Validation of a Novel Head-Mounted Perimeter versus the Humphrey Field Analyzer

Wisam Najdawi, BS[1], Chris Johnson, PhD[2], Andrew Pouw, MD[2]

[1] Carver College of Medicine, University of Iowa, Iowa City, IA
[2] Department of Ophthalmology and Visual Sciences, University of Iowa Hospitals and Clinics, Iowa City, IA

UNIVERSITY OF IOWA HEALTH CARE
Department of Ophthalmology and Visual Sciences

THE UNIVERSITY OF IOWA

BACKGROUND

- Glaucoma is the leading cause of irreversible blindness worldwide[1].
- Standard automated perimetry, commonly with the Humphrey Field Analyzer (HFA; Carl Zeiss Meditec Inc., Dublin, CA), is the current accepted clinical standard for diagnosis and monitoring of glaucomatous visual field loss[2].
- The HFA is a large device that does not allow for examination outside the clinic and can be uncomfortable for patients with limited mobility or large body habitus.
- Recently, there has been growing interest in the development of a head-mounted virtual reality perimeter to address these limitations[3-4].

PURPOSE

- The purpose of the present study was to validate a novel head-mounted perimeter, the Smart System Virtual Reality Perimeter (SSVR, M&S Technologies, Niles, IL), compared to the HFA as an alternative method of visual field testing.

MATERIALS AND METHODS

- IRB-approved prospective cross-sectional study conducted at a tertiary ophthalmology department
- Inclusion criteria: Adult patients with glaucoma or glaucoma suspects
- Exclusion criteria: Non-glaucomatous ophthalmic disease affecting central vision, neurocognitive or psychiatric disease, non-English speakers, prisoners, high myopia or disc tilt, and false positive rate >15% for the HFA or >25% for the SSVR

Figure 1. The Smart System Virtual Reality Perimeter in position for testing.

- Data collected include: demographics, glaucoma diagnosis, and visual field metrics including mean deviation (MD), pattern standard deviation (PSD), and test duration (TD)
- Testing algorithms: HFA, 24-2 Swedish interactive thresholding algorithm (SITA) Standard with size III stimuli; SSVR, 24-2 Neighborhood-Zippy Estimation by Sequential Testing (ZEST) with stimuli increasing in size with eccentricity
- Subjects were randomized to complete visual field testing with the HFA followed by the SSVR, or vice-versa
- Statistical analyses were performed using the Student paired *t*-test or Wilcoxon signed rank test as appropriate (a=0.05)

RESULTS

- 45 eyes from 25 subjects (Ages 74.5±9.0, 40.0% Male) were included in the present analysis.
- 5 (11.1%) of eyes had suspect glaucoma, 9 (20.0%) had mild glaucoma, 11 (24.4%) had moderate glaucoma, and 20 (44.4%) had advanced glaucoma.

Table 1. Visual field metrics of the Smart System Virtual Reality (SSVR) Perimeter versus the Humphrey Field Analyzer (HFA) stratified by glaucoma diagnosis severity

All	SSVR	HFA	p
Mean Deviation	-7.46±6.64	-7.04±6.92	0.249
Pattern Standard Deviation	5.45±2.88	6.91±4.82	0.001*
Test Duration	313.13±82.63	368.71±64.26	<0.001*
Suspect			
Mean Deviation	-2.74±3.73	-1.30±2.28	0.063
Pattern Standard Deviation	2.95±2.07	2.72±1.96	0.625
Test Duration	261.00±72.71	329.80±72.57	0.120
Mild			
Mean Deviation	-2.49±3.53	-1.30±2.57	0.169
Pattern Standard Deviation	3.33±2.04	2.01±0.34	0.095
Test Duration	258.00±69.42	330.89±45.85	0.023*
Moderate			
Mean Deviation	-3.59±2.98	-3.50±2.86	0.878
Pattern Standard Deviation	3.98±1.96	4.46±3.05	0.412
Test Duration	262.82±57.30	339.27±50.29	<0.001*
Advanced			
Mean Deviation	-13.00±5.54	-13.00±5.82	1.000
Pattern Standard Deviation	7.83±1.89	11.51±2.52	<0.001*
Test Duration	378.65±52.93	411.65±52.15	0.004*

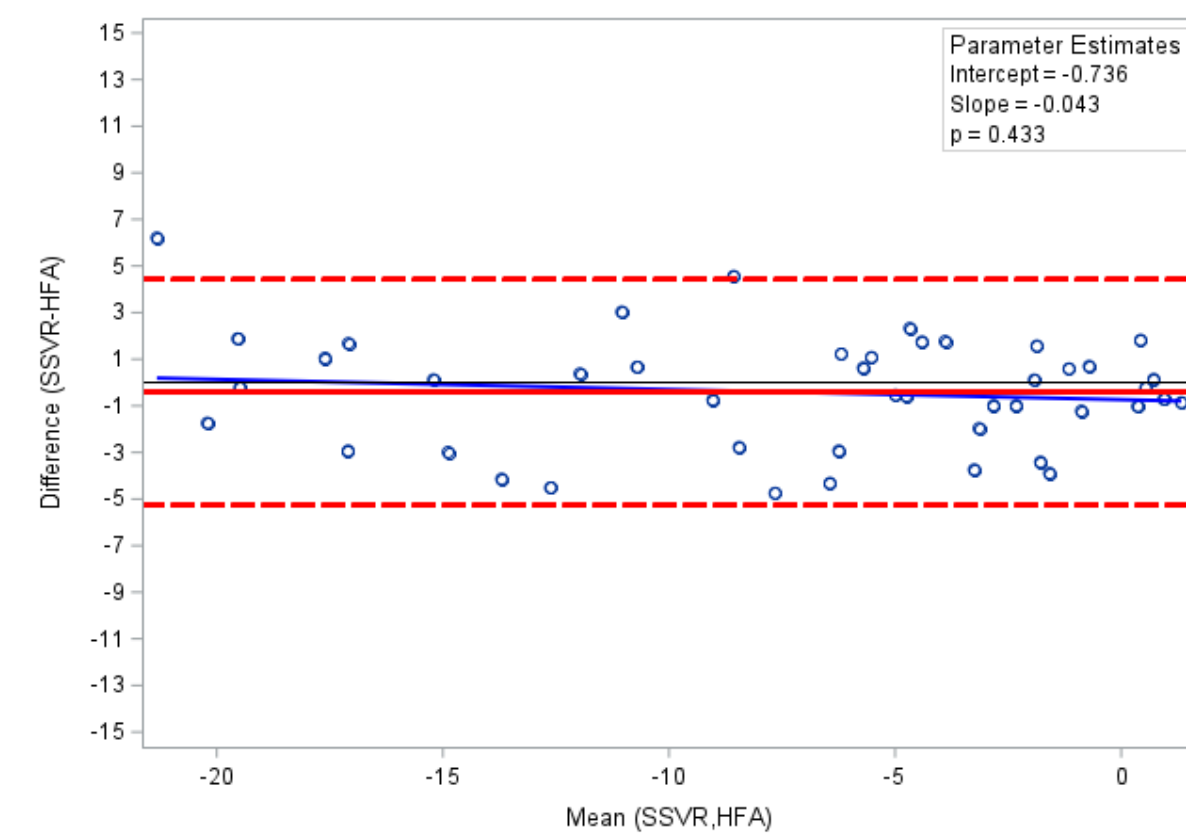* p-value indicates a statistically significant difference

Figure 2. Bland-Altman plot of the mean deviation values of the SSVR versus HFA for all included visual fields
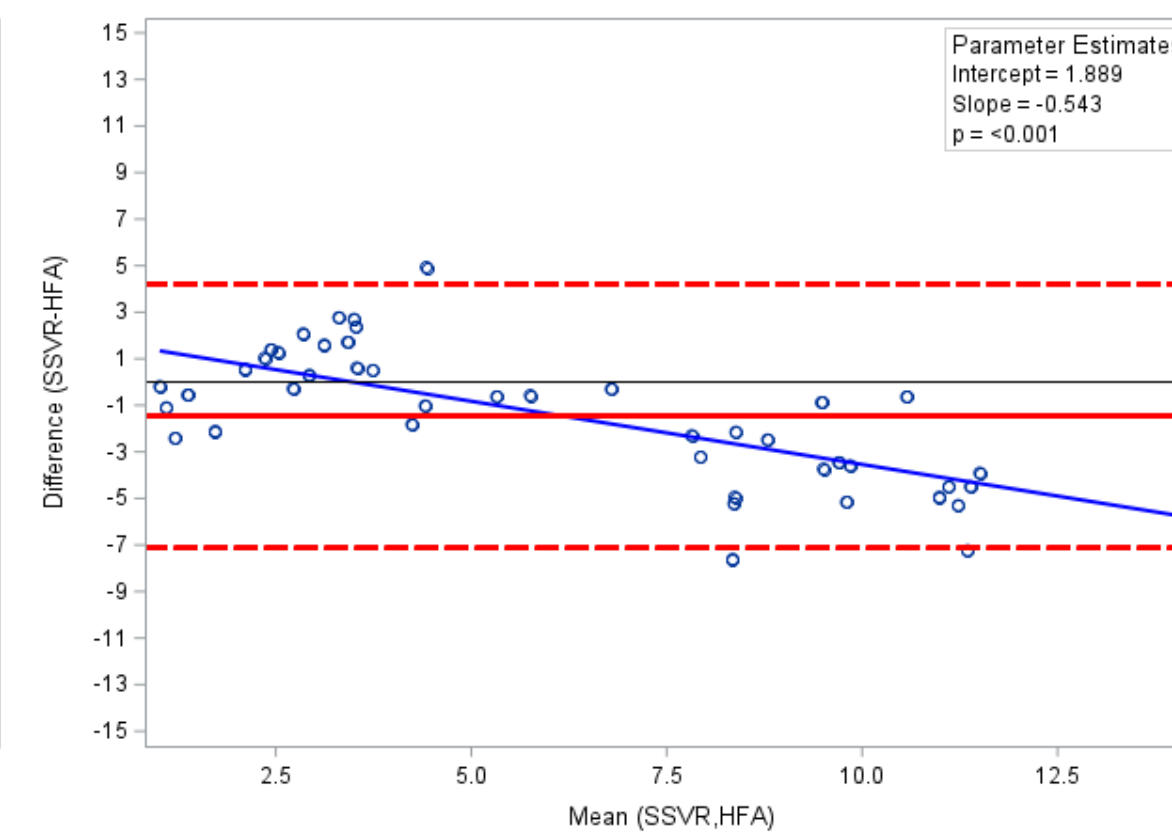

Figure 3. Bland-Altman plot of the pattern standard deviation values of the SSVR versus HFA for all included visual fields
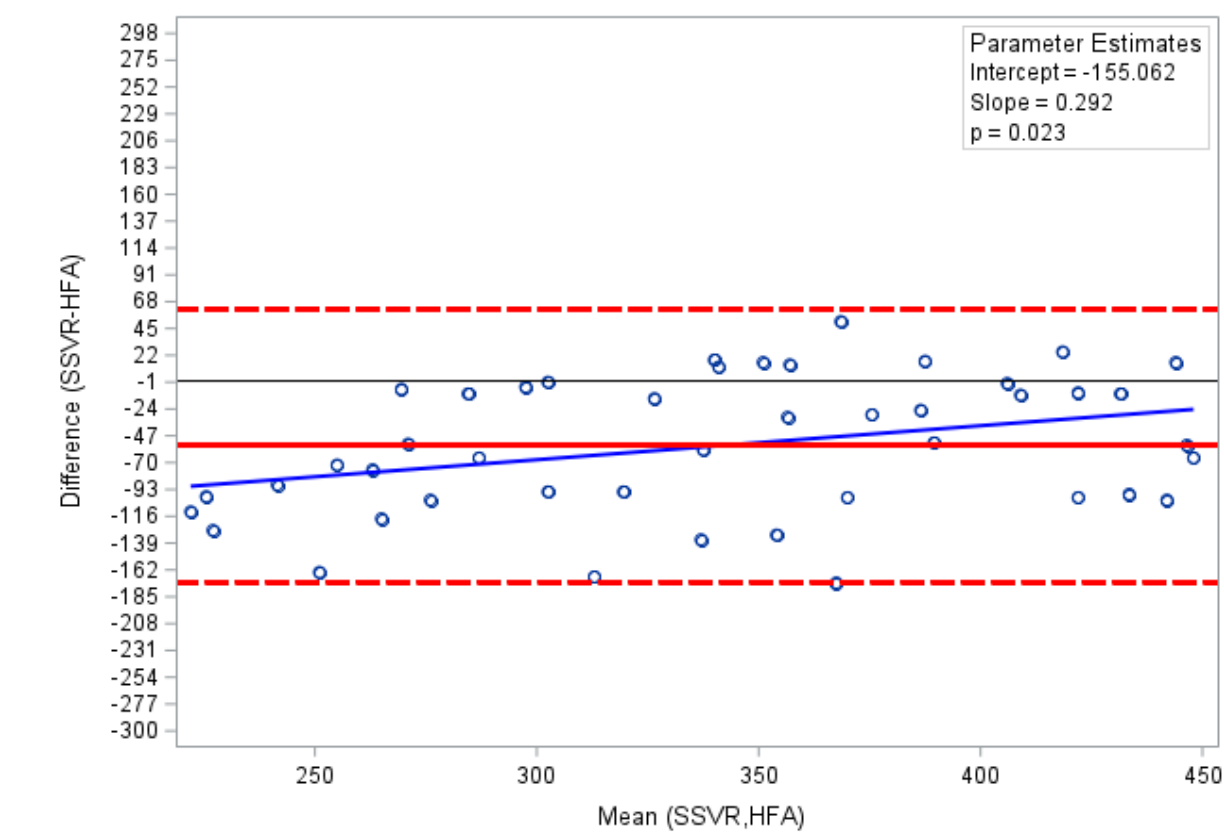

Figure 4. Bland-Altman plot of the test duration values of the SSVR versus HFA for all included visual fields

- Of the 32 patients tested to date, 90.6% reported they would prefer to use the SSVR at follow-up appointments if it becomes regularly available.

CONCLUSIONS

- The SSVR is a reliable alternative to perimetry using the HFA for testing MD, particularly as glaucoma severity increases.
- The SSVR differs from the HFA with regard to PSD in advanced severity glaucoma. This may be due to the method by which PSD is calculated.
- TD was significantly shorter using the SSVR versus the HFA, which will likely improve the patient testing experience.
- When surveyed, the majority of participants preferred the SSVR for visual field testing.
- For patients with postural limitations, the SSVR may be preferable to the HFA for visual field testing.
- The dynamic range of the SSVR is smaller than that of the HFA.

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