

## With recent advances in optic nerve imaging, are baseline optic nerve stereoscopic photos still necessary?

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### **Baseline Optic Nerve Photos Are Still Necessary**

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The examination of the optic disc and retinal nerve fiber layer is essential in the diagnosis and monitoring of glaucomatous optic neuropathy. Currently, technology has allowed us to take images of the optic disc using confocal scanning laser ophthalmoscopy, scanning laser polarimetry, and optical coherence tomography. These new techniques provide objective and quantitative measurements that are highly reproducible, with high sensitivity and specificity, and with values that are compared to age-matched normals to facilitate identification of abnormal structure. Their printouts are quite impressive, colorful, and full of information.

Given these advanced techniques, are baseline optic nerve stereoscopic photos still essential? I say YES! Serial photography is an old, yet stable, and less expensive technology. You won't have problems with intercompatibility of photographs taken today, years ago, and years later. Serial photographs allow analysis of changes over time.<sup>1-6</sup> You can examine these photos at your convenience and comfort. Non-quantitative changes such as disc pallor, peripapillary atrophy, and disc hemorrhages are better identified

with photos.<sup>3</sup> Stereoscopic photos can help distinguish between cupping and pallor.<sup>3</sup>

We can also make good estimations of optic disc parameters using a high plus lens and the slit-lamp reticule. And with the introduction of digital photography, various software to generate quantitative measurements of optic disc parameters based on digital photos are available.<sup>7</sup>

However, like the other optic nerve imaging technologies, the quality of the photos is dependent on the quality of the camera, the experience of the photographer, and presence of any media opacity in the subject's eye. Despite these limitations, stereoscopic photos allow permanent recording of optic nerve appearance for future reference.

Hence, even in the midst of advanced methods of imaging and analyzing the optic disc, baseline stereoscopic photographs are still essential in the practice of glaucoma. Rather than being opposed against one another, these technologies may be viewed as complementary to one another in their ability to image the optic nerve. Moreover, these techniques are excellent aids to careful clinical evaluation.

Remember, every picture tells the story of a glaucomatous nerve.

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### **Baseline Optic Nerve Photos Are No Longer Necessary**

**Janet Ongkeko-Perez, MD, FPAO**

Stereoscopic photos of the optic disc are subjective and qualitative with recognized interobserver variability especially between general ophthalmologists and experienced readers. Image quality is easily affected by acquisition techniques and resolution. Also, experts miss progression up to 50% of the time.<sup>1</sup>

Efforts to refine the use of photos led to the development of early instruments based on the principle of stereopsis such as stereophotogrammetry, stereochronometry, stereochronoscopy, and raster-stereography. But these instruments never achieved widespread clinical use. However, the experience gained through the study of such instruments provided a basis for the understanding of computerized image analysis.

The past two decades have seen the emergence and rapid development of major technologies, systems, software, and database for comparative analysis in the diagnostic imaging of the posterior segment. Presently, scanning laser polarimetry (SLP), confocal scanning laser ophthalmoscopy (CSLO), and optical coherence tomography (OCT) are available for optic nerve head (ONH) and retinal nerve fiber layer (RNFL) imaging. They have gained widespread

use for the diagnosis and follow-up of patients with or at risk for glaucoma.

So why does computerized imaging make baseline stereoscopic photos unnecessary?

Being computer-assisted, computerized imaging provides objective, quantitative, and highly reproducible measurements that show very good agreement with clinical estimates of the ONH structure and visual function. Advances in computer imaging technology provide useful measures that assist the clinician in glaucoma diagnosis and monitoring.<sup>2</sup>

Numerous studies have shown the diagnostic accuracy and advantages of using computerized imaging and analysis. ONH imaging has similar or even better sensitivity and specificity as compared to stereophotography.<sup>3-4</sup> The conclusion of the Confocal Scanning Laser Ophthalmoscopy Ancillary Study to the Ocular Hypertension Treatment Study (OHTS) suggests that baseline glaucoma probability score, Moorfields regression analysis (MRA) classification, and stereoparameters alone or when combined with baseline clinical and demographic factors result to a high predictive value for future development of glaucoma and are as effective as stereoscopic photographs for estimating the risk of developing glaucoma in ocular hypertensive subjects.<sup>5</sup>

The Glaucoma Automated Tests Evaluation (GATE) study and its ancillary study showed that automated imaging technologies are accurate; with the Heidelberg Retinal Tomograph (HRT) being the most sensitive at 87% and the glaucoma detection (GDx) nerve fiber analyzer the most specific at 97%. Automated imaging technologies are effective aids in glaucoma diagnosis among individuals referred from the community to hospital eye services and can also aid in glaucoma diagnosis especially by non-glaucoma subspecialty trained clinicians. Computerized imaging probably has its greatest usefulness in diagnosing more subtle forms of glaucomatous optic neuropathy. The GATE study also found that imaging is a cost-effective triage component in the United Kingdom together with intraocular pressure and visual acuity.<sup>6-7</sup>

In the European Optic Disc Assessment Trial, common imaging devices outperform most general ophthalmologists in classifying optic discs.<sup>3</sup> Hence the study recommends the use of imaging devices in clinical practice. Also, the authors noted that imaging devices may also serve as a teacher, by providing objective

feedback in disc assessment. This feedback then leads to improvements in clinical assessment skills.

In the paper by Greenfield and Weinreb, the numerous roles of computerized imaging in clinical care were discussed.<sup>2</sup> Computerized imaging provides an effective means of establishing baseline documentation for future comparison which is important in progressive diseases such as glaucoma. It also provides a measure of the optic disc size which is critical to the interpretation of estimates of cup-to-disc ratio and rim integrity. Computerized imaging may also aid in early diagnosis by objectively demonstrating early changes in the course of the disease such as changes in the peripapillary RNFL including comparison with age-matched controls.

There is already strong support for the use of glaucoma computerized imaging. Recommendations on the imaging of the optic disc and the RNFL in glaucoma were included in the 2017 American Academy of Ophthalmology preferred practice guidelines.<sup>8</sup> The consensus initiative of the World Glaucoma Association also recommends digital imaging to facilitate assessment of the optic disc and RNFL since it provides an objective and quantitative approach to glaucoma detection and monitoring. The OCT may be the best currently available digital imaging instrument for detecting and tracking optic nerve structural damage in glaucoma.<sup>9</sup>

A comprehensive review by the Ophthalmic Technology Assessment Committee Glaucoma Panel of the American Academy of Ophthalmology also concluded that the ONH and RNFL imaging devices provide quantitative information to the clinician.<sup>10</sup> And that, ongoing advances in imaging and related software, as well as the impracticalities associated with obtaining and assessing optic nerve stereoscopic photographs, have made imaging increasingly important in many practice settings. The panel likewise stated that information obtained from imaging devices is useful in clinical practice when analyzed in conjunction with other relevant parameters that define glaucoma diagnosis and progression.

Imaging technology continues to evolve. But ultimately, as clinicians we need to be familiar with the devices that we use and incorporate the test results to the broader clinical assessment of the patient.

So, are baseline stereoscopic photos really no longer necessary? YES.

Both tests are complementary to each other. But take into consideration that stereoscopic photos have technical shortcomings with variable accuracy and precision due to its subjectivity. The value of computerized imaging in clinical practice is now more widely recognized. Studies have shown that imaging technology have even better sensitivity and specificity as compared to optic disc photos. And of course, consider the financial cost of each test, why not consider having just imaging done? Choose the one test that is reproducible, quantitative, objective, and will provide more information that ultimately will help you detect the presence of glaucoma.

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## Consolidating the Evidence

Mario V. Aquino, Sr., MD

At present, evaluation of the optic nerve head (ONH) and visual fields are still the gold standard for detecting and monitoring glaucoma. Quigley *et al.* reported that 30-40% of retinal nerve fiber layer (RNFL) death takes place before it can manifest a visual field defect.<sup>1,2</sup> This makes assessments of the RNFL and optic nerve head (ONH) the most important examinations in the early diagnosis of glaucoma. Stereoscopic disc photography and imaging devices are the 2 ways to objectively examine the RNFL and ONH. The former is qualitative and the latter is quantitative. Imaging devices bypass inter- and intra-observer variability of optic disc assessment.<sup>3</sup> Will imaging devices eventually replace stereophotography and make the latter unnecessary?

The last decade has produced significant advances in hardware and software platform of imaging devices for the standardized, objective, and quantitative assessment of ONH morphology and RNFL. With its ability for rapid data acquisition, high-resolution, enhanced precision, reproducible registration, and improved algorithms, imaging devices have the potential to greatly facilitate early glaucoma diagnosis and monitoring.<sup>3,4</sup> However, it should not mislead us to think that glaucoma diagnosis can be solely machine-based at the current time. Image quality is dependent upon operator skill, signal strength, several patient-related factors (i.e. age, pupil diameter, optic disc shape and size, media clarity, and axial length), and instrument-dependent variables. It may result in false positive or false negative findings. The rapidly changing imaging technology has negatively impacted longitudinal studies seeking to validate the use of imaging for detection of glaucoma progression. You can neither compare images taken with latest device with earlier models, nor images of one machine with another.<sup>4,7</sup> A color stereoscopic or monoscopic disc photo is still the gold standard and the preferred way to document the RNFL and ONH. Optic disc photography shows you details that cannot be seen with imaging devices. It provides a more accurate baseline for future comparison.<sup>8</sup> Photographs do not get outdated, and the information contained in them can be very useful for demonstrating change years later. The inability of imaging devices to detect clinical features like optic disc hemorrhage, subtle notching, beading of the circumferential vessels, bayonetting of vessels, narrowing of retinal arterioles, increased

vertical excavation of the optic cup, presence of beta-zone parapapillary atrophy, and violation of the ISNT rule, is a definite liability for their use. Moreover, features like optic disc edema, optic atrophy, epiretinal membrane, retinal scar, branch vein occlusion, vitreous floaters, posterior vitreous detachment, and other non-glaucomatous optic neuropathy, which could explain false negative or false positive imaging results, are not visible with the digital imaging techniques.<sup>9,10</sup>

ONH imaging devices cannot serve as a stand-alone. It is only an adjunct to other clinical measures especially in making a diagnosis of glaucoma for the first time.<sup>3</sup> One should not request for ONH imaging right away from the reason stated above. A slit-lamp clinical evaluation of the ONH and RNFL using a high-power fundus lens should be done first. If it looks suspicious, request for a visual field examination. If the visual field is normal, then request for a baseline stereoscopic disc photo or at the very least a monoscopic ONH photo for future comparison.

In conclusion, even with latest advances of imaging devices, optic disc photo is still necessary.

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