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BACKGROUND

- Glaucoma is the leading cause of irreversible blindness worldwide¹.
- 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 loss².
- 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 limitations³⁻⁴.

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 ($\alpha=0.05$)

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

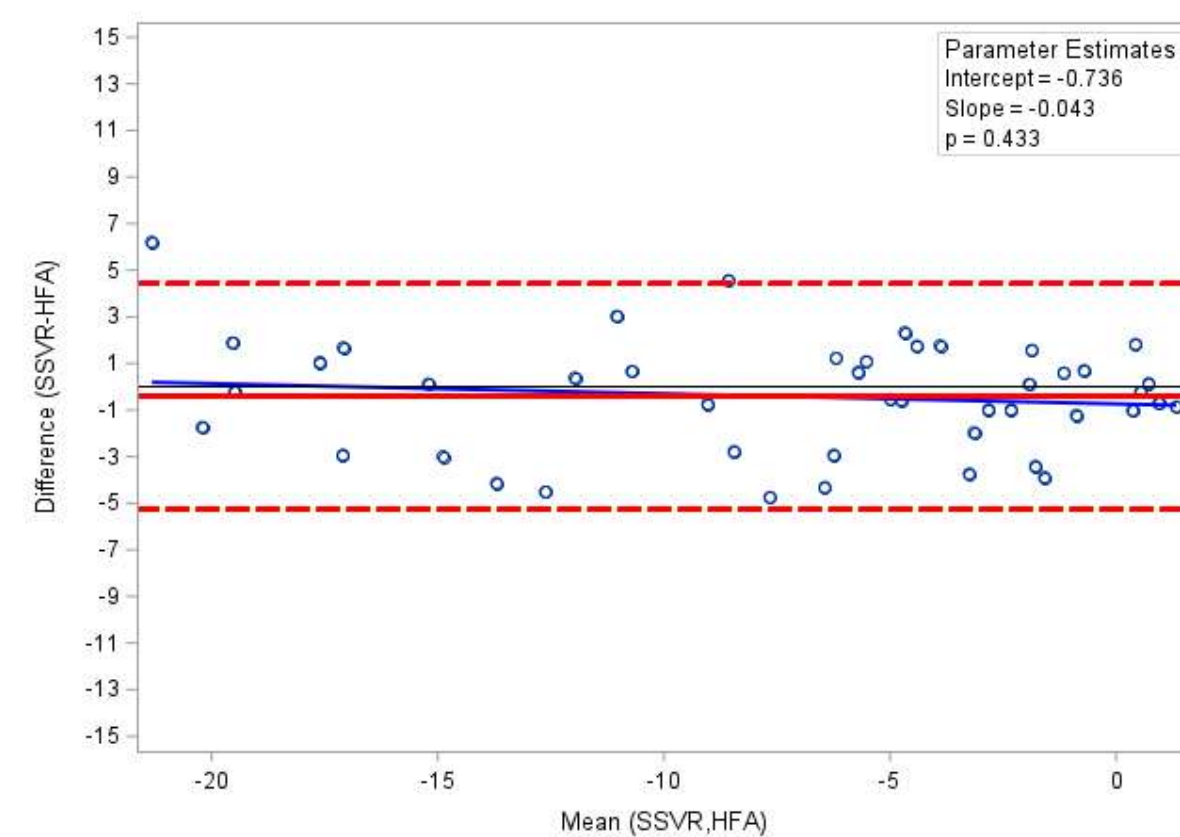


Figure 2. Bland-Altman plot of the mean deviation values of the SSVR versus HFA for all included visual fields

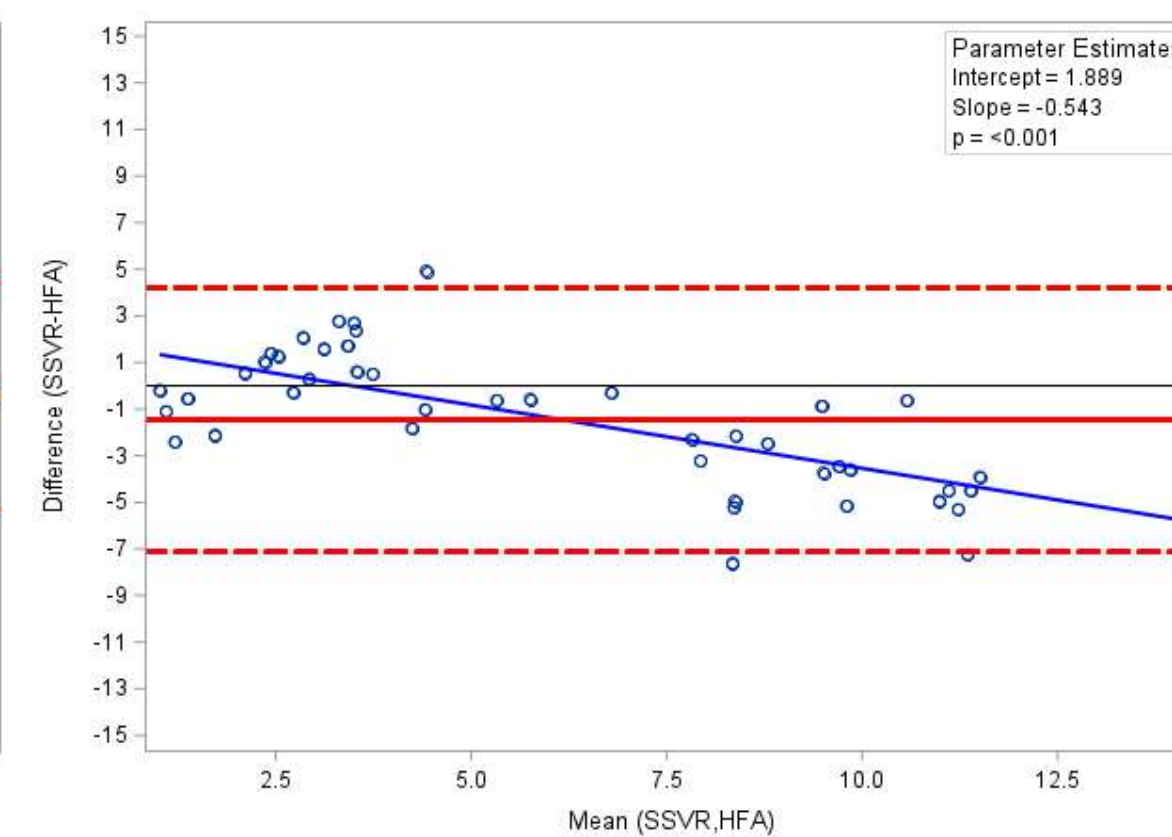


Figure 3. Bland-Altman plot of the pattern standard deviation values of the SSVR versus HFA for all included visual fields

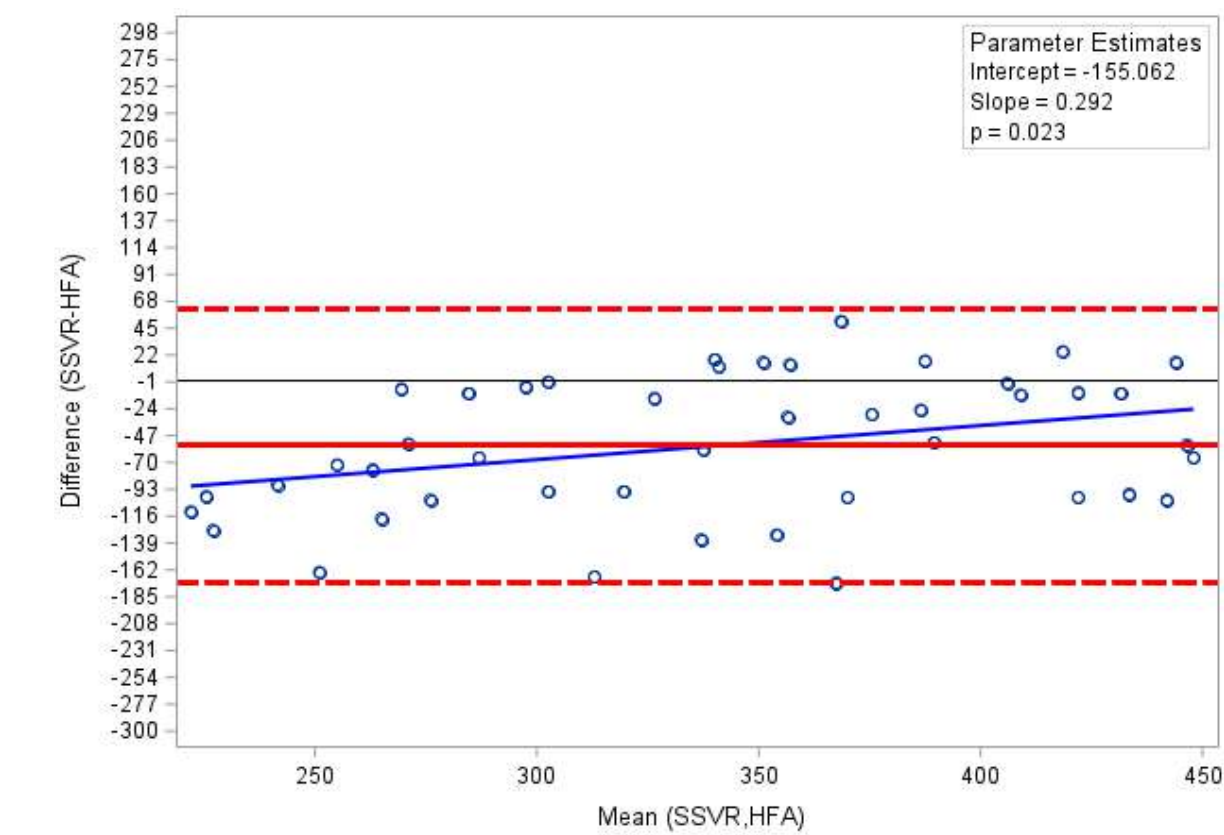


Figure 4. Bland-Altman plot of the test duration values of the SSVR versus HFA for all included visual fields

- 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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