The Role of Visual Fields in the Early Detection of Glaucoma and Its Progression

A justification for evaluating the visual field.

BY CHRIS A. JOHNSON, PhD

Although many clinical components must be considered in the diagnosis and management of glaucoma, the visual field test is undoubtedly important for determining the stage of glaucomatous damage, the efficacy of medical or surgical treatment, and the prognosis as well as for assessing the patient’s quality of life and his or her ability to perform the activities of daily living. This article discusses the role of visual field testing for screening, early disease detection, and the identification of progression and the rate of visual field loss related to glaucoma (Figure).

SCREENING

Although general screening for glaucoma has been a controversial issue,1,5 tailoring screening procedures to populations with limited access to traditional health care, assessing high-risk populations, and testing in locations with travel restrictions have been useful.2,5-7 Until recently, visual field testing in eye clinics and private offices has required the use of expensive equipment that occupied a considerable amount of space in a dedicated testing room. The advent of portable, low-cost electronic devices now makes it possible to bring the visual field testing equipment to the individual rather than requiring the person to go to an eye care facility.

Changes in health care in combination with innovations in smart tablets and other electronic devices will encourage the use of portable visual field screening devices, home testing, telemedicine, and automated analysis. A battery-operated low-cost display system (eg, smart tablet, iPad and iPhone [both from Apple]) that is properly calibrated can perform quantitative testing at remote sites outside of an eye care center using a testing protocol. The results can be sent via the Internet to a coordinating center where the data are scored by an electronic analysis procedure and/or trained experts in visual field interpretation. The findings can then be quickly sent back to the testing site, indicating whether the testing is acceptable or needs to be repeated, whether the patient’s results are within or outside normal limits, whether or not results that are outside normal limits are likely to be due to causes other than glaucoma (ie, testing problems, performance difficulties, visual pathology other than glaucoma), and whether glaucomatous visual field deficits are mild, moderate, or severe. In this manner, it is possible to determine which individuals need further assessment at an eye care center for potential medical or surgical treatment. This procedure can therefore improve the long-term visual outcome of individuals with glaucoma who may not have otherwise been able to seek assistance, which provides strong justification for visual field screening for glaucoma. In addition to glaucoma, this procedure may also be able to identify other diseases that damage the visual pathways.

EARLY DETECTION

Technological advances have improved clinicians’ ability to detect glaucomatous changes in the structural...
(optic disc, retinal nerve fiber layer) and functional (visual fields, contrast sensitivity) properties of the visual pathways, but as generally reported for the past 200 years, structural abnormalities can often be detected prior to functional losses. As a result, new testing procedures have been developed that are designed either to test specific visual functions (eg, motion perimetry, flicker perimetry, frequency-doubling perimetry, pulsar perimetry) or to provide finely detailed mapping of the visual field (eg, rarebit perimetry, microperimetry). These procedures have improved clinicians’ ability to detect early glaucomatous losses, reduced testing time, increased reliability, and provided relatively stable variability characteristics throughout the entire operating range of the tests.

PROGRESSION

Visual field progression and its rate are important factors in the management of glaucoma patients. Despite the significance of assessing progression, no consensus has been reached as to which procedures are the most appropriate, and all of the major multicenter trials in glaucoma have used a different method. Many new procedures have improved clinicians’ ability to distinguish true progression from test-retest variability, but several of them require extensive knowledge and training by the clinicians who rely on these procedures. In a busy clinic, it is often impossible to spend the time and effort necessary to properly interpret and understand these findings, and thus a simple, direct approach is required to determine glaucomatous progression and its rate. Fortunately, several procedures (guided progression analysis, glaucoma progression analysis, and visual field index [VFI] on the Humphrey Visual Field Analyzer [Carl Zeiss Meditec] and linear regression and cluster regression analysis on the Octopus perimeter [Haag-Streit USA]) rapidly give busy clinicians a strong impression.

ADVANCES

New procedures use novel strategies for performing testing to enhance efficiency and reliability and to provide a more refined application of the information provided by visual field testing. Microperimetry has minimized the influence of eye and head movements during visual field testing, while analytic procedures that combine structural and functional information are also being actively pursued. Eventually, devices should become available that will not only analyze and present these results together but will also acquire, analyze, and compare structural and functional properties simultaneously. In the future, research directed toward understanding the role of attention, practice (learning), multitasking, and decision criteria on visual field performance would be helpful. Furthermore, procedures that are optimized for evaluating the macula and the far periphery beyond 30º eccentricity would improve physicians’ understanding and means of managing glaucoma.

CONCLUSION

The past 30 years have produced tremendous changes in perimetry and visual field testing, but the basis of the most widely used procedure (detection of a small white target on a uniform background) has remained the primary method of evaluating peripheral visual func-
tion for the past 2 centuries. Visual field testing may be approaching an asymptote or saturation point, suggesting that a paradigm shift in perimetry that is analogous to the shift from manual to automated perimetry that occurred more than 30 years ago is needed. I encourage young investigators to pursue these possibilities.

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