

1.3.3 Recording of the Optic Nerve Head (ONH) Features

At baseline, some form of imaging is recommended to provide a record of the ONH appearance [I,D]. If colour photos are not available, a detailed manual drawing is recommended. Even if it is difficult to draw a good picture of the ONH, the act of making a drawing encourages a thorough clinical evaluation of ONH [II,D].

Stereoscopic is preferred to non-stereoscopic photography [I,D]. Colour photography with a 15° field gives optimal magnification. Sequential photographs can be used to detect progression of optic disc damage.

1.3.3.1 Quantitative Imaging

Quantitative imaging of the optic nerve head, retinal nerve fibre layer and inner macular layers have been widely used to assist glaucoma diagnosis and to detect glaucomatous progression during follow-up.

1.3.3.2 Classification

For cross sectional classification, imaging instruments typically provide three potential outcomes: “within normal limits”, “borderline” and “outside normal limits”. No imaging device provides a clinical diagnosis but just a statistical result, based on comparison of the measured parameters with the corresponding normative database of healthy eyes. Therefore an interpretation of the result in the context of all clinical data is mandatory [I,D]. The clinician should also assess the quality of the image and analysis and judge whether the normative database is relevant for the particular patient before including the classification in the assessment of the patient [I,D]. For instance, imaging artefacts and software errors are quite common and more frequent in eyes that are highly myopic or have very tilted nerves, and few devices have normative data appropriate to these eyes. The various imaging technologies have their own advantages and limitations, and their classification shows only partial agreement in early glaucoma¹¹¹. In addition, agreement between classification with quantitative imaging and visual field testing is only moderate in early glaucoma.

1.3.3.3 Detection of progression

Most commercial imaging devices have software for quantifying glaucomatous progression, including the rate of progression. The classification algorithms described above should not be used to assess progression [I,D]. In general, normative databases are not needed for progression analysis because the patient’s baseline images provide the reference for change. High quality baseline images are, therefore, of considerable importance. The user should assess the test series for the quality of images and software analysis before including the software output in the assessment of the patient [I,D]. Agreement between structural progression and functional deterioration, over the relatively short duration of reported studies, is only partial or poor^{112, 113}.

Provided the images in a series are of good quality and progression analysis is

consistent over several tests, imaging devices provide useful data, additional to those gained from visual field testing, concerning a patient's glaucoma damage.

1.3.3.4 Imaging instruments

A complete list of all available technologies is beyond the scope of the guidelines.

- **Heidelberg Retina Tomography (HRT)**
The Heidelberg Retina Tomograph (Heidelberg Engineering, Heidelberg, Germany) is used to profile and measure the three-dimensional anatomy of the optic nerve head and surrounding tissues. It can also detect progressive changes in optic nerve head surface topography. To classify an optic nerve head, three methods can be used: the Moorfields Regression Analysis (MRA), the linear discriminant analysis formulas and the Glaucoma Probability Score (GPS)¹¹⁴⁻¹¹⁶. The classification algorithms tend to over-report 'outside normal limits' in large optic discs. For progression analysis, the software provides a map of surface height changes compared to baseline (Topographic Change Analysis [TCA]); the area and volume of changing regions is presented as a plot over time. Graphs of rim area over time are also available.
- **Scanning laser polarimetry (GDx-ECC)**
The GDx-ECC instrument (Carl Zeiss Meditech Inc., Dublin, CA, USA) measures retinal nerve fibre layer thickness around the optic nerve head on the basis of retardation of the illuminating laser light. All polarizing structures in the eye cause retardation, especially the cornea. With Enhanced Corneal Compensation (ECC), polarization artefacts arising both from the anterior segment and behind the retina are attenuated¹¹⁷. The main parameter to help distinguish healthy subjects from glaucomatous patients is the NFI (nerve fibre indicator), although clinicians should also evaluate the distribution of the retinal nerve fibre layer around the optic disc (the 'TNSIT' curve). Trend and change from baseline analyses for progression are available.
- **Optical coherence tomography (OCT)**
Optical coherence tomography is based on interferometry. Current instruments, Fourier-domain (FD) or Spectral domain (SD) and swept-source OCT systems, provide faster image acquisition, higher resolution and better image segmentation than time-domain OCT. Several companies produce FD/SD OCT instruments. Their technical, software and normative database characteristics vary; thus the values measured with different OCT systems are not interchangeable. Three main parameter groups are measured and analysed for classification and detection of progression: Optic Nerve Head, Retinal Nerve Fibre Layer and Ganglion Cell Complex. In general, the optic nerve head parameters with OCT may be less informative than the retinal nerve fibre layer and the ganglion cell complex parameters¹¹⁸. To identify and measure glaucomatous progression with OCT systems trend analysis of the retinal nerve fibre layer thickness and inner macular retinal thickness parameters are particularly useful¹¹⁹.

How to use imaging at baseline [II,D]

Glaucoma suspects with normal or unreliable visual field

Glaucoma with early and moderate damage

How to use imaging for monitoring progression [II,D]

Frequency should be similar to that for VF testing

- Patients should be followed with the same test/method to facilitate estimation of progression [I,D].
- Baseline, repeated within 3 months after baseline, and then up to 4 more times in the first two years in case of high risk of progression [II,D].
- Baseline, repeated annually, for ocular hypertensives [II,D].

Although knowing the test-retest variability would be indispensable in determining the optimal frequency of performing imaging tests, in every-day clinical work it seems currently impossible to take into account the large number of parameters and their largely variable reproducibility nor to verify the cost effectiveness of imaging for glaucoma¹²⁰.