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The Importance of Optic Nerve Imaging in Clinical Practice

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Glaucoma is a disease of the optic nerve characterized by a specific pattern of progressive injury to retinal ganglion cells and their axons, which results in alteration of optic disc topography, commonly known as “cupping,” and associated visual field loss. Glaucoma is, therefore, a disease that is defined, staged, longitudinally assessed, and treated based upon the structural appearance of the optic nerve and its function. While intraocular pressure reduction remains the mainstay of therapy, assessment for progressive disease depends solely on periodic assessment of the structure and function of the optic nerve. Careful, accurate assessment and documentation of the appearance of the optic disc become indispensable for diagnosis and disease management. Perhaps more importantly, documentation of the appearance of the optic disc is critical to longitudinal patient care.

Clinical evaluation of the optic disc is based upon assessment of the optic nerve during the ophthalmic examination. In the past, this was performed with direct ophthalmoscopy or slit-lamp biomicroscopy with the aid of a Hruby lens. In current practice, clinical stereoscopic examination of the optic disc at the slit-lamp is achieved with a handheld indirect lens (60, 78, or 90 diopter) and indirect ophthalmoscopy. Each of these techniques has its own advantages and disadvantages, but all purely clinical approaches to optic disc evaluation are limited by their subjective nature.

Documentation of the appearance of the optic disc at baseline is most often achieved with standard stereophotography. Clinical examination and review of stereophotographs provide a method for qualitative assessment of the optic disc, but provide only limited quantitative information. The recognition of the intrinsic relationship between the optic nerve and disease management and the need for a more quantitative approach to optic nerve assessment has been an underlying driving force for the development of confocal scanning laser ophthalmoscopy.

Confocal scanning laser ophthalmoscopy of the optic disc using the Heidelberg Retina Tomograph II (HRT II) provides detailed, precise, quantitative information about the contour of the optic disc that is invaluable in the assessment of the optic disc and has altered our approach to the optic disc examination. Clinicians are now able to quantify the amount of neuroretinal rim and describe its features in great detail. In addition to global assessment of rim area, measurable features of the optic disc now include focal loss of neural rim, volumetric assessment of the rim and cup, precise assessment of disc area, evaluation of the shape of the cup, and characteristics of the retinal nerve fiber layer, among others.

This quantitative information allows for easier detection of disease by identifying features of the disc that are more typical of glaucoma than normal individuals. Computer-assisted analysis, such as the information revealed by Moorfields Regression Analysis, aids the clinician in initial diagnosis by revealing structural features and relationships of the optic disc that are both not evident during clinical examination and require computerized interpretation of large amounts of data.

Although the wide biologic variability in the appearance of the normal optic disc makes the diagnosis of glaucoma difficult in some patients even with the aid of quantitative information, longitudinal assessment of quantitative information can provide earlier determination of disease progression. This aids not only in the assessment of established disease, but also assists in the initial diagnosis of the disease by detecting subtle changes in optic disc topography that are not visible by clinical examination or more traditional methods of optic nerve assessment. These early quantifiable changes in disc topography most often precede any reliable, detectable changes in traditional, achromatic perimetric measures of visual function. One of the key purposes of this book is to help clinicians translate these scientific advances into clinical practice and the care of patients.

This revolution in our approach to optic disc imaging parallels the introduction of automated perimetry. Early versions of the automated perimeter were limited by available hardware and software, lack of good normative databases, and lack of clinical experience. Although it took many years for automated perimetry to gain widespread acceptance, this technology is now the gold standard for evaluation of visual function. The same process of instrument development applies to the HRT, which in the HRT II combines high technology, ease of use, a normative database, and algorithms to aid in the differentiation of normal from abnormal and detection of progression. The information gleaned from automated optic nerve assessment is more reliable and reproducible and will likely be more sensitive and specific than subjective interpretation of disc photographs for most practitioners.

Where is our new technology leading? The integration of new scientific information into clinical practice is often difficult for the busy clinician. Information provided by the HRT II improves patient care by augmenting clinical assessment of the optic nerve, allowing us to move beyond subjective interpretation of the optic nerve to data-driven decision-making. New evidence from longitudinal studies involving HRT assessment of optic disc parameters will serve to enhance our understanding not only of glaucoma pathophysiology, risk assessment, and the relationship between structural and functional alteration in glaucoma, but also will enable us to more appropriately initiate therapy and advance therapy when indicated. This process of a more directed therapeutic approach offers us the opportunity to fine-tune our therapy by minimizing it in persons with only modest amounts of nerve injury, while maximizing it in those that are progressing toward blindness. Given the need for accurate disc assessment, it is highly likely that each of us will have an imaging device as part of our routine ophthalmic practice and that it will play an integral role in the management of persons with glaucoma and those at risk for this blinding disease.