Scotopic perimetry in Age-related Macular Degeneration

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Perimetry is typically used for assessing the regional variations in function for patients with retinal disease. Standard perimetry only measures cone-mediated sensitivity. Until recently, it has not been possible to obtain rod-mediated perimetry other than by custom-built devices. There are many factors, however, that make rod-mediated fields attractive. Despite their different etiologies, retinal degenerations share many common features. For example, many of the mutations causing retinitis pigmentosa are expressed in rod photoreceptors, and night blindness is often the earliest symptom. Similarly, a growing body of evidence indicates that rods are affected early in age-related macular degeneration (AMD) and Stargardt disease. In addition, some of the contemporary treatment strategies are common to these diseases. These treatment strategies require localized outcome measures of rod and cone function to evaluate treatment efficacy.

The MP-1S was the first fundus perimeter to provide highly localized measures of rod and cone function. It incorporates a fundus-tracking system and follow-up mode to maintain constant stimulus projection on the retina and facilitate repeat testing of identical loci despite eye movements. The scotopic MAIA is a more recent option for scotopic perimetry. It provides a faster test, but has a limited dynamic range. Average normal sensitivity for elderly patients with spot size 3 within the macula is approximately 15 dB, so the machine has a floor effect for patients with losses > 1.5 log unit. The MP-1S has a greater dynamic range because neutral density filters can be adjusted to fit the range needed for the patient. The mean normal value for 13 elderly subjects tested to date is 23 dB for a stimulus size 3. The 8 dB difference in normal scotopic sensitivity on the two fundus perimeters is also seen in patients with macular disease. To date, we have compared 10 patients on both devices. The correlation in mean sensitivity between the two devices is high (r= 0.73) with the Nidek MP-1S having sensitivity on average 10 dB higher than the MAIA-2S.

The Nidek MP-3S is a next-generation fundus perimeter designed to replace the MP-1S. In general, it is easier to use than the MP-1S. It incorporates a red screen that does not interfere with the dark adaptation of the patient. Other advances include “fade-out-protection” for the fixation light to avoid the Troxler effect, which is particularly common in an otherwise dark field. Rather than the joystick on the MP-1S for aligning the patient, the MP-3S actively tracks the pupil position of the patient. Another important advantage of the MP-3S is the higher luminance of the background for standard testing. The 34 cd/m2 background is 10 times brighter than the background of the MP-1, making it truly a photopic, rather than mesopic, test. Thus the MP-3S can be used in standard mode with a background that saturates rods and produces a cone-mediated sensitivity map, or in scotopic mode, with no background to produce a rod-mediated sensitivity field. Rather than having to insert filters as in the MP-1S, the filters in the MP-3S are fixed and

automatically moved into position when a scotopic test is specified. This leads to much greater ease of use and less possibility of technician error while running the test.

Representative normal sensitivity maps for 2 different spot sizes on the MP-3S are shown in Figure 1. For spot size 3, the values are comparable but slightly higher than for elderly subjects tested on the MP-1S (7 corresponds to 27 on the MP-1S, given the 2.0 log filter). For the larger spot size 5, values are considerably higher consistent with spatial summation. It is also important to point out that the range over which patients can be tested can be varied by adjusting spot size. There is a tradeoff between the greater spatial localization with spot size 3 and the larger dynamic range with spot size 5.

MP-3S scotopic microperimetry

Spot size 3 Spot size V

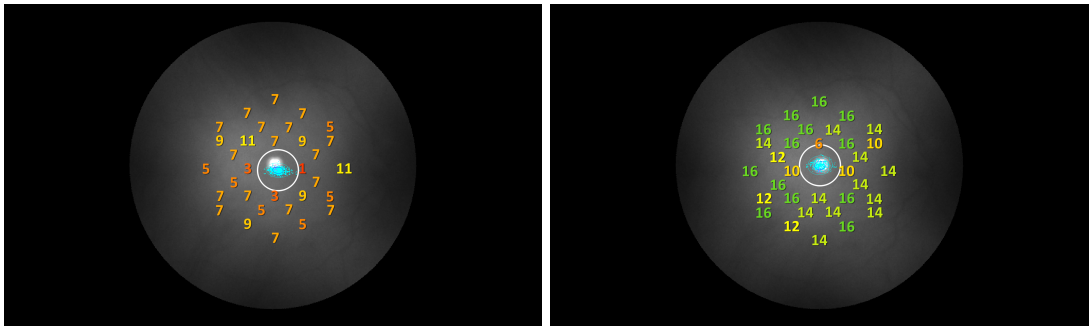


Figure 1. Comparison of spot sizes 3 and 5 on MP-3S in normal subject

In order to compare results from patients on the MP-3S to those from the MP-1S, we tested 10 patients with age-related macular degeneration using the following parameters:

Table 1 Comparison of Nidek MP-3S to Nidek MP-1S

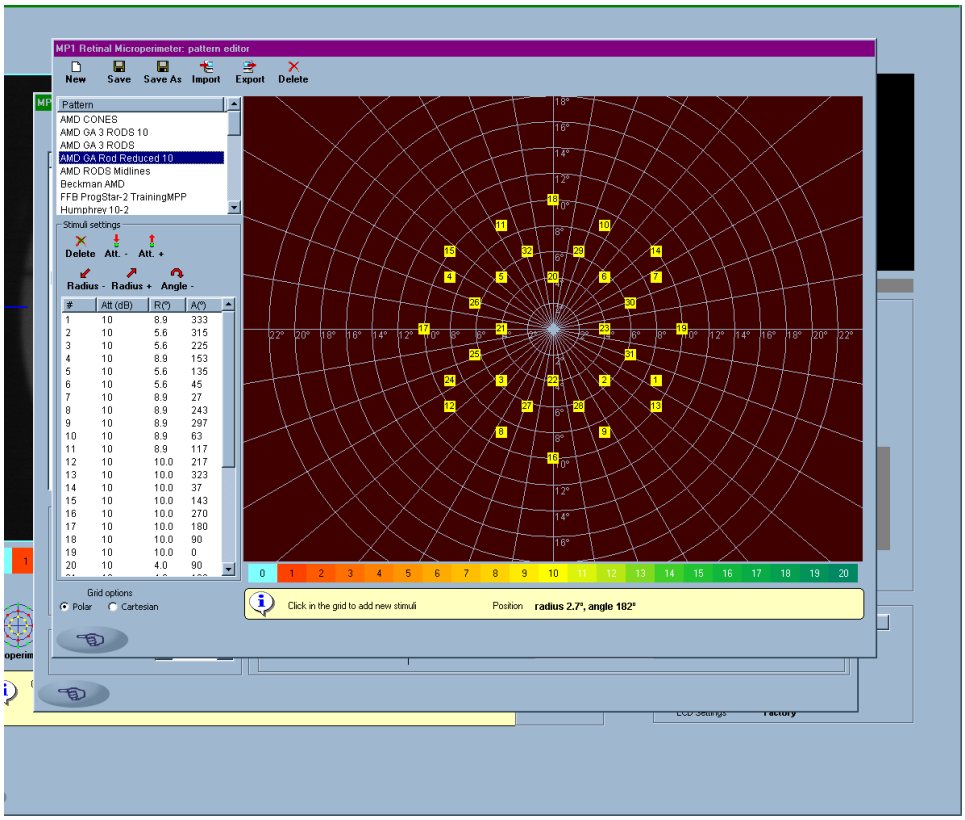
	MP-3S	**MP-1S**
Mode	Scotopic	Scotopic
Pattern	NdkSctRed36p	AMD GA Rod Reduced
Test loci	32	32
Spot size	5	5
Filter	Internal	Blue+ 2.0
Fixation	3 deg circle	3 deg circle
Staircase	4:2	4:2

The patients will be greater than 55 years of age. Each patient will be evaluated with the following procedures:

- Best-corrected visual acuity of both eyes
- Slit lamp examination to screened for a narrow angle prior to dilation
- Pupil dilation with 30 minutes patching for dark-adapted testing of the better seeing eye
- Dark-adapted visual field test on Nidek microperimeter, model MP-3S using a protocol that takes approximately 20 minutes
- Dark-adapted visual field test on Nidek microperimeter, model MP-1S using a protocol that takes approximately 20 minutes
- Imaging on Heidelberg Spectralis Optical Coherence Tomography and fundus autofluorescence unit

MP-3S and MP-1S testing order will be randomized and both tests will be conducted on the same day. Coefficients of repeatability will be obtained for each test and compared to the literature. We will determine the range of values for point sensitivity to determine the amount that a patient has to change at a given location to be significant. The limits of agreement for the two devices measuring scotopic sensitivity will be compared to limits of agreement for mesopic testing.

Appendix



32-point pattern used for scotopic testing on MP-1S and MP-3S

Spot	X	Y
1	8	-4
2	4	-4
3	-4	-4
4	-8	4
5	-4	4
6	4	4
7	8	4
8	-4	-8
9	4	-8
10	4	8
11	-4	8
12	-8	-6
13	8	-6
14	8	6
15	-8	6
16	0	-10
17	-10	0
18	0	10
19	10	0
20	0	4
21	-4	0
22	0	-4
23	4	0
24	-8	-4
25	-6	-2
26	-6	2
27	-2	-6
28	2	-6
29	2	6
30	6	2
31	6	-2
32	-2	6

Coordinates for 32-point pattern