Sponsored by Next Sight

Automated Fundus Photography:

Implications for Clinical Practice and Telemedicine

Results from a clinical study affirm advantages of the utility of automated versus traditional fundus cameras in telemedicine and remote screening applications.

BY ALBERTO DI BARI, MD

The Nexy automated fundus camera by Next Sight is an easy-to-use platform that delivers high-quality images. Nexy may offer distinct advantages in both routine clinical practice for making a diagnosis and observing patients, as well as for use in remote screening applications. For instance, because images can be stored both locally to a network and on cloud-based software, there is great potential for this device in telemedicine applications.

MANUAL VERSUS AUTOMATED FUNDUS CAMERAS

While automated cameras are easy to use and apply in practice, the operator is somewhat limited in the ability to make adjustments. On the other hand, manual fundus photography is distinctly operator-dependent, for better and for worse. Adjustments can be made to capture the image, but using these systems requires specialized training, and the photographer's skill can affect the image's quality.

In my opinion, Nexy's simplicity of use and automatic image acquisition result in better use in routine and preliminary eye examinations than other cameras. The results of a study in our clinic suggested that the Nexy produces images that are no different than, and in some cases superior to, a traditional fundus camera (TFC).[1] As a result, it is powerful enough for use in practices that focus on providing specialty retinal care, including diabetes, age-related macular degeneration, and glaucoma.

The settings on the Nexy camera permit automated image capture in seven different zones, two central and five peripheral. These images can be stitched together to form a mosaic of the retina, although they each may be useful for detecting and monitoring pathology.

While the quality of the image captured on the Nexy camera is independent of the operator, the time to acquire an image is somewhat reliant on the operator, who must learn to capture fundus photographs in an entirely new manner. As a result, learning how to position the patient is the biggest obstacle to integration.

CLINICAL STUDY

We recently completed a study in our clinic to quantify three aspects of automated fundus photography using the Nexy platform: (1) image acquisition time; (2) image quality compared with standard fundus photography and scanning laser ophthalmoscopy; and (3) whether it would be plausible to use the device in telemedicine applications.[1]

For our study, we enrolled 350 eyes of 177 patients; of these, 71% were considered healthy, and 29% had been previously diagnosed with a retinal pathology. In addition, 54% of eyes were found to have a condition that might affect the ability to focus or capture an image. Therefore, 40% of eyes were examined in miosis.

IMAGE ACQUISITION

We found that image acquisition time decreased significantly in cases performed at the end of our series, which suggested there is a learning curve associated with the Nexy. As noted earlier, this is related to establishing a clinical protocol for positioning patients. In addition to positioning errors, a number of factors may extend acquisition time, including cataract, prior refractive surgery, keratoconus, refractive error greater than 5.00 D, and miosis (pupillary size < 2.5 mm). After excluding the first 50 cases to account for the learning curve, we noted that mean acquisition time for the Nexy (49.1 ±33 seconds) was comparable to manual fundus photography (44.3 ±23 seconds).[1]

IMAGE QUALITY

We compared 189 images captured with the Nexy and a TFC (CR6-45NM, Canon), and 148 images were captured with the Nexy, a TFC, and a scanning laser ophthalmoscope (SLO)—using a near-infrared, 785-nm light source (RS-3000 Advance, Nidek)—to assess a number of parameters related to image quality.

Using a four-point grading scale, we found that images from the Nexy were of comparable quality to (and in some cases better than) a TFC, but both of these systems produced images

that were of slightly lower quality compared with a SLO.[1] However, as a SLO is a highly specialized imaging modality, the implications for image quality relative to a SLO may not be relevant for all potential users of the Nexy device.

We found that the Nexy more often produced superior-quality images in the presence of a cataract compared with a TFC (Figure 1), and that it was also superior for capturing certain pathologies (Figure 2).[1]

TELEMEDICINE APPLICATIONS

To assess the suitability of each device for telemedicine applications, we submitted images captured with the Nexy, a TFC, and a SLO to an independent ophthalmologist for a sick/healthy diagnostic classification. Our analysis found that specificity was 99.6% (Nexy), 100% (TFC), and 96% (SLO). Sensitivity was 91.6% (Nexy), 80.6% (TFC), and 94.5% (SLO). Overall, images from the Nexy resulted in very low rates of false positive (0.4% Nexy vs 0.0% TFC vs 4.0% SLO). The rates of false negative diagnoses were significant, but the Nexy showed better performance then a TFC (8.1% Nexy vs 19.4% TFC vs 5.5% SLO). No loss of image quality was noted from compressing the Nexy image file (to about only 200 kb) for transmission and storage over the internet.

CONCLUSION

Our clinical study confirmed the proposed advantages of an automated fundus camera relative to a TFC and demonstrated complementary clinical utility as a SLO. Compared to a TFC, the Nexy demonstrated a similar image quality, proved to be superior in the presence of a cataract (48% better Nexy, 15% better TFC, 37% Nexy=TFC), and proved to be better at detecting specific retinal patterns, such as Drusen, posterior high myopic degenerations, and macular dystrophy (Figure 3).[1] Our study produced similar results in image acquisition time (mean time: 49" Nexy, 44" TFC), image failure rate (Nexy=TFC= 6/189 eyes), and in eyes with miosis (32% better Nexy, 40% better TFC, 28% Nexy=TFC). A summary of our conclusions with respect to image quality is depicted in Figure 3.[1]

In regard to the stand-alone diagnostic use of retinography, we can observe that the percentage of false negatives (= unidentified pathological retinas) is not yet optimal, even if the Nexy (8.1%) showed, in our sample, less than half the false negatives compared to the a TFC (19.4%). To improve these data, we suggest that the image analysis must be integrated by the knowledge of other clinical data, that the ophthalmologist must have advanced retinal skills, and that some artificial intelligence software may be able to help the eye and the human experience in diagnostic interpretation.

We must acknowledge an important limitation of our study: the results with the Nexy will likely differ if compared to other TFC setups. That said, our study provides a general framework for understanding the clinical applicability of automated fundus photography that is easily generalizable. Moreover, our results highlight that the Nexy is easy to learn to use, that it is amenable for use in telemedicine applications, and that it can be easily integrated into any patient health system, such as an electronic medical record or health medical record system. ■

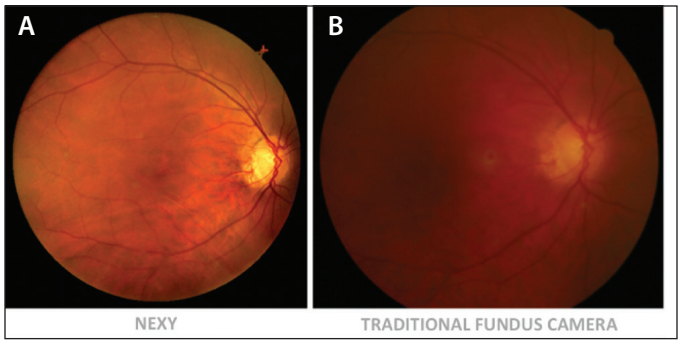
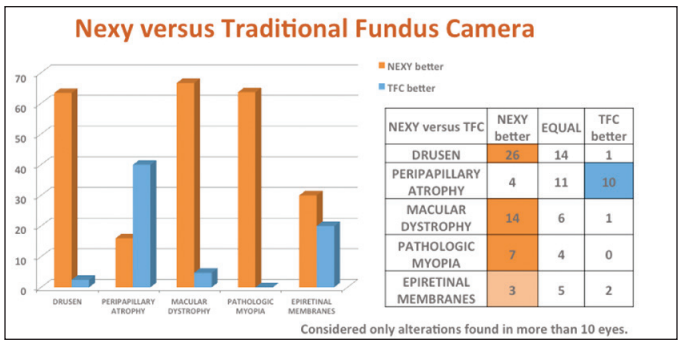


Figure 1. Sample images of the same eye with a cataract acquired with the Nexy (A) and a TFC (B).



NEXY versus TFC	NEXY better	EQUAL	TFC better
DRUSEN	26	14	1
PERIPAPILLARY ATROPHY	4	11	10
MACULAR DYSTROPHY	14	6	1
PATHOLOGIC MYOPIA	7	4	0
EPIRETINAL MEMBRANES	3	5	2

Figure 2. A comparison of the Nexy versus a TFC for imaging specific retinal pathologies.

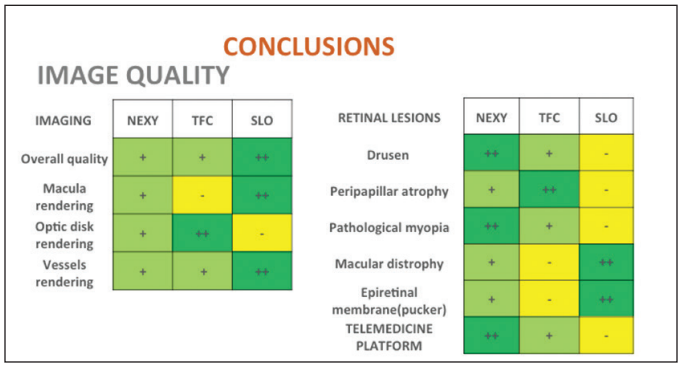


Figure 3. Impressions from our clinical study comparing the Nexy to a TFC and a SLO.

1. Di Bari M, Di Bari A, Genisi C. Fully-automated fundus camera imaging: a comprehensive analysis. Presented at: Ophthalmic Hub, March 30-31, 2018, Kiev, Ukraine.

Alberto Di Bari, MD
- Owner of a private ophthalmology center, Turin, Italy
- Consultant Surgeon, Santa Caterina Clinic, Turin, Italy
- Scientific Board Member, FCA Medical Group (Cemedi), Turin, Italy
- studiodibari@hotmail.com
- Financial disclosure: None