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Testing 3 new visual field devices in an emergency department setting

Visual field testing plays a central role in diagnosing and managing glaucoma and other optic nerve and visual pathway disorders. While conventional automated perimetry (e.g., Humphrey Visual Field [HVF] testing) is currently considered the gold standard, it has significant drawbacks. Specifically, it requires expensive machinery and trained operators and has a relatively large machine footprint. In addition, successful testing depends on providing patients with adequate instruction and supervision, including monitoring for and maintaining patient positioning. In our experience, patients often dislike the experience of HVF perimetry.

Ideally, perimetry should be adaptable to different settings, have a short testing duration and be comfortable and easy for patients to use while maintaining accuracy. In pursuit of this goal, there have been continued advances in perimetry hardware and software.

This article examines innovations in visual field testing with recently developed devices designed to be portable, user-friendly for patients and even appropriate for home visual testing. The tested devices are Therapeutic Goods Administration (TGA) approved for clinical use in Australia.

About the devices tested

VisuALL – virtual reality headset-based perimeter

While several head-mounted visual field testing devices are on the international market, we chose to test the VisuALL (**Figure 1**) as it is TGA approved and has good local support. The perimetry results obtained from this device are comparable with conventional perimetry (30-2, 24-2, 10-2 and binocular fields are available), with similarly presented results and testing durations.[1,2]

The VisuALL has multiple testing applications in addition to visual field assessments, including visual acuity, contrast sensitivity, colour vision, pupillometry and extraocular motility. The device connects wirelessly to a Bluetooth-enabled 'clicker' and computer, with the option to upload visual fields to the patient's electronic medical record as a PDF file. Patients can wear their own glasses – patching is not required – and instructions are delivered via video in the patient's preferred language.

Figure 1. The VisuALL ETS. Source: olleyes.com

Melbourne Rapid Fields (MRF) – laptop- or tablet-based perimetry

MRF is a laptop- or tablet-based perimetry software program. While it was originally developed for tablet screens, MRF can also be used on any computer or laptop with a webcam after performing a calibration step that adjusts the test for different screen sizes.

MRF is designed to facilitate patients to perform self-directed fields with computer voice guidance and, as such, has been designed with an easy-to-use, patient-friendly interface. As it is web-based, MRF may also be used on a patient's home device, with clinicians able to view the results remotely – a particular benefit for patients who live in rural or remote areas.

The test must be performed in a dark room with the device's screen set to maximum brightness. The webcam monitors the patient's distance from the device, and the software provides verbal instructions to ensure appropriate positioning during the test. Each eye is tested individually, with the patient being required to close or patch the other eye, and a mouse clicker is used to record when a stimulus has been seen.

The fixation target moves between the centre of the screen and the 4 corners of the device to allow the full visual field to be mapped, with options to perform 24-2, 30-2, 10-2 and binocular visual fields. Frequent instructions during the test remind the patient to maintain fixation on the target.

The makers of MRF, GLANCE Optical, are pioneers in flatscreen perimetry. MRF is used in approximately 300 clinics worldwide and has been validated by 18 international peer-reviewed papers.

MRF perimetry has been demonstrated to produce results comparable to HVF perimetry and shows good intrasession test-retest repeatability.[3] The printout closely resembles a HVF printout and a mean deviation progression trend is graphed.

MRF is also highly scalable – a single MRF account can turn multiple flatscreen devices at multiple sites into perimeters. There is no limit to how many visual fields can be conducted simultaneously from one account.

Eyeonic – laptop-based perimetry

Eyeonic has a modern interface that would appeal to younger users. Like MRF, it can be used on any computer or device, eliminating the need for dedicated visual field hardware. As such, Eyeonic can potentially improve clinic workflow and patient experience.

With modern graphics illustrating each instruction, the software shows patients how to set up the test, including closing or patching one eye at a time, using reading glasses, darkening the room and sitting comfortably with no tilt to the device screen. Video instructions are also available.

Notably, to aid concentration during the test, the fixation target is a rotating star, frequent encouraging comments are made throughout the test, and a progress bar under the fixation target informs patients of their progression through the test. Patients can record their responses using the mouse or space bar, which could be more ergonomic for some patients. The test speed is also individualised for each patient according to the speed of responses.

The blindspot is mapped first, and its size is used to calculate the appropriate viewing distance, with patients being instructed to move closer or further away and their position monitored for the duration of the test through the webcam.

The stimuli are spirals and their size varies depending on the distance from fixation; this circular contrast perimetry provided accurate perimetric testing with comparable results to standard automated perimetry.[4]

Are portable perimetry devices a suitable alternative to HVF in the emergency department?

We conducted a pilot study exploring the usability and integration of 3 portable perimetry devices in the emergency department (ED) workflow at a public hospital in Sydney. Each device was trialled for 30 days.

We recruited 36 patients (72 eyes) with acute ophthalmic presentations. The mean age was 44.6 ± 12.3 years. Patients underwent portable visual field assessments conducted by various clinicians, including orthoptists, ophthalmic ED doctors and nurses. The user experience and preferences of patients were evaluated via survey, while a focus group discussion was conducted to garner feedback from clinicians on integration into the ED workflow (**Table 1**).

Many studies show reliability, outcomes and retest performance between each of the 3 devices and the HVF Analyser (24-2 Sita Standard and Fast) for both global and regional thresholds. Therefore, this study did not directly compare the perimetry results with the HVF Analyser.

When interpreting our findings, it should be noted that we are end-users and not visual field experts. Additionally, the clinicians who operated the devices in our ED varied greatly in experience with and training in visual field testing – clinicians ranged from inexperienced general ED nurses and junior doctors to veteran hospital orthoptists. Further, this trial was aimed at emergency patients with little or no previous HVF experience and various clinical presentations. →

Focus group discussion – Head-to-head comparison between devices regarding integration into clinic workflow			
	MRF-web	**Eyeonic**	**Olleyes**
Accessibility in ED setting	Cloud-based, portable	Cloud-based, portable	Lightweight and portable, can be used in any setting. Suitable for children and bed-bound patients
	Requires dedicated dark and quiet ambient setting	Requires dedicated dark and quiet ambient setting	Needs to be locked away, limiting after-hours access
Ease of use for patient	Clear instructions available in different languages. Rapid test time (3–4 minutes per eye for 24-2)	Modern and patient-friendly user interface. Fast test time (4–6 minutes per eye for 24-2). Spacebar clicker easy to use	Clear instructions. Rapid test time (2–4 minutes per eye for 24-2). Tests both eyes at once. Clicker easy to use
	Mouse button clicker not easy to use, 'Moving target is distracting'	Only language available is English. 'Spinning wheel is disorientating'	'Dry eyes'; Causes motion sickness'
Ease of use for staff	User-friendly and easy to set up. Non-intimidating; requires minimal monitoring and verbal instruction	User-friendly, non-intimidating; requires minimal monitoring and verbal instruction	Real-time monitoring of test progress
	No function to monitor test progress in real time	Set-up process slightly cumbersome. No function to monitor test progress in real time	Intimidating for unfamiliar staff, requires multiple steps and equipment for set up
Proposed ideal setting for use	Emergency department	Home visual field setting	Wards, waiting rooms, outreach clinics

Table 1. Focus group discussion results.

User experience insights

A head-to-head comparison of user experience was conducted for both patients and clinicians (**Figure 2**). Of the 36 patients, 21 (58.3%) had prior experience with standard automated perimetry (SAP); 90.4% favoured portable perimetry, highlighting its potential as a preferred option over traditional visual field testing with SAP.

Notably, patients found voice commands (56%) and clear instructions (17%) instrumental in facilitating test performance, alleviating barriers such as time constraints, technical difficulties, and concentration issues (**Figure 3**).

Clinicians emphasised the importance of seamless integration into the clinical workflow, shedding light on device-specific advantages and challenges regarding user friendliness, patient compliance and ease of use. In the ED, the user base will vary in skill sets and often in rotation, so devices must be intuitive and user-friendly for beginners. To optimise these devices' functionality in critical settings, clinicians recommended refining device ergonomics, minimising patient discomfort and simplifying setup procedures to optimise device functionality in critical settings.

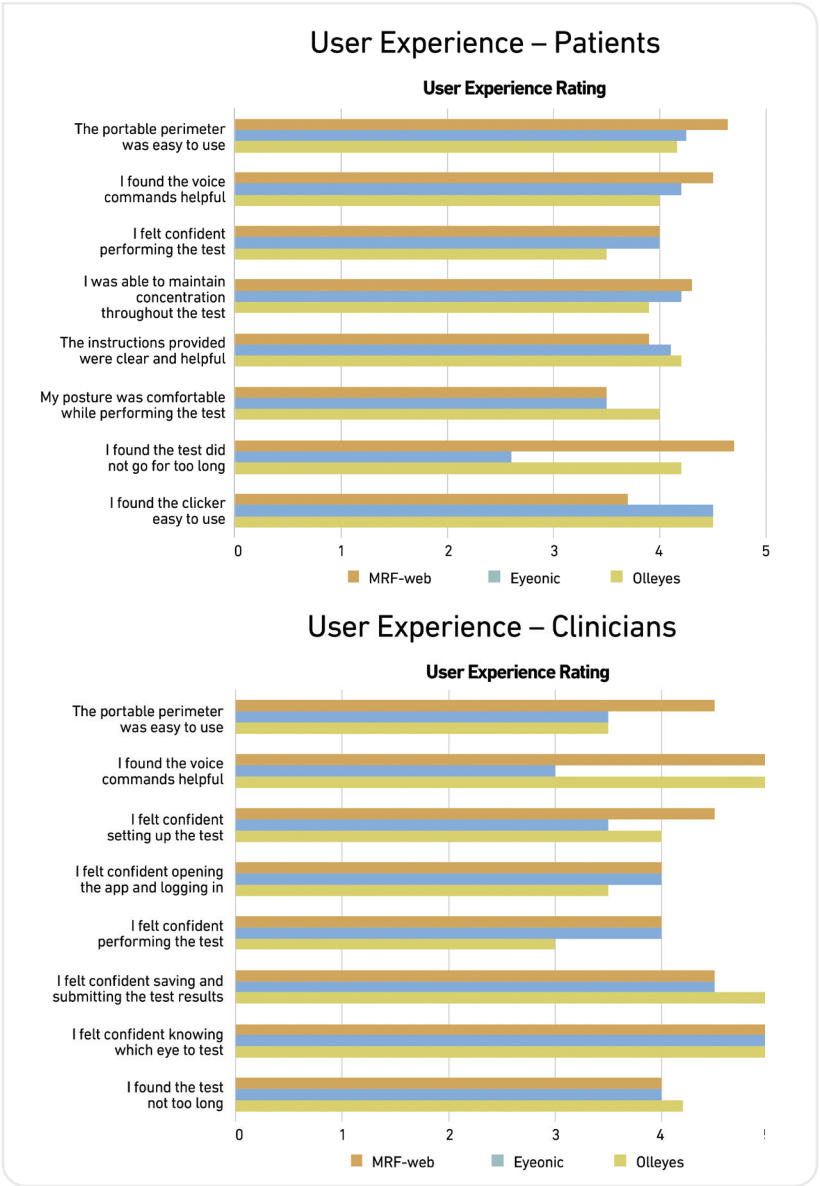

Figure 2. Head-to-head comparison of user experience for patients and clinicians.

VisuALL by Olleyes

The VisuALL exhibited rapid testing capabilities and an innovative approach by allowing simultaneous testing of both eyes independently. Its user-friendly setup and testing speed garnered attention from both patients and clinicians. This device particularly demonstrated its portability advantage in a bed-bound, new-onset stroke patient with a hemifield defect.

Our experienced orthoptist staff favoured the VisuALL heavily. The features they found most helpful were the clear audio instructions, easy-to-use clicker button and automated eye patching. They also valued not having to monitor for head positioning, which meant they could leave the patient unsupervised for the test duration. By contrast, our orthoptists felt that the laptop-based tests were heavily influenced by head positioning and felt the need to supervise field-naive patients.

However, challenges relating to the VisuALL were identified, including motion-related discomfort experienced by some patients and technical complexities during setup noted by our non-ophthalmic ED nurses. A second technical difficulty at the public hospital was connecting the device to the hospital Wi-Fi. Ultimately, we had to connect using a mobile Wi-Fi dongle, which added an extra setup step. The cost of the device is approximately $28,000.

MRF

MRF's strength was its cloud-based portability, enabling its use in various settings beyond the traditional ED environment. Its accessibility and adaptability were particularly noted, offering a promising prospect for outreach programs and home-based testing. Rapid data transmission facilitated real-time assessment and decision-making, potentially expediting urgent interventions. However, some patients found that using the mouse or space bar was less intuitive than the typical HVF clicker.

Tests cost between $10 and $13 each. Unlike VisuALL and other goggle-based perimeters requiring a hardware purchase, MRF can use existing flatscreen devices, potentially eliminating the need to purchase a dedicated device.

Eyeonic

Eyeonic's intuitive and patient-centric interface design, offering a smooth user experience and good patient compliance, stood out. The device boasted relatively fast test times per eye, crucial in emergency scenarios where swift evaluations are essential.

Being cloud-based and suitable for home use, the Eyeonic test could improve clinic workflow further by cutting down the time patients spend in clinic. The device also aids collaborative care between optometry and ophthalmology as visual fields performed for both can be centralised in one database.

However, challenges related to some features – especially for some patients with discomfort with motion-related visual experiences – were noted during the study.

An Eyeonic subscription for clinicians ranges from $60 to $180 per month, depending on the volume of use. Like MRF, Eyeonic can use existing devices, and a hardware purchase may not be necessary.

Final thoughts: suitability for integration into clinical workflow

Portable perimetry is suitable for a select group of patients in the acute or screening setting, allowing for increased clinical efficiency and patient comfort. The cloud-based storage used by these devices, combined with their portability, allows physicians to deliver care in different clinical settings regardless of location. As such, portable and remote visual field testing is paramount to the continuity of quality care within our communities.

Based on our experience with multiple portable perimetry devices, the MRF, with its cloud-based portability and ease of use, was favoured by ED nurses. The VisuALL was distinguished by its lightweight design, versatility and ability to test both eyes simultaneously, making it particularly suitable for wards, waiting rooms and outreach clinics. It was favoured by hospital orthoptists. Eyeonic was ideally placed for home visual field testing due to its modern, cloud-based, patient-friendly interface. It was the device favoured by doctors.

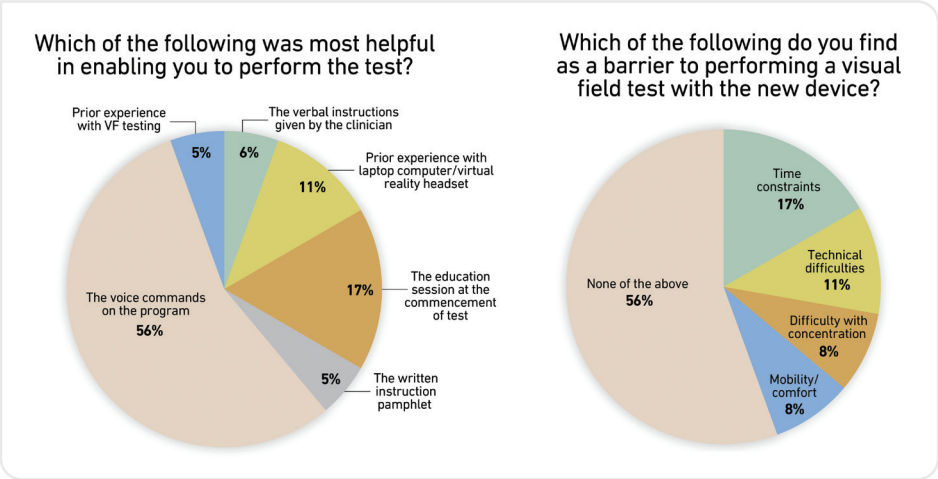

Figure 3. Perceived barriers and aids in performing perimetry.

Uses in glaucoma patients

HVF remains the gold standard in progress monitoring for patients with established glaucoma. The primary reason is that HVF has long-term evidence of progression tracking, and new devices cannot fully integrate with historical HVF data.

Most of the newer devices are likely to be used for screening purposes or in the community among low-risk glaucoma patients in the early stages of disease. Home visual field testing in these low-risk cases is still in its infancy but has many potential advantages and is an area we are currently exploring.

Uses in an optometry setting

The potential uses of portable perimetry in the optometry setting are multi-fold. First, their portability and ease of use make them low-cost, space-saving alternatives to standard Humphrey or Medmont perimeters. They are also less intimidating for patients.

Their ability to provide quick and reliable results also makes them good screening tools for patients, including paediatric and geriatric populations. Moreover, facilitating home-based virtual perimetry is well within the optometrists' scope, enabling the monitoring of low-risk glaucoma.

Lastly, the versatility of portable perimetry devices could potentially facilitate telemedicine initiatives and outreach programs, especially in low-resource settings. Optometrists can remotely monitor visual fields, offer consultations, and provide eye care services to patients in remote or underserved areas, expanding access to eye care and improving patient outcomes.

Financial and conflict of interest declaration

All devices were provided by their respective distributors free of charge for this pilot study. No authors have a financial or conflict of interest relating to the investigated diagnostic devices. A Future Vision Foundation grant supported this study.

More information regarding the different devices can be found at their respective websites: visuALL (olleyes.com), MRF (visiondata.net.au) and Eyeonic (eyeonic.com.au) •

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