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Software for device provides corneal, total eye analyses

Clinicians improve refractive procedures, aid in contact lens fittings with diagnostic functions

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Nidek has released new diagnostic software called the OPD-Station that lets clinicians use data from its OPD-Scan device to perform a variety of corneal, total eye, and internal eye analyses using several sophisticated new functions.

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The OPD-Station software is used to analyze the corneal shape and total eye aberrometry measured by the OPD-Scan, display the data in the form of maps, and manage the data. The stand-alone program can be installed on a laptop or desktop computer so that it can be used when the clinician is not at the OPD-Scan itself, and it provides additional information important in making a diagnosis, said Jack T. Holladay, MD, MSEE, FACS, an ophthalmic surgeon in Houston. Dr. Holladay developed several of the OPD-Station's features in collaboration with Nidek.

"The software program has more reports and functionality than the actual software on the OPD-Scan because it is intended for review and for other reports and analyses that one may want to generate from original exams," Dr. Holladay said.

"The OPD-Station is essentially a separate computer that does analysis of the output from the OPD-Scan," said Paul J. Dougherty, MD, a refractive and cataract surgeon with a multi-office private practice in the Los Angeles area and a clinical instructor of ophthalmology at the Jules Stein Eye Institute, University of California at Los Angeles.

"This system offers improved diagnostic ability for the refractive and cataract surgeon," Dr. Dougherty said. "The OPD-Station, unlike any other diagnostic technology available, separates the lens-versus cornea-based aberrations. The surgeon can then demonstrate the visual effects of these aberrations to the patient."

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New software functions

New functions available on the OPD-Station include maps of point spread function (PSF), modulation transfer function (MTF), and retinal image simulations. It also has improved color mapping. The PSF, MTF, and retinal image simulations are collectively known as the Holladay Summary.

The PSF simulation is based on aberrometry and corneal topography data measured by the OPD-Scan and displays a simulation of the distribution of the point spread, Dr. Dougherty said. Results of these PSF simulations can then be used to generate retinal image simulations of a projected eye chart.

"Clinicians can demonstrate to patients what they are likely to see with various forms of refractive surgery or better explain their refractive surgery outcomes," Dr. Dougherty explained.

"This is useful to help determine whether someone's visual complaints are primarily corneal or related to the lens," he added. "Particularly in this era of increased use of wavefront laser surgeries as well as wavefront and phakic IOLs, this software often will help the surgeon determine the proper course of action in evaluating patients with respect to which surgery is most appropriate for them, whether it be a corneal or a lens-based surgery."

The OPD-Station package also includes the Corneal Navigator software, which uses corneal parameters from topography measurements to

Figure 1 The OPD-Station software (Nidek) is used to analyze the corneal shape and total eye aberrometry measured by the OPD-Scan, display the data in the form of maps, and manage the data. (Photo courtesy of Nidek)

determine corneal features. The software analyzes the topography and produces a differential diagnosis, with eight kinds of corneal classification determined by neural network analysis. The Navigator software shows the statistical possibility by percentage that the cornea is normal or falls into: astigmatism, suspected keratoconus, keratoconus, pellucid marginal degeneration, post-myopic refractive surgery, post-hyperopic refractive surgery, post-penetrating keratoplasty, or other irregular astigmatism.

The developers programmed the software to recognize the different conditions, but the technology is not perfect.

"The limitation is that the neural network can never answer a question or pick up a diagnosis that it hasn't been trained to recognize. It can't be any smarter than the data that were put in," Dr. Holladay said.

For example, because today's improved LASIK techniques scarcely alter the cornea, it is difficult for the software program to differentiate between normal eyes and those that have had successful LASIK, Dr. Holladay said.

"The software cannot be used to diagnose a particular disease definitively," Dr. Dougherty said. "It assists the surgeon in helping determine whether or not a patient has one of these pathologies, in combination with other diagnostic tools such as slit-lamp examination, clinical history, retinoscopy, and manual keratometry."

While the OPD-Scan device and the OPD-Station software are approved by the FDA, the Corneal Navigator was still under review as of early October. Nidek developed the Corneal Navigator in collaboration with Stephen D. Klyce, PhD, and Michael K. Smolek, PhD.

The Holladay Summary Report function of the OPD-Scan exemplifies Dr. Holladay's views on the importance of efficiency and comprehensive data.

"My philosophy for the topographers and for the wavefront devices has always been the same. You have to be able to provide the doctor with a single report that the technicians have taken that is placed in the patient's chart so that when the doctor is in the room examining the patient he or she can look over this report and have all of the information needed to make a clinical decision," he explained.

"Very few doctors have time to sit down at an instrument and go through all of the reports and the analyses and then examine the patient. You can't see 20 or 40 patients a day if you don't have that report when you see the patient," he added.

When this report is printed, the two maps at the top are wavefront and higher-order wavefront. One characteristic of the wavefront map is particularly valuable, Dr. Holladay said, explaining that the OPD-Scan measures wavefront in diopters, providing a spatial refraction that identifies the refractive error at every point in the pupil.

"The wavefront map on the OPD can actually be expressed in diopters, exactly the same way we express the corneal topography map, making it easier to evaluate the maps," Dr. Holladay said. "It allows clinicians to apply all the knowledge that they have accumulated over the last 20 to 25 years of reading topography maps directly to wavefront maps. If the map is in micrometers, one can't look at a topography map and a wavefront map and make any comparisons because the units are totally different and the displays look different."

Finding value of maps

The value of these two maps is that the wavefront (OPD) map, expressed in diopters, provides all of the aberrations in the eye, while the higher-order map removes sphere and cylinder and shows which aberrations can and cannot be corrected with glasses, Dr. Holladay said.

The second pair of maps consists of the refractive map and the local radius of curvature map, the two most important maps for topography, he continued. The refractive map shows the change in power across the surface of the cornea, while the local radius map shows in more detail the minor fluctuations in the radius of the cornea.

In the lower left corner is an internal OPD that lets clinicians look at the difference between the corneal topography map and the whole eye map, take the difference, and see the internal optics of the eye, primarily the crystalline lens, Dr. Holladay said. The last map, in the lower right corner, is the MTF, a graph that shows the performance of the eye at all spatial frequencies.

"The area under that curve is an overall measure of the performance of the eye as an optical system," Dr. Holladay said. "The green curve is 'normal,' and the patient's curve with and without spectacle correction is shown, along with the area of each compared with the normal. Excellent optics are >90%, and poor optics are <50%."

Other values at the bottom of the report provide data such as average scotopic, photopic, and mesopic pupil size; the distance from the center of the map to the center of the pupil in mesopic and photopic conditions; the asphericity quotient (Q) of the cornea; and other quantitative parameters.

The OPD-Station also is equipped with the "CL Fit" software that assists the practitioner in fitting contact lenses. Data from the OPD-Scan topographer are used to select the most appropriate contact lens to help achieve the most optimal fit.

Another advantage of the OPD-Station is the ability to use and analyze OPD-Scan data at remote locations, rather than only while sitting at the device, Dr. Holladay said. Patient files with data from the OPD-Scan can be exported to a memory stick, floppy disk, CD, or some other medium, then loaded onto a computer at another location and run through OPD-Station.

This is possible through NAVIS, Nidek's medical database management system. The NAVIS system allows inter-office networking of information because all the exam data are digitalized, Dr. Dougherty said.