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Microperimetry

a method which combines perimetry and macular topography

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The photos are made with the Nidek Microperimetry (MPI) device.*

Review:

Today, when investigating retinal diseases, we have several instruments to assess retinal function beside testing the visual acuity, such as conventional visual field testing (perimetry), colour vision tests, electroretinogram (ERG), multifocal ERG (mfERG) and electrooculogram (EOG).

The scanning laser ophthalmoscope (SLO, Rodenstock, Germany)

helped us to test and to understand the topographic function of the macula area.

Since three years we do have the possibility to assess functional parameters of the retina in an enlarged field of the macula with a new instrument called microperimetry (MPI, Nidek technologies, Italy). This instrument allows us to assess the central visual field and to correlate the findings directly

to the fundus location and therefore opens a new diagnostic field in retinal diseases.

Microperimetry-1 (MPI) is an instrument for fundus-related perimetry. It captures fundus images of the patient's retina and at the same time projects light stimuli onto the retina. The light stimuli size have been correlated to Goldmann stimulus sizes (Goldmann I-V) and the pattern are chosen by the operator and

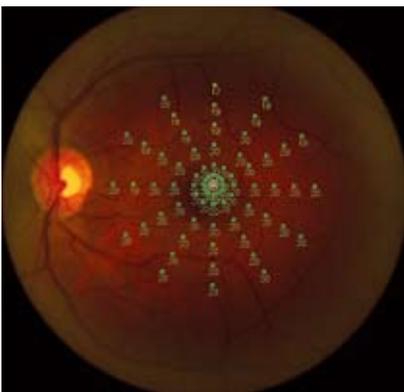


Figure 1.
Fundus microperimetry of the left eye of a normal subject. The local sensitivity of the measured points is shown in two ways – first as a colour code (here dark green for best sensitivity) and second as a numerical code in dB from 0 to 20 (here 20 meaning best sensitivity). The small blue dots in the center are the fixation points during the exam.

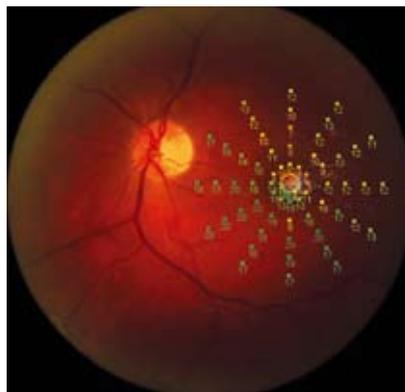


Figure 2.
Fundus microperimetry of a patient's left eye with macular superior branch retinal vein occlusion. Note the decreased sensitivity in the upper part of the macula (sensitivity values down to 4, colour code orange to yellow). The fixation, delineated as small blue dots, is diffusely spread over the temporal macula meaning that it is unstable.

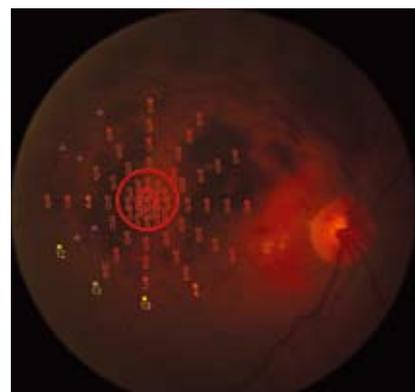
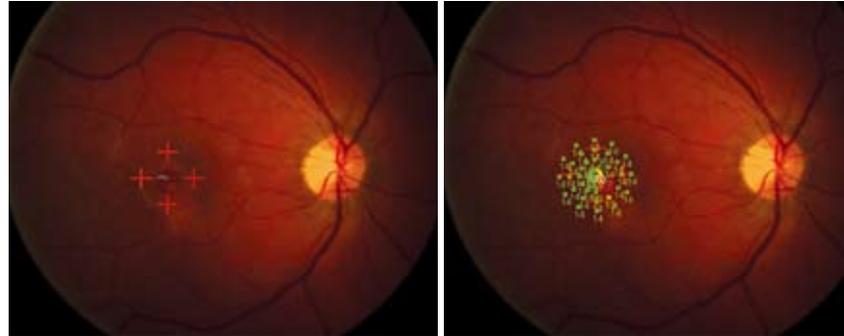


Figure 3.
Fundus microperimetry of a patient's right eye with central retinal vein occlusion. The sensitivity is decreased in most of the measured areas with values around 0 dB (colour code red). Only on the outer lower central visual field the patient is able to perceive the light stimulus to 13 dB. The fixation (small blue dots) is spread over the macula.

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Figure 4. Fundus microperimetry of a patient's right eye with macular hole stage 3. On the left side the perimetry shows a paracentral scotoma nasally inferior. On the right side the fixation over time is shown as small blue dots. The fixation here is located temporal superior from the macular hole and seems to be quite stable.



can therefore be adapted to different diseases of the macula. The patient's subjective response to each stimulus (seen/not seen) is recorded (functional information) together with the retinal location of the stimulus (anatomical information). The software of the instrument disposes several pre-designed investigation pattern. The investigator has nevertheless the possibility to choose specific locations to be investigated on the fundus. A complete exam can be performed as a follow-up exam at a later time and the results can therefore be used as follow-up parameters,

regarding evolution of a disease over time and effect of therapy.

This investigation assesses also the patient's fixation site and the stability of the fixation over the time of the examination.

The ideal conditions for examination are titrated before investigation in performing a training session with the patient. A lot of problems can hereby be avoided and a time consuming examination for the patient and the investigator can thus be avoided. A conventional exam for one eye takes then about ten to twenty minutes.

According to the manufacturer,

the microperimetry exam can be performed with or without dilated pupils. Nevertheless in our experience an examination is best performed in mydriasis as it seems to be easier for patients to fixate the fixation target, the fundus tracking system works better and the fundus images are easier to acquire. Like in other perimetry examinations the patient is asked to look at a central fixation stimulus which can be positioned by the investigator. In persons with low visual acuity or with fixation problems a larger or thicker fixation cross or even a circle can be chosen. Bright light stimuli are then

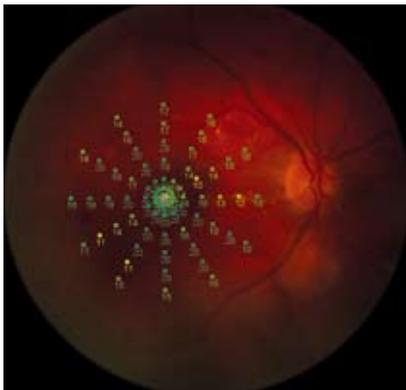


Figure 5: Fundus microperimetry of the right eye of a diabetic patient with diabetic retinopathy and maculopathy. The microperimetry results are still good and the best corrected visual acuity is 1.0. But already some localized area with decreased sensitivity can be delineated (yellow to green colour).



Figure 6. Fundus microperimetry of a young woman's left eye with multifocal choroiditis and fibrosis syndrome. The central area shows still some good sensitivity. The lower and temporal central visual field with fibrosis and chorioretinal atrophy has low sensitivity. Microperimetry follow-up controls help in these cases to assess the evolution of the disease since visible morphological change might appear later than functional changes.



Figure 7. Fundus microperimetry of a young woman's left eye with angioid streaks. The nasal part of the macula with large areas of fibrosis and atrophy due to angioid streaks has low sensitivity. Still, the temporal inferior part shows quite good sensitivity. Also here the assessment of the functional change helps us to follow the progress of the disease.

presented for a fixed amount of time at the fundus position the investigator wishes to investigate and the patient presses a stick-button when he perceives the stimulus. The eye movements during the investigation are corrected automatically with a fundus movements tracking system. Microperimetry is at the same time performing a continual fixation recording during the entire exam.

"The eye movements during the investigation are corrected automatically with a fundus movements tracking system."

is available and the results are also analyzed and given as fixation of the central 2 or 4 degrees over time in percentages. At the end of an exam a colour picture is acquired and the perimetry results are integrated with the fixation pattern.

In clinical routine the visual acuity (VA) is one of the most important parameters in the visual performance of a patient. It is of course not the only parameter of importance. The peripheral visual field can be assessed by a conventional perimetry exam. Regarding the central visual field most of the perimetry devices do have a macular program. Nevertheless it is often difficult to determine a visual field defect in the macula especially when the patient has only small or a relative central or paracentral scotoma. Additionally the fixation location in the retina is not assessed in conventional perimetry and it is therefore not always easy to identify the corresponding

This means that while the patient is looking at the fixation target the eye movements are recorded by a tracking module. At the end of the exam a map of the patient fixation positions

location of the scotoma in the retina. Often the Amsler chart helps to roughly detect a functional defect in the central ten degrees of the visual field. With microperimetry we do have nowadays the possibilities to integrate the retinal function with the topographical retinal location. This device allows specialized retinal clinics to investigate retinal function in choroidal or retinal neovascularization before and after therapy, in vitreoretinal disease before and after surgery and to determine whether the patient's disease is located in the retina or in the following visual pathway. Finally MPI is also useful to understand and assess unknown macular diseases.

The importance to distinguish the visual acuity and the central visual field has been elaborated recently by different authors. Richter-Mueksch et al. delineates that the visual acuity measured before and after vitreoretinal surgery may underestimate functional benefit. In other words, the results of vitreoretinal surgery were better in microperimetry than in visual acuity. Springer et al. investigated patients with central serous chorioretinopathy (CSCR). The MPI enabled quantification of functional defects in patients with CSCR. Although visual acuity was only slightly reduced, all patients showed extensive scotomata in fundus perimetry, which correlated well with the location of the pathology.

The retinal microperimetry (MPI) allows an accurate analysis of the central retinal function, combining a digital retinography, a computerized perimetry and a fixation assessment in one exam. In combination with other retinal investigation devices, MPI has already helped us and will in the future help us to follow and to understand retinal diseases.