What Are the Important Points to Document on an RNFL Evaluation With OCT?

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The structural changes in glaucomatous eyes often precede the functional changes noted on subjective clinical testing such as automated perimetry. Unfortunately, it can be difficult to identify early anatomical changes using clinical drawings and photographic studies. Several imaging modalities such as the Heidelberg Retina Tomograph 3 (Heidelberg Engineering GmbH, Heidelberg, Germany), Stratus OCT (Carl Zeiss Meditec, Inc., Dublin, CA), and GDx (Carl Zeiss Meditec, Inc.) may help you to document glaucomatous changes objectively and to quantify alterations in the optic nerve and retinal nerve fiber layer (RNFL). This article focuses on optical coherence tomography (OCT) per the reader's question.

HOW OCT WORKS

OCT uses a super-luminescent diode light source to transmit low-coherence light into the eye. The light scans across the retina in a transverse plane similar to that used in B-scan ultrasonography. A detector captures the reflected light for analysis using an automated computer algorithm. Fortunately for the purposes of a glaucoma evaluation, the RNFL is highly reflective, so a direct measurement of it can be made in microns. Clinically, the OCT device compiles the data from all of the scans and presents a summary in a color-coded printout with several parameters included for your evaluation (Figure 1).

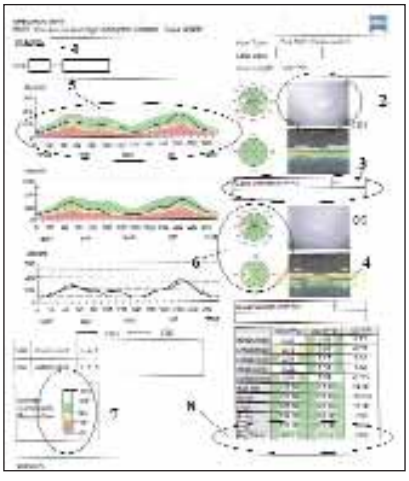

Figure 1. The numbers on this RNFL printout delineate the authors' recommended interpretive sequence.

THE INTERPRETIVE SEQUENCE OF THE OCT'S RNFL PRINTOUT

Each point corresponds to a matching number on Figure 1.

1. Confirm the patient's name and identification number as well as the date of the examination.
2. Check the acquired image for the quality of reflectance and ensure that the nerve is centered and encircled correctly. If the optic nerve is not centered, the thickness reading will be higher close to the optic nerve and lower far away from the optic nerve.
3. Verify that the signal strength (a quality measure of acquired data) is close to 10. Typically, a signal strength of less than six indicates a test to which you should not give great weight clinically. Also, if the signal strength decreases, there will be a corresponding decrease in the measured RNFL thickness.
4. Ensure that white lines sur-

round the RNFL, which indicates the proper acquisition of targeted tissue. The RNFL is the topmost red layer. If the lines delineate another area, the algorithm failed, and the data cannot be used. If there is a sudden drop-off in the contour or a large stretch of flattening, then the algorithm may have failed to calculate the RNFL properly, and you should discard the numerical values in this region.

5. Check that the double-hump RNFL data output is aligned appropriately. The humps should be over the superior and inferior areas of the plot. If there are not two humps in these areas or if the humps (thickest RNFL) appear somewhere else, you may need to investigate further.

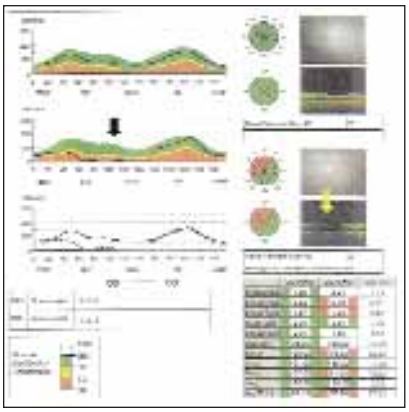

Figure 2. This scan poorly identifies the RNFL due to a failed algorithm. The yellow arrow denotes the OCT device's failure to identify the RNFL, and the black arrow reveals a corresponding dip in the RNFL's value.

6. Assess the pie charts, which reflect both clock-hour and quadrant RNFL values for each eye. These zones are averages over the given quadrant or clock hour. The numerical data are the average thickness over the given region in microns. The RNFL should be thickest in the superior and inferior regions.

7. Review each segment, which is a color-coded probability plot compared to the normative database. Green values indicate an RNFL of normal thickness, yellow denotes a borderline value, and red indicates a value outside the normal range.

8. Note the average RNFL thickness for both of the patients' eyes. You will often use this global indicator as a guide to the patient's overall status.

PEARLS AND PITFALLS

Always ensure that the OCT images and analysis are of adequate and consistent quality prior to accepting the analyzed data. Remember that the signal strength should be greater than six and that there should be no obvious misalignment of the surface-detection algorithm, as evident when the white lines do not correspond to the RNFL (Figure 2). Also, the upper red layer (representing the RNFL) and the lower red layer (representing the retinal pigment epithelium, choriocapillaris, inner/outer photoreceptor junction, and plexiform layers) should have a more intense (red) signal than the retinal ganglion cells, inner/outer nuclear layer, and photoreceptors layer (cooler colors in between the red zones). Finally, check the original individual images obtained for even reflectance. You may then confidently evaluate the summary printout.

Cloudy media such as corneal haze, cataracts, and dense vitreous hemorrhage can interfere with OCT imaging. It may be necessary to dilate the pupils of many, but not all, patients. Also, beware of dry eyes. A patient should receive minimal topical anesthesia before imaging. The drier the ocular surface is, the thinner the RNFL will appear to be.

CONCLUSION

Using a stepwise approach, you should be able to interpret the OCT device's RNFL printouts in an accurate and consistent manner without difficulty. The information obtained from OCT can help you to diagnose glaucoma and monitor the status of the disease over time. The key is to be consistent in the way you obtain, interpret, and record data. Future technologies will permit more data points to be included for analysis and will provide patients with a more user-friendly and time-efficient method for data's acquisition. ❑

Section editors Malik Y. Kahook, MD, and Robert J. Noecker, MD, MBA, are in academic glaucoma practice. Dr. Kahook is Assistant Professor of Ophthalmology and Director of Clinical Research in the Department of Ophthalmology at the University of Colorado at Denver & Health Sciences Center. Dr. Noecker is Director of the Glaucoma Service and Associate Professor/Vice Chair at the Department of Ophthalmology at the University of Pittsburgh. Dr. Kahook acknowledged no financial interest in the products or companies mentioned herein. Dr. Noecker has received grant/research support from Carl Zeiss Meditec, Inc., and has received honoraria from Heidelberg Engineering, Inc.

Further Reading:
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Schuman JS, Puliafito CA, Fujimoto JG. *Everyday OCT: a Handbook for Clinicians and Technicians.* Thorofare, NJ: Slack, Inc.; 2007.
Wollstein G, Paunescu LA, Ko TH, et al. Ultrahigh-resolution optical coherence tomography in glaucoma. *Ophthalmology.* 2005;112:229-237.

SEND US YOUR QUESTIONS!

Fellows and residents are encouraged to submit their questions for consideration. Interested parties should send a question, their name, and their academic affiliation to Dr. Kahook at malik.kahook@uchsc.edu.