all that is necessary. Pulsar Perimetry is useful when a defect is suspected but the visual field appears normal. It is ideal for early diagnosis but not for use in moderate to advanced glaucoma. White-on-white perimetry is used for moderate and advanced glaucomatous damage.

Pulsar Perimetry is also more resilient to optical blur and cataract-related blur and helps identify early scotomas.

**ASSESSING STRUCTURE AND FUNCTION**

In a patient being treated for early glaucoma, we performed visual fields, OCT, and fundus photography. Loss was evident on the OCT, with the right eye showing less damage than the left eye. The left eye OCT image showed loss inferiorly, with the GCC also showing loss inferiorly. Visual fields with the G Protocol showed corresponding pattern loss in the corrected probabilities plot.

In another patient who possibly had early glaucoma, fundus photography showed deep cupping. Although we can perform OCT or visual fields after the slit-lamp examination, I chose to perform OCT first, which confirmed the suspicion, with RNFL loss visible (Figures 2A and 2B). Visual field analysis showed early damage in the corrected probabilities plot, and the Polar Analysis of Octopus perimetry predicted defects that corresponded with the OCT findings (Figures 2C and 2D).

**CONCLUSION**

It is important that we change our diagnostic strategies to identify more cases of glaucoma early and appropriately. Multiple tests are necessary to diagnose and manage glaucoma, including intraocular pressure, fundus photography, OCT, and visual fields. Perimetry is necessary and should be fast, accurate, reliable, and repeatable. Techniques that allow better fixation control and monitoring of the patient enhance reliability of visual fields. Polar Analysis and Cluster Analysis have become integral parts of managing glaucoma in my practice. Pulsar Perimetry proves useful in complicated early cases that may pose a diagnostic dilemma. Tests should be repeated to confirm diagnosis, and follow-up and monitoring are needed to identify progression, which is the hallmark of the disease.

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