

VISUAL FIELDS AS SCREENING TOOLS

Problems remain, but this form of testing allows physicians to accurately assess glaucoma's impact on patients' vision.

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This article assumes that screening people for glaucoma has merit. Although I believe that it does, limited data support this notion.¹ There is not even much support for screening asymptomatic adults for vision impairment,²⁻⁴ although that is debatable.⁵

How would one design a screening program for glaucoma? Because the disease is a worldwide problem, screening needs to happen in locations as varied as US clinics and remote villages in the developing world. The screening tests must detect disease without creating too many false positives and cost as little as possible. It must also be possible to perform these tests in a wide variety of locations with varying degrees of infrastructure. Although the perfect screening test has not been invented, a mixture of structural and functional testing is probably best,⁶ and visual fields should play a prominent role.

THE NERVE

Because glaucoma affects the optic nerve, it makes sense to screen for disease by examining the nerve, which can even be done in the context of a diabetic retinopathy screening.⁷ Unfortunately, there are a couple of problems. First, it is not easy to see the nerve. It takes equipment and skill. The cost of direct ophthalmoscopy is low, but the technique requires a lot of practice and provides a restricted view. In my experience, imaging systems based on the iPhone (Apple) have a limited role in eyes with undilated pupils, because many of the images are of poor quality and cannot be interpreted. Nonmydriatic fundus cameras are definitely an option, but these instruments are expensive, ranging in cost from about \$10,000 to approximately \$25,000. Moreover, the table-mounted options require electricity and are not very portable. Optic nerve imaging systems are wonderful, but they are extremely expensive, require electricity, and are not very portable.

The second problem is one of interpretation. The normal optic nerve shows tremendous variability in size, shape, and cup size, which often makes distinguishing disease from health challenging, especially in cases of early glaucoma and

in eyes with large nerves. Although it is possible to set the threshold for abnormality so that only moderate to advanced disease is detected, the problem of obtaining the images to examine limits the applicability of a nerve examination. Perhaps a better way to screen would be to test the function of the nerve. Visual fields are one such functional test.

THE EVOLUTION OF VISUAL FIELD TESTING

By definition, visual field testing is the only way to identify people who are actually affected by glaucoma. Like nerve imaging, the cost of field testing can range from practically free to very expensive. The instruments range from highly portable to less so. Unlike with imaging, however, the results of visual field testing are subject to the abilities of the person taking the test.

The goal of advances in visual field testing is to provide accurate, reproducible information in a patient-friendly amount of time, and the current gold standard is static automated threshold perimetry. Such a machine costs \$25,000 to \$30,000, requires electricity, and is not portable. Smaller field machines such as the Oculus Easyfield (Oculus), the Octopus 300 (Haag-Streit), the Humphrey Matrix 800 (Carl



(Courtesy of Sumant S. Thapa, MD, PhD)

Figure. The visualFields easy app in operation in Nepal.



AT A GLANCE

- It makes sense to screen for glaucoma by examining the optic nerve. Visual field testing evaluates its function.
- Glaucoma is a worldwide problem, which means successful screening methods must be portable, inexpensive, accurate, and quick.
- Clinical trials with a tablet- and iPad-based supra-threshold field test are underway.

Zeiss Meditec), and the Humphrey FDT (Frequency Doubling Technology; Carl Zeiss Meditec) were developed to make field testing much more portable. FDT has been available since the late 1990s and has been used extensively to screen for glaucoma,⁸ but a very recent meta-analysis suggests that it does not perform very well as a stand-alone screening test.⁹ My own experience with FDT-based screening in the early 2000s indicated good sensitivity but poor specificity, resulting in a very low positive predictive value (J.H., unpublished data). Moreover, all of these machines require electricity and are moderately expensive.

CURRENT RESEARCH

For the past 4 years, I have been participating in two clinical glaucoma screening trials funded by the Centers for Disease Control and Prevention and awarded to Jay Katz, MD, at Wills Eye Hospital. With regard to field testing, the first trial essentially brought the office to the patient in that we used an Octopus 900 (Haag-Streit) to screen each patient.¹⁰ The second trial is designed to screen patients using optic nerve photography with off-site interpretation followed by a complete eye examination, including field testing with the Octopus 900. Both trials involve transporting multiple pieces of equipment packed in shipping crates in a large van to screening locations throughout Philadelphia. Although this approach works well in the city, it is not a practical solution in developing countries.

A field machine that makes more sense for glaucoma screening in the developing world would be ultraportable, would not require electricity, and would perform testing rapidly. Such a device was recently developed by George Kong, FRANZCO, PhD; Chris Johnson, PhD; Suman Thapa, MD, PhD; and Alan Robin, MD. They have created both a tablet- and iPad-based suprathreshold field test that has been used in India and Nepal (Figure). The iPad app, visualFields easy (George Kong Software), is available as a free download from the App Store (Apple). Clinical trials with the

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device are now underway, but impressive presentations by Dr. Johnson at the 2015 ARVO Annual Meeting¹¹ and North American Perimetric Society meeting and by Dr. Robin at the 2016 American Glaucoma Society Annual Meeting¹² showed the device hard at work in the field.

CONCLUSION

Screening for glaucoma is not easy. Because no single test has ever been found to be satisfactory, a combination of structural and functional evaluations that mirror what is done in the office will be necessary. I believe that field testing should always be part of a screening examination, because it allows the physician to accurately gauge the visual impact of the disease. ■

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