in the second part of her series about use of an OCT. Dr Rachel Hiscox discusses assessment of the optic disc. Module C38974, one point for optometrists and independent prescribers

Continuing education CET

What you should know about OCT assessment

Part 2 – Disc analysis

In following on from the Part 1 of this series (31.10.14), which looked at macular scan interpretation, this article will review OCT disc analysis for glaucoma detection and monitoring.

Background
In 2013, the number of people with glaucoma worldwide was estimated to be 64.3 million, with this number predicted to increase to 76 million by 2020. Without timely diagnosis and referral for treatment, the incidence of bilateral blindness secondary to glaucoma will also rise. Currently, identification of glaucoma in primary eye care relies upon the classic triad of change in visual fields are detected. With glaucoma defined as an optic neuropathy characterised by progressive structural loss of retinal ganglion cells, assessment of the optic disc structure of the retina would seem to be key in the diagnosis and management of glaucoma. OCT can be used to provide repeatable objective and quantitative evaluation of the retinal structure, with the ability to detect measurable changes in the healthy and glaucomatous eyes at a high degree of sensitivity and specificity. It has been demonstrated that 40–50 per cent axonal loss may occur before any change in visual fields are detected. With structural changes, including ganglion cell and retinal nerve fibre layer (RNFL) loss, monitoring visual field loss, evaluation of patients with OCT could result in earlier detection of glaucoma.

When to use a disc OCT scan
The 6x6mm 3D disc scan consists of 128 B-scans, with each B-scan consisting of 512 A-scans. This high density of scans is important as it means that RNFL thickness values are not interpolated, as is the case for protocols which include fewer B-scans. Like the 3D macular cube scan, the 3D disc scan can be captured in just a few seconds, and captures information over the whole of the optic nerve head, allowing not only the RNFL thickness to be calculated, but also the optic nerve topography and shape to be imaged. OCT disc scans should be performed on all patients in order to establish baseline thickness measures, often making it difficult to rely upon if scan quality is low. The accuracy of RNFL thickness can be affected by media opacities, incorrect focus, or even dry eye. RNFL thickness is within or above normal limits. (C) Significance plot showing that RNFL thickness is borderline or outside normal limits. (D) RNFL thickness is within or above normal limits. (E) 3.4mm ring, and on a significance grid normal distribution) or ‘outside normal limits’. Normative comparisons for a healthy (A-C) and a glaucomatous (D-F) eye. (A) TSNIT graph showing RNFL thickness is within (green) or above (blue) normal limits. (B) 4.4mm diameter circle showing RNFL thickness is within or above normal limits. (C) Inferior temporal RNFL loss, showing asymmetry across the horizontal raphe. (D) A ‘cooler’ plot, showing diffuse RNFL loss. (E) A healthy optic nerve head B-scan with (A) the structures identified and (B) a raised optic nerve head scan disc drusen, crowded optic nerve heads or intracranial pressure. 3D disc scan components

● Shadowgram
As discussed in the first article in this series, the shadowgram is a surface image of all the layers in the disc. It plays an incredibly important role in the analysis of disc scans, giving an indication of whether the analysis performed is likely to be reliable. In a reliable scan, the shadowgram will appear sharp (indicating high scan quality) and will show no signs of fixation errors or blinks (Figure 2). Fixation errors, blinks and poor scan quality will all result in reduced diagnostic accuracy therefore the scan should be repeated. Poor scan quality can be caused by media opacities, incorrect focus, or even dry eye.

● Temperature thickness plot
The temperature thickness plot for disc scans gives a representation of the RNFL thickness across the scan area, with thicker areas appearing as warmer colours, and thinner areas as cooler colours. RNFL thickness is calculated between the inner plexiform layer and the outer edge of the RNFL. Observation of the temperature thickness plot can show whether the patient has a normal RNFL thickness pattern, and highlight any areas of thinning (Figure 3). In order for the thickness of the RNFL to be defined accurately a high quality scan is needed RNFL thickness measures should not be relied upon if scan quality is low. In addition, the high reflectance of blood vessels can cause the automated segmentation to misclassify RNFL thickness measures, often making the RNFL appear thinner around the major blood vessels. The accuracy of the automated segmentation should be checked for each scan by applying the layer boundaries.

● Normative comparison
All commercially available OCT machines come preloaded with an internal normative database, enabling practitioners to classify a patient’s RNFL thickness as ‘normal’, ‘borderline’ (within 1-5 per cent of the normal distribution) or ‘outside normal limits’ (within the bottom 1 per cent of the normal distribution). Normative comparison is often shown in three different ways; on a TSNIT chart, on a 3.4mm ring, and on a significance grid (Figure 4). When normative comparison provides a useful reference to determine whether RNFL thickness is within normal limits, it must always be interpreted with caution. An area of red (outside normal limits) does not automatically mean the patient has glaucoma, and likewise, a completely green plot does not mean the patient definitely does not have glaucoma. Normative databases are not exhaustive and typically contain less than 500 patients. Additionally, they do not always include a range of ethnicities and refractive errors, both of which affect RNFL thickness. Non-glaucomatous myopic eyes tend to have a thinner RNFL, and will therefore often be falsely classified as ‘outside normal limits’. However, these limitations aside, identification of both diffuse and localised RNFL atrophy with normative comparisons has been shown to have reasonable levels of sensitivity and specificity, with sensitivity improving with increasing visual field defect. The use of normative comparisons should be used to highlight possible areas of damage, prompting the optometrist to carry out further tests, eg dilated biomicroscopy, stereoscopic disc examination, extended visual fields, application technology or corneal thickness calculation. Normative comparisons should never be used in isolation of other tests.

● Disc topography
Bare in mind, the optic nerve head is crucial in the detection and monitoring of glaucoma. With advances in technology, this has moved from direct or indirect observation with an ophthalmoscope to corneal topography. In practice, corneal topography provided by a photodocumentation and fundus photography with the use of OCT, it is now possible to obtain automated topographical disc measurements, including C/D area ratios and disc diameters (Figure 5). As the disc topography values are automatically determined by segmentation algorithms, they provide repeatable...
goal is to monitor the optic disc area over time. Measurement of optic disc size can be useful in determining glaucoma progression, particularly when differences in disc area are significant. For example, if the disc area shows a consistent increase, it may indicate the presence of glaucomatous progression.

In the third and final article, we will look at anterior assessment with an emphasis on the anterior chambers of the eye. Anterior segment OCT is particularly useful in assessing the cornea, iris, and lens, which are critical for visual function and can be affected by conditions such as glaucoma.

References