MICROPERIMETRY

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Clinical investigation of retinal disorders has both a morphological and a functional approach. The functional approach is probably more relevant when looking at a retinal disease (before and/or after treatment) from the patient's point of view. When testing retinal function with psychophysical tests we are more related to visual experience than with any other functional method (1). Visual acuity is still considered the gold standard in clinical practice, but it does not entirely reflect functional vision (which describes the impact of sight on quality of life activities). The ubiquity and success of evaluating retinal sensitivity by static (and kinetic) perimetry demonstrates that quantification of retinal threshold is critical in the diagnosis and follow-up of many retinal disorders. But, conventional visual field examination is, by definition, inadequate for the accurate functional evaluation of macular diseases, particularly when foveal function is compromised and the patient may have unstable or extrafoveal fixation. Moreover, the detection of the site and stability of retinal fixation (foveal or extrafoveal), and the quantification of retinal threshold over small, discrete retinal lesions (i.e. choroidal neovascularization, drusen, edematous areas) is beyond the possibilities of conventional perimetry. Standard visual field testing has also major limitations is patients with low visual acuity. In low vison patients, standard visual field testing is: insensitive to small scotomas ($< 5°$); does not allow a precise identification of size, shape and depth of scotomas and is unable to identify preferred retinal locus (the site of extrafoveal fixation). These limitations have been overcome by the introduction of microperimetry.

Microperimetry (also known as fundus perimetry) allows for exact topographic correlation between fundus details and its light sensitivity (differential light sensitivity or retinal threshold). The principle of microperimetry rests on the possibility to see —in real time— the retina under examination (by infrared light) and to project a defined light stimulus over an individual, selected location. Because light projection is just related to previously selected anatomical landmarks, and it is independent of fixation and any other eye movement, the examiner obtains the functional response of the selected area (2). The characteristics of fixation (location and stability) are easily and exactly quantified with microperimetry. Scanning laser ophthalmoscope (SLO) microperimetry was the first technique which allowed to obtain a fundus-related sensitivity map, in patients with any level of visual acuity or fixation characteristics. Using red light background illumination and stimuli, precise identification of individual fixation locus and increment threshold at manual preplanned loci could be quantified with SLO microperimetry (3). But, SLO fundus perimeter did not allow to perform fully automatic examination. Moreover, automatic follow-up examination —to evaluate exactly the same retinal points tested during baseline microperimetry— was not available with this instrument. These limitations have been overcome by the MP1 microperimeter, a recently developed automatic fundus perimeter (4). This instrument performs automatic microperimetry, independent of fixation characteristics. MP1 microperimeter automatically compensates for eye movements during the examination via a software module that tracks the eye movements with respect to an initial frame. Automatic follow-up examination quantifies retinal threshold exactly over the same retinal points tested during baseline examination (even if fixation changes during follow-up time). Static microperimetry is more commonly used, but a kinetic test is also available. SLO microperimeter

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results are displayed over the black and white infrared image of the fundus, MP1 microperimeter results may be reported over a high quality color retinography.

The quantification of macular threshold and retinal fixation characteristics allows the clinician to improve his/her diagnostic accuracy and better predict the outcome of surgical and non-surgical treatments of different macular disorders.

Clinical applications of microperimetry may be summarized as follows:

— Advanced age-related macular degeneration (atrophic and neovascular AMD): detection of location and stability of fixation (foveal and extrafoveal); quantification of scotoma characteristics; quantification longitudinally over time of the functional impact of any treatment (medical, laser or surgical) at specified retinal locations.

— Early AMD: evaluate the functional deterioration over discrete macular lesions along the natural history or following treatment (5).

— Diabetic macular edema: evaluation of the functional impact of different degrees of macular edema; comparison of functional values with OCT data; evaluation of the effects of different laser treatment modalities (ETDRS standard, subthreshold, micropulsed, etc.) on macular function.

— Vitreo-retinal interface disorders : comparison of macular function with OCT data; prognostic value of microperimetric data vs vitreo-retinal surgery results.

– Any maculopathy which needs detailed functional evaluation.

— Low-vision patients: quantification of fixation location and stability; planning of visual rehabilitation program and evaluation of results.

In conclusion, the variable impact on visual function of macular diseases depends on the extension and degree of pathological alterations in the macular area. In the past, the role of psychophysical tests was merely to document the decrease of visual acuity, and the progression of central scotoma associated with progressive maculopathy. Currently, the use of microperimetry (fundus perimetry) has greatly improved the role of psychophysical tests in the evaluation of any maculopathy. Fixation characteristics are critical for reading, and any variation of size, shape and intensity of scotoma greatly influences visual performance. Microperimetry allows to exactly quantify location and stability of fixation, and retinal threshold in the macular area. Automatic follow-up examination allows the clinician to evaluate the natural history of any disease, and to monitor the effect of any therapeutic intervention. Maintenance and improvement of quality of vision (not merely visual acuity) is the new goal of any treatment of macular/retinal disorder. But quality of vision needs to be quantified in a reliable and reproducible way. Microperimetry may play a fundamental role in this area.

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