The Value of Adding SD-OCT to Nonmydriatic Fundus Photography Screening

The imaging technology can provide additive benefit to screening in the primary-care setting.

BY RISHI P. SINGH, MD

Nonmydriatic fundus photography has been widely used as a screening tool in the primary-care setting for the detection of ophthalmic diseases. Numerous studies have examined or validated the use of nonmydriatic fundus imaging in screening for diseases such as diabetic retinopathy, glaucoma, and age-related macular degeneration, using technologies ranging from Polaroid cameras in the 1990s to digital imaging devices with automated image analysis in the current century.1,3

Recently, Tarabishy and colleagues4 at the Cole Eye Institute assessed the accuracy and sensitivity of single-field nonmydriatic digital fundus imaging, performed in a primary care setting and interpreted by an ophthalmologist. In the study, both eyes of 1175 consecutive patients in an executive health program were imaged using a digital nonmydriatic camera. The fundus images depicted a single 45° field centered on the optic nerve and macular area. The investigators found that this screening modality was sensitive and accurate for the detection of pathologies including macular degeneration, diabetic retinopathy, and optic nerve cupping.

ADDING SD-OCT
Spectral-domain optical coherence tomography (SD-OCT) is an imaging technology that has been widely adopted in ophthalmology, but its efficacy as a screening tool for common ophthalmic diseases has not been fully explored to date. We performed a study5 to determine whether adding SD-OCT improved the diagnostic capability of nonmydriatic fundus imaging. The study had 2 aims: to evaluate the feasibility of obtaining SD-OCT images in patients attending a screening visit in the primary care setting, and to determine whether adding SD-OCT to nonmydriatic fundus image reading provided additional diagnostic information.

This prospective study, approved by the Cole Eye Institute institutional review board, included 574 consecutive patients in an executive health program. The 3D OCT-2000 (Topcon), which incorporates a high-resolution fundus camera, was used to obtain both SD-OCT and fundus images.

SD-OCT images were obtained as cube sections through the macula and the optic disk, and corresponding fast macular thickness maps and nerve fiber layer analyses were performed. Single 50° field fundus photos were centered on the macula and optic nerve. Two masked graders evaluated all images. They first interpreted the fundus photographs and were then presented with the corresponding SD-OCT data and asked whether it confirmed, was noncontributory to, or refuted their initial diagnosis. In addition, the 2 masked graders reported cup-to-disc ratios, and these were compared to automated cup-to-disc ratios computed by the SD-OCT device.

RESULTS
Regarding the first aim of the study, to evaluate the feasibility of performing SD-OCT in a primary care setting, adequate images were obtained in 568 of 574 patients (98.9%) patients. Poor scans were attributed to patient movement or to lack of signal intensity due to...
media opacity. In cases in which the nonmydriatic fundus image was deemed to be of poor quality, SD-OCT could be performed and evaluated in 85.7%.

Of the total 568 patients evaluated, SD-OCT findings were normal in both eyes in 516 (90.9%). Vitreomacular adhesion, vitreomacular traction, or abnormal foveal contour was detected in 17 (2.9%), epiretinal membrane (ERM) in 20 (3.5%), drusen in 12 (2.1%), lamellar hole in 2 (0.3%), and cystoid macular edema in 1 (0.2%). Figure 1 shows an example of a patient in whom the fundus photograph appears essentially normal, but a prominent epiretinal membrane is seen on SD-OCT cube scan.

Regarding the second aim of the study, to determine whether SD-OCT aided in diagnosis, the 2 masked graders said that the SD-OCT images confirmed their initial photo-based diagnosis in 86.7% of cases and refuted it in 13.3%.

Figure 2 shows an example of a patient with what appears to be geographic atrophy, and SD-OCT confirms the presence of outer retinal atrophy consistent with the diagnosis.

Figure 3 shows an example of a patient in whom the fundus photograph led to initial diagnosis of retinitis pigmentosa without cystoid edema; SD-OCT refuted the diagnosis, showing clearly that there is significant cystoid edema present.
firms the presence of outer retinal atrophy consistent with the diagnosis. Figure 3 shows an example of another patient for whom the SD-OCT refuted the initial diagnosis of retinitis pigmentosa without cystoid edema; the SD-OCT shows clearly that there is significant cystoid edema present.

**CONCLUSIONS**

The strengths of this study include its large sample size, its prospective design, and its use of masked graders. The limitations include the use of a relatively healthy patient cohort, leading to low abnormal rates for both SD-OCT and fundus imaging.

A recent study has validated that optical coherence tomography results in better detection of retinal pathology than standard nonmydriatic fundus photography. The use of SD-OCT in a primary care setting appears to be feasible, as we achieved a 98.9% rate of image acquisition. SD-OCT, used as an adjunct to fundus photography, appears to have some added benefit, confirming the initial diagnosis in the large majority of cases. Overall, we concluded that SD-OCT does provide an additive benefit when evaluating patients in a nonmydriatic screening program.

Studies of this combination of screening modalities in populations with a greater prevalence of ocular pathology would be helpful in further assessing its usefulness. Still to be answered is the question of whether the incremental gain in information gathered is worth the costs of the machine and additional acquisition time.

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