DIAGNOSTICS
Better understanding of technology enhances correlation between findings
by Roibeard O’hEineachain in Milan

A combined analysis of structural and functional tests could reduce the seeming discrepancies between the two types of glaucomatous parameters reported in many large clinical trials, according to a series of related presentations at the Glaucoma Day sessions of the XXX Congress of the ESCRS.

“Knowing the limitations and the strength of every diagnostic tool in the different phases of the disease and in different subtypes of patients may help produce a better interpretation and integration of clinical data,” said Enrico Martini MD, Ospedale di Sassuolo, Sassuolo, Italy.

Among the sources of imprecision in the study of glaucoma’s structure-function relationships is the fact that structural changes are measured on a linear scale and functional changes on a logarithmic scale, he explained. In addition, structure-function maps are based on an average eye and do not take full account of the considerable variability in the correspondence between areas of the optic nerve head and areas of the visual field, Dr Martini said.

Visual field artefacts
Visual field is the gold standard to detect damage and progression in glaucomatous patients, however, there are numerous factors that can distort the findings of perimetry, said Michele Lester MD, PhD, University of Genoa, Genoa, Italy.

For example, patients might have difficulty in fixating, or they might be tired. In addition, sometimes patients do not initially understand how to do the test or they understand but their performance is not as good as it could be, indeed they get better with practice, he added.

Dr Lester noted that fatigue can lead to a patient performing well at the beginning of a test and poorly as the testing progresses. That can result in a “cloverleaf” pattern perimetry reading, characterised by high sensitivity in the central area and reduced sensitivity in the periphery. In such cases, kinetic perimetry may perform better than full-threshold static perimetry, he said.

In those and similar cases, decreasing the field size from 30-2 to 10-2 allows closer scrutiny of scotomas near the fixation point. In addition, increasing the size of the stimulus spot can provide a closer inspection of individual areas of the visual field, he noted.

“If the visual field result does not make sense, check the correlation between the visual field defect and damage in the optic nerve head retinal nerve fibre layer,” Dr Lester added.

Machines can’t yet replace clinicians
In the early stages of glaucoma it is generally structural changes in the nerve head and retinal nerve fibre layer that first become evident, but interpreting the measurements used to detect the changes requires skill and experience, said Gabor Holló MD, PhD, Dsc, Semmelweis University, Budapest, Hungary.

“The overlap between changes detected with the various optic nerve head and retinal nerve fibre layer analysis techniques and changes detected by visual field tests are different for the different technologies. There is at present no best technique so you have to use the brain computer,” he said.

He noted that there are three main modern imaging technologies currently in use for detecting glaucomatous damage to the optic nerve head. They are the Heidelberg Retinal Tomograph (HRT, Heidelberg Engineering), the GDx-VCC/ECC scanning laser polarimeter (Carl Zeiss Meditec) and the group of optical coherence toms (OCTs).

The HRT is a confocal scanning laser ophthalmoscope developed first of the three technologies. Users of the device have two different program options to interpret the machine’s findings: the Moorfields regression analysis for the rim damage, and the glaucoma probability score (GPS), which describes the shape of the peripapillary retinal surface and the transition between rim and cup.

“The classifications for these programs are very straightforward, the findings are classified as within normal limits, borderline or outside the statistically normal limits. But statistical classification may not reflect the biological disease,” Prof Holló said.

Potential confounding factors include optic nerve heads that are either unusually small or unusually large. Peripapillary retinal nerve fibre layer of very small optic nerve heads has a particularly convex shape because the structures are crowded, and large optic nerve heads will have very flat peripapillary surface, he added.

The GDx-VCC/ECC instrument provides an analysis of the retinal nerve fibre layer based on the retardation of the polarised light reflected from the back of the eye. The retardation is primarily caused by retinal nerve fibers, thus the more fibers the greater the retardation and vice versa, he explained.

Prof Holló said that the GDx-ECC (enhanced corneal compensation) is superior to the older VCC (variable corneal compensation) technique in all respects (Figure 1). Though the GDx measurements tend to be slightly less reproducible than those with Fourier-domain OCT, it is a much less expensive technology, he added.

Currently there are two main types of OCT technology used for glaucoma diagnostics: the older time-domain OCT and also the more modern and advanced Fourier-domain OCT technology (Figure 2). Of the several Fourier-domain OCT systems the Spectralis® (Heidelberg Engineering), the RTVue-100® (Optovue), and the Cirrus® (Carl Zeiss) are particularly well evaluated for use in glaucoma, he said.

The Fourier-domain OCT machines provide much faster image acquisition, with up to 55,000 A-scans per second compared to 400 A-scans per second for time-domain OCT, Prof Holló noted. They therefore have much better resolution and provide much more information regarding the ganglion cell complex (GCC) or inner macular thickness parameters, which are particularly important in glaucoma. Nonetheless, care is necessary to differentiate glaucomatous GCC damage from that caused by other conditions like macular drusen and very small subretinal neovascular membranes, he said.

“Instruments that detect structural changes are more sensitive than perimetry in early stages of glaucoma, but it is the opposite in the later stages of disease. Therefore, individual decision on the method to be applied for evaluation of progression is not avoidable,” Prof Holló said.