Point-Counterpoint

If there is only one device to monitor glaucoma progression, it would be the ….

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Optical Coherence Tomography

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Glaucoma is an optic nerve pathology in which there is progressive loss of retinal ganglion cells.[1] The ultimate goal is to control intraocular eye pressure to slow down disease progression and preserve visual function. Because of this, the early identification of disease progression is vital.[2]

Glaucoma progression cannot be identified in the clinics, so ophthalmologists use machines such as the standard automated perimetry, short-wavelength automated perimetry, and frequency-doubling technology.[3] Unfortunately, with these tests, it is not easy to differentiate between changes due to glaucoma and age, and there is often lack of consistency in the measurements.[2] Glaucomatous optic nerve changes also appear years before there are any identifiable visual field changes.[4]

The optical coherence tomography (OCT) objectively records the configuration of the optic nerve head and measures the thickness of the retinal nerve fiber layer (RNFL).[5] Measurements are very reproducible, especially when a spectral-domain OCT is used.[6]

In a 5-year prospective study by Yu *et al.* in 2016, the group aimed to find out if progressive RNFL thinning can predict worsening visual field loss in glaucoma.[7] The study population included 139 open angle glaucoma patients (or a total of 240 eyes). Results showed that continuous RNFL thinning identified by Guided Progression Analysis (GPA) and Trend-Based Progression Analysis (TPA) related to worsening of visual fields.

The Advanced Imaging Glaucoma Study Group compared the detection of long-term glaucoma progression using the OCT and visual field tests. The study included 536 glaucoma suspects (or those with preperimetric glaucoma) and 153 perimetric glaucoma eyes followed for 54.1+16.2 and 56.7+16.0 months, respectively. The study concluded that the OCT can detect progression in early glaucoma better than visual field tests. The value of RNFL decreases in advanced glaucoma; but the ganglion cell complex can still detect progression in all stages.[8]

In conclusion, the OCT is helpful in the management of glaucoma, and can be used in combination with other diagnostic tools for early cases. Because it can take objective measurements, it is highly useful in monitoring for disease progression. Lastly, it is an excellent means to assist ophthalmologists in deciding when to treat and intensify treatment.[9]

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Automated Perimeter

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If there is only one device to monitor glaucoma progression, it would be an automated perimeter. These are my 5 reasons. First, visual field test is still the most common method for detecting functional glaucoma progression in clinical trials and clinical practice, and currently remains to be the gold standard.[1] Second, a number of strategies incorporated in most perimeters have been developed to assist the clinician in identifying visual field changes suggestive of progression. They simplify the analysis of complex visual field variability and provide a degree of objectivity with excellent sensitivity and specificity.[2,3] Third, studies have proposed that structural changes measured by optical coherence tomography (OCT) appear to be more useful in detection of progression in early glaucoma, while monitoring functional changes using visual field test is more informative during the later stages of the disease. Correlation between the two tests is ideal, but what if you were to have only 1 device?[4-6] Despite the fact that authors have concluded that OCT is more sensitive than perimetry in detection of early glaucoma progression,

they still do not advocate reliance on OCT alone in monitoring glaucoma. OCT cannot be used singly to monitor glaucoma progression even in the early stage. Thus, visual field test still has a role in detection of progression in this stage. For detection of progression to occur at the earliest possible time point, frequency of visual field testing must be adequate. Other strategies to increase sensitivity of visual field tests have also been introduced.[7,8] Fourth, in moderate to advanced glaucoma, the more important stages of the disease, visual field tests have been shown to be more reliable than structural test in the detection of progression. This is due to the "floor effect" from the presence of nonneuronal tissues and retinal blood vessels which may affect measurement of structural changes. Nonstandard functional testing strategies employing a bigger stimulus size or the central 10-degree program may be used in advanced disease.[2,9] Fifth, visual field loss is clearly associated with decreased quality of life. Visual field tests to demonstrate areas of visual field loss may help to explain a patient's poor quality of life. Only visual field exam can truly reflect the patient's visual field loss. This is something the patient will most likely understand, as well.[10,11]

On the other hand, challenges that are inherent with the use of OCT include the following: (1) OCT may be unreliable 20% of the time and will be affected by artifacts in almost 40%; (2) A 5-micron change in average retinal nerve fiber layer (RNFL) thickness is considered significant; (3) RNFL measurements can be affected by dry eye, presence of a vitreous floater, and release of an epiretinal membrane. In patients with myopia, epiretinal membranes and uveitis, OCT parameters do not accurately reflect glaucoma severity.[12,13] In active uveitis, RNFL may be normal or thick; then will thin out as the inflammation resolves. But this will not necessarily indicate progressive structural damage.

We have heard about all the advantages of OCT and admittedly, there has been much improvement in technology over the years. However, challenges with its use in detecting glaucoma progression still exist and despite all its advantages, it is just not yet ready to replace perimetry. Thus, I maintain that if there is only one device to monitor progression in glaucoma, it is visual field because it is still the gold standard. It has different progression software that may be useful in every stage of glaucoma, and at the end of the day, only functional tests can predict functional loss.

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Consolidating the Evidence

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Glaucoma is a chronic disease causing irreversible blindness.[1] Its progression is insidious and the rate variable and unpredictable. Hence, integral to its management is the need for periodic monitoring.

Monitoring of the status of glaucoma can be achieved through assessment of the structural and functional components of the disease—2 different aspects wherein glaucoma damage can be evaluated. Structural damage as manifested by thinning of the retinal nerve fiber layer (RNFL) and thinning of the ganglion cell complex (GCC) is measured by optical coherence tomography (OCT) and functional damage as manifested by scotomas is quantified by perimetry/visual field (VF).[2-5]

Studies have shown that the relationship between structural and functional damage is complex.[6-8] This can be attributed to individual variation and disease severity. In glaucoma management, it is believed that structural tests can better identify progression in the early stages of the disease and functional tests can better quantify damage in the later stages of glaucoma.[9-12] The Advanced Imaging for Glaucoma Study Group illustrated several methods to evaluate progression in glaucoma suspects and preperimetric glaucoma (GS/PPG) and in perimetric glaucoma (PG).[13] Progression was detected in 62.1% of PG eyes and 59.8% of GS/PPG eyes by OCT versus 41.8% and 27.3%, respectively by VF.[14] When PG eyes were stratified according to severity, OCT had significantly higher detection rate than VF in mild PG but not in moderate and advanced PG.[14] The rate of RNFL thinning slowed dramatically in advanced PG but GCC thinning rate remained steady even in advanced disease. This difference has been attributed to the "floor effect" of current OCT machines to measure RNFL thinning in advanced glaucoma.[14-17] Future improvements in software, as well as scanning techniques, will surely improve the sensitivity and specificity of OCT in monitoring progression in advanced disease.

Another reason why OCT has been shown to detect progression higher than VF is its more objective nature, with less variability between scans from different visits compared to VF that is more subjective requiring reliable responses from patients.[18-20] Moreover, the effects of short- and long-term fluctuations in VF testing can confound the monitoring of progression. Several studies have also highlighted the predictive role of OCT RNFL and GCC thinning in functional decline of glaucoma suspects and patients as measured by VF.[12,21-22] And others have demonstrated that some patients progress by either functional or structural alone, or both, in all glaucoma stages.[14,16,21] And that if the different methods of measuring progression in OCT and VF were compared, there was only moderate overlap among the different parameters measured.[14] Thus, using OCT and VF together for disease monitoring is a better option than either one alone to better track disease progression more frequently and more thoroughly.

In summary, clinicians should be knowledgeable of the different structural and functional tests available and the factors that can affect accuracy and reliability of the measurements. Evaluation of the status of glaucoma by both methods can better monitor the disease progression.

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