Six-month Longitudinal Comparison of a Portable Tablet Perimeter With the Humphrey Field Analyzer

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• PURPOSE: To establish the medium-term repeatability of the iPad perimetry app Melbourne Rapid Fields (MRF) compared to Humphrey Field Analyzer (HFA) 24-2 SITA-standard and SITA-fast programs.
• DESIGN: Multicenter longitudinal observational clinical study.
• METHODS: Sixty patients (stable glaucoma/ocular hypertension/glaucoma suspects) were recruited into a 6-month longitudinal clinical study with visits planned at baseline and at 2, 4, and 6 months. At each visit patients undertook visual field assessment using the MRF perimetry application and either HFA SITA-fast (n = 21) or SITA-standard (n = 39). The primary outcome measure was the association and repeatability of mean deviation (MD) for the MRF and HFA tests. Secondary measures were the point-wise threshold and repeatability for each test, as well as test time.
• RESULTS: MRF was similar to SITA-fast in speed and significantly faster than SITA-standard (MRF 4.6 ± 0.1 minutes vs SITA-fast 4.3 ± 0.2 minutes vs SITA-standard 6.2 ± 0.1 minutes, $P < .001$). Intraclass correlation coefficients (ICC) between MRF and SITA-fast for MD at the 4 visits ranged from 0.71 to 0.88. ICC values between MRF and SITA-standard for MD ranged from 0.81 to 0.90. Repeatability of MRF MD outcomes was excellent, with ICC for baseline and the 6-month visit being 0.98 (95% confidence interval: 0.96-0.99). In comparison, ICC at 6-month retest for SITA-fast was 0.95 and SITA-standard 0.93. Fewer points changed with the MRF, although for those that did, the MRF gave greater point-wise variability than did the SITA tests.
• CONCLUSIONS: MRF correlated strongly with HFA across 4 visits over a 6-month period, and has good test-retest reliability. MRF is suitable for monitoring visual fields in settings where conventional perimetry is not readily accessible. (Am J Ophthalmol 2018;190: 9–16. © 2018 Elsevier Inc. All rights reserved.)

THE HUMPHREY FIELD ANALYZER (HFA) IS THE CLINical standard for reliable and reproducible visual field outcomes in patients with glaucoma[1]; however the cost of the device and its lack of portability limit its accessibility to patients from impoverished places and those in rural and remote locations. There are some who have used hardcopy charts, tablets, virtual reality goggles, and other devices as portable visual field screeners or threshold devices.[2–7] In comparison, the Melbourne Rapid Fields (MRF) is an iPad tablet application (iPad 3 or later) that allows in-office or remote visual field testing owing to its low cost and portability. MRF has been shown to produce comparable results to the HFA and have good intrasession test-retest repeatability[8,9]; however, the longer-term repeatability of this device is unknown. Detection of visual field progression in glaucoma depends on frequency of testing and variability of the visual field testing procedure[10,11]; therefore, knowing the longer-term repeatability of the device is important in determining whether MRF is suitable for clinical use.

The MRF has been validated as a tangent perimeter that can perform efficient and reliable thresholding comparable to HFA 24-2 SITA-standard protocol.[9] It has been shown to be robust to variations in ambient light, blur, and viewing distance.[8] When retest was undertaken after a 5-minute break in 78 cases with glaucoma (intrasession test-retest repeatability), patients classified as mild (mean deviation [MD] ≥ −6 dB, n = 41) gave a coefficient of repeatability (standard deviation/mean) of 7.8% for their MD, whereas 37 cases with moderate to severe defect (MD < −6 dB) returned a coefficient of repeatability of 24.2% in their MD.[9] Retest variability for the Medmont M700 automated perimeter has been reported as 2.9 dB (11.6%), whereas abnormal locations have a larger coefficient of repeatability (33%; SD ∼8.0 dB).[8] Hence,

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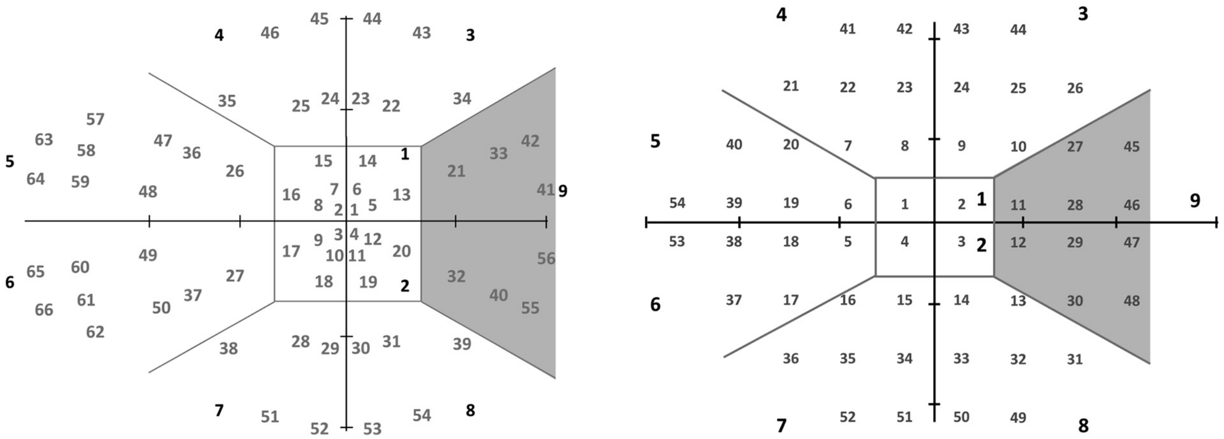

FIGURE 1. Location of test spots for the Melbourne Rapid Fields (Left, 66 spots) and Humphrey Field Analyzer (Right, 54 spots) and definition of 8 zones used for regional analysis. The gray zone includes the blind spot and was excluded from analysis. All results are considered as right eye equivalent.

test-retest repeatability depends on the threshold of the location, and for the MRF it appears comparable to that reported for other perimeters.[8,12]

Despite the similarity to the literature and high intratest repeatability, it is not known whether this good performance of the MRF will be returned over longer retest periods. This is because the MRF differs from the HFA in many ways,[8] and it is not clear how these differences may impact on long-term reliability. The main differences in the MRF rest in test spot location, test spot size (which increases into the periphery), and its thresholding logic. Threshold variability is known to increase with eccentricity in normal.[13] As the MRF spot size increases in the periphery of MRF test patterns[8] it could be expected that the MRF will have reduced variability owing to the larger spot sizes.[13] Another factor to influence variability is the MRF thresholding logic, which is achieved using a 3-step Bayes predictor.[8,14] Although similar procedures have been shown to return reliable outcomes with 6-12 steps,[14,15] it is not clear that this will hold for a 3-step prediction. In particular, it is not apparent how this approach will compare to the SITA algorithms, which use a post hoc Bayes prediction returned from 4/2 dB (SITA-standard) or 4 dB step (SITA-fast) procedures.

Given these differences in test logic, the repeatability of both the MRF and HFA are in need of comparison, especially when applied in a review schedule common to clinical settings. This 6-month longitudinal study was undertaken to investigate the medium-term repeatability of the MRF compared to that found for HFA SITA-fast and SITA-standard outcomes derived from a common cohort of patients who undertook repeated testing on these devices.

METHODS

THE CLINICAL TRIALS REPORTED IN THIS MANUSCRIPT were undertaken with approval of the local ethics committees (Integrated Research Application System IRAS ID: 204698: West of Scotland Research Ethics Service REC No: 16/WS/0130: and AIIMS IEC-564/03.11.2017) and were conducted in accordance with the tenets of the Declaration of Helsinki, with all subjects giving informed consent prior to participation. This clinical trial has been registered as ISRCTN77744218 at https://doi.org/10.1186/ISRCTN77744218.

• **MELBOURNE RAPID FIELDS APP:** The MRF app (GLANCE Optical Pty Ltd, Melbourne, Australia) produces efficient and reliable thresholds using an iPad (Apple, Cupertino, California, USA) tablet device viewed at 33 cm with the patient wearing his or her normal reading glasses. The radial test pattern comprises 66 test locations (Figure 1); more details of the test procedures are found elsewhere.[8,9] The 9.7-inch iPad subtends 30 × 24 degrees (H × V) at a viewing distance of 33 cm (13 inches: eccentricity 15 × 12 degrees with central fixation). Regions having greater eccentricity than 15 × 12 degrees can be tested by having the patient shift fixation to 1 of the 4 corners of the iPad, allowing 1 quadrant of 30 × 24 degrees (H × V) to be tested at a time. Voice commands generated by the tablet instruct the patient on how to perform the test and when to alter fixation during the test to permit evaluation of the peripheral visual field. Apart from the need to alter fixation, some of the other procedural or test differences in the application have been detailed before.[8,9] Our previous study found that despite these differences the MRF returns outcomes that were strongly correlated to HFA thresholds,[9] and the purpose of this study is to