THE IMPORT OF SPACE AND TIME

During glaucoma progression, subtle changes can be masked by background fluctuations – and, therefore, entirely missed by standard monitoring methods. Fortunately, there is an alternative.

Glaucomatous visual losses typically appear as “clusters” of adjacent defects corresponding to pathways of affected retinal nerve fiber layer (RNFL) bundles. To better reflect this observation – and thus improve the sensitivity of glaucoma progression monitoring – Haag-Streit developed its Cluster Analysis system, which is based on the distribution of nerve fibers in the retina (1).

Cluster Analysis works by grouping together visual field test locations innervated by adjacent RNFL bundles (2) – and, as the names suggest, analyzes them in those clusters. Each cluster contains at least four visual field test locations by measuring visual losses per cluster and calculating the mean cluster defect – Cluster MD – the system is able to identify even very low-level visual deterioration. The high sensitivity is derived from an averaging procedure that cancels out variations associated with measurements from single locations within the cluster. The result? Cluster Analysis is more sensitive to glaucomatous change than systems based on point measurements.

The process sounds complex, but interpretation of the system output is simple: Cluster MDs that are similar to the norm (p<5 percent) are marked with a “+” symbol, while values that differ significantly from the expected range are marked in orange (p<5 percent) or red (p<1 percent). The system also provides a visual representation, with cluster fields shaded light to dark according the degree of difference from the norm.

To assess disease progression, physicians employ the Cluster Trend Analysis capability, which – by methods similar to those used in Cluster Analysis – compares cluster values over time. Worsening at p<5 percent and p<1 percent is indicated with, respectively, open and solid red arrows, and the rate of change (dB/yea) is indicated by a numerical value. This technique has been shown to be more sensitive than MD Trend Analysis and by contrast, provides the clinician with objective information regarding both the location of defects and the speed of their progression. In Figure 2, we see how the system illustrates defects in the superonasal and superior clusters, and quantifies their progression (2.5 dB/year and 1.1 dB/year respectively). Statistically significant (p<1 percent) change is indicated with a red downward arrow; near absolute sensitivity loss is indicated with a black symbol (inferonasal cluster). Fundus images show rim thinning and RNFL loss spreading from the 1 o'clock position towards the 6 o'clock position. This correlation between fundus and visual field changes confirms glaucomatous progression.

References