

Assessment of a goggle-based visual field device



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PURPOSE

Astronauts can be affected by Spaceflight Associated Neuro-ocular Syndrome (SANS), including optic disc edema, flattening of the globe, choroidal and retinal folds, and hyperopic refractive shifts. SANS can develop after an extended period in space and across multiple spaceflights. Additional assessment methods are needed to understand the time course, impact, and potential treatment options of SANS. Development of a portable instrument to assess visual field (VF) changes in SANS is a priority as long-duration spaceflights are likely to increase. The purpose of this study was to compare a new mobile, goggle-based visual field device (GBVF) designed for potential use in spaceflight to the Humphrey Visual Field Analyzer (HFA).

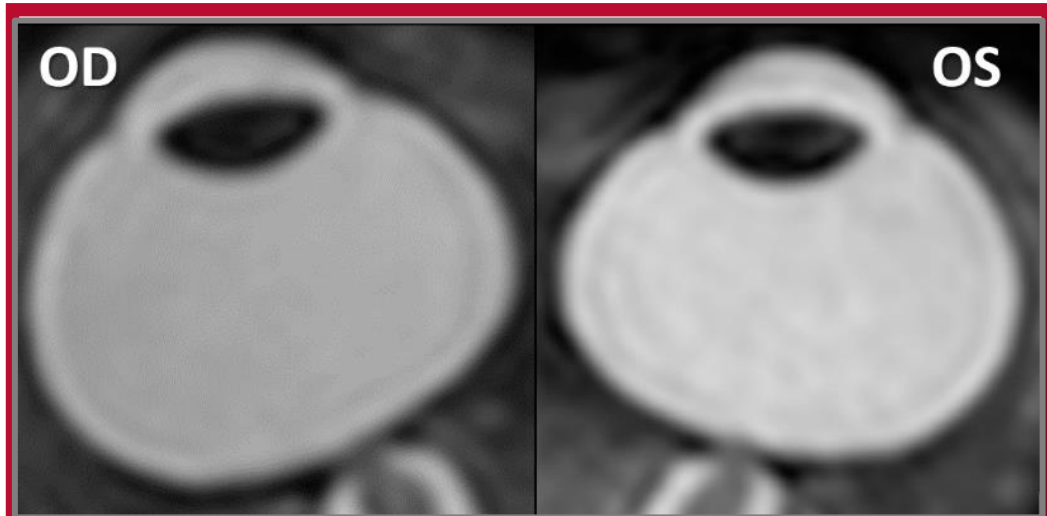


Figure 1. Orbital MRI demonstrating posterior globe flattening in SANS.



Figure 2. Optic disc edema in SANS.

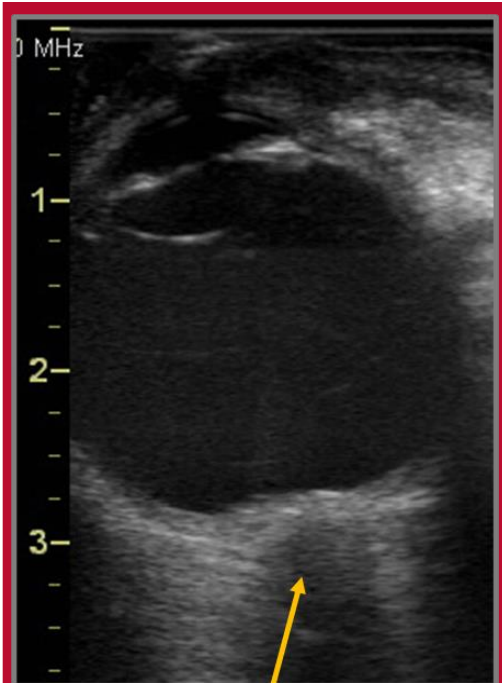


Figure 3. Ultrasound of optic nerve head elevation in SANS.

METHODS

A total of 50 subjects (mean age 45.5) were recruited and completed the informed consent process under the IRB at The Ohio State University. Of these, data were successfully collected for 48 subjects, 24 of whom were previously diagnosed with a VF defect. Participants completed threshold VF testing with HFA 24-2 SITA standard and the GBVF device which used a similar 24-2 protocol. The GBVF device consisted of a head-mounted VF tester running a novel program. Repeated measures ANOVA with VF instrument as a fixed factor was used in all analyses. For quadrant analyses, the quadrant was used as a fixed factor.



Figure 4 Goggle-based visual field device (GBVF). Produced by NIDEK Technologies.

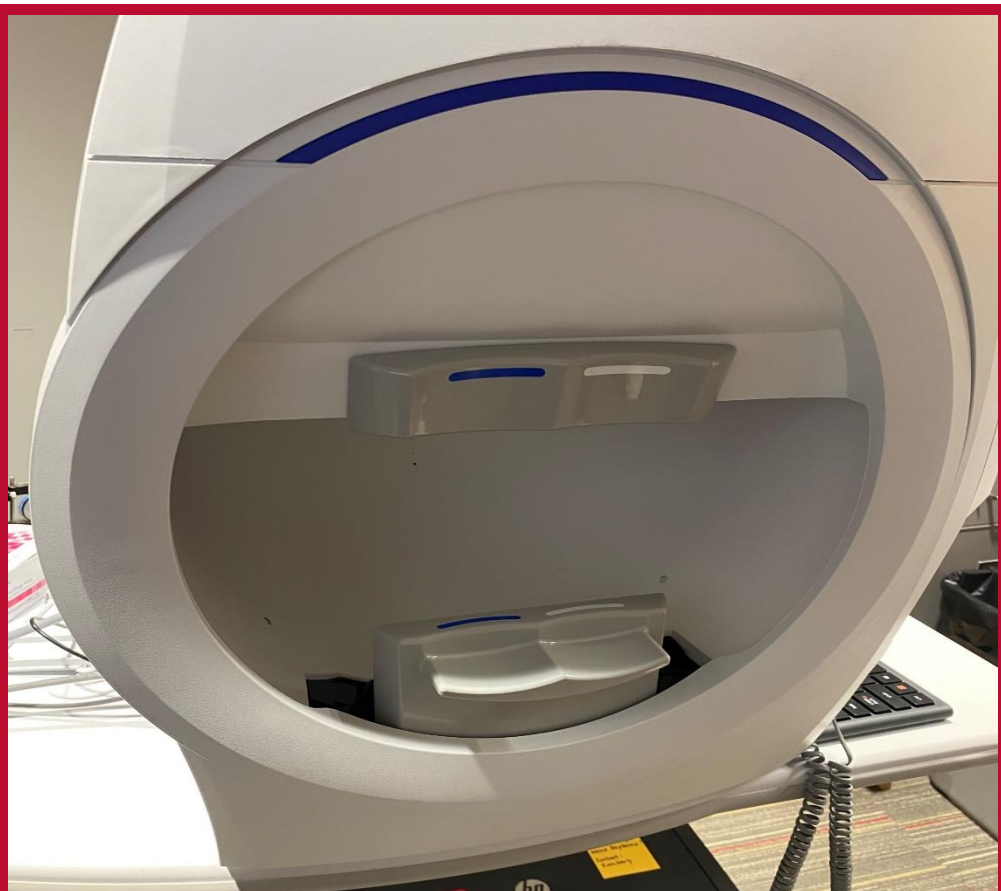


Figure 5. Humphrey field analyzer (HFA)

RESULTS

For subjects without a previously diagnosed VF defect, the instrument factor was not significant for any of the analyses (point-by-point comparison: OD $p=0.40$, OS $p=0.52$, quadrant analysis for summed decibel levels: OD $p=0.68$, OS $p=0.23$, quadrant analysis for average decibel levels: OD $p=0.63$, OS $p=0.24$). Overall, 14 right eyes and 13 left eyes were determined to have a VF defect from the sensitivity and grayscale plots or from the HFA pattern standard deviation value. For eyes with a VF defect, the point-point comparison showed a significant difference for the right eyes ($p=0.02$) but not for the left eyes ($p=0.17$) (Table 2). The quadrant analyses were not significantly different.

Table 1. Results of comparisons of the Humphrey visual field analyzer and the Goggle based visual field device for subjects with no previously diagnosed visual field defects.

Eye	Analysis	Results for instrument factor (p value)
Normal – Right eye	Point by point	0.40
Normal – Left eye	Point by point	0.52
Normal – Right eye	Quadrant summed decibel levels	0.68
Normal – Left eye	Quadrant summed decibel levels	0.23
Normal – Right eye	Quadrant average decibel levels	0.63
Normal – Left eye	Quadrant average decibel levels	0.24

Table 2. Results of comparisons of the Humphrey visual field analyzer and the Goggle based visual field device for subjects with visual field defects determined from visual inspection or from the pattern standard deviation (HFA only). The asterisk indicates a significant difference between the results from the two instruments ($\alpha = 0.05$).

Eye with the visual field defect	Analysis	Results for instrument factor (p value)
Visual field defect – Right eye	Point by point	0.02*
Visual field defect – Left eye	Point by point	0.17
Visual field defect – Right eye	Quadrant summed decibel levels	0.31
Visual field defect – Left eye	Quadrant summed decibel levels	0.60
Visual field defect – Right eye	Quadrant average decibel levels	0.56
Visual field defect – Left eye	Quadrant average decibel levels	0.60

Visual field sensitivity and grayscale plots from the two devices were visually compared. 8 of 98 (8.2%) visual fields were determined to be definitively different. In 5 of these cases (5.1% of the 98 total comparisons), the visual field defect only appeared or the defect was worse with the goggle based visual field device (example shown in Figure 6). In 3 cases (3.1%), the visual field defect only appeared or the visual field defect was worse for the Humphrey visual field analyzer (example shown in Figure 7). There were instances where the pattern standard deviation (only available for the HFA) showed a visual field defect not detected with visual inspection of the sensitivity and grayscale plots.

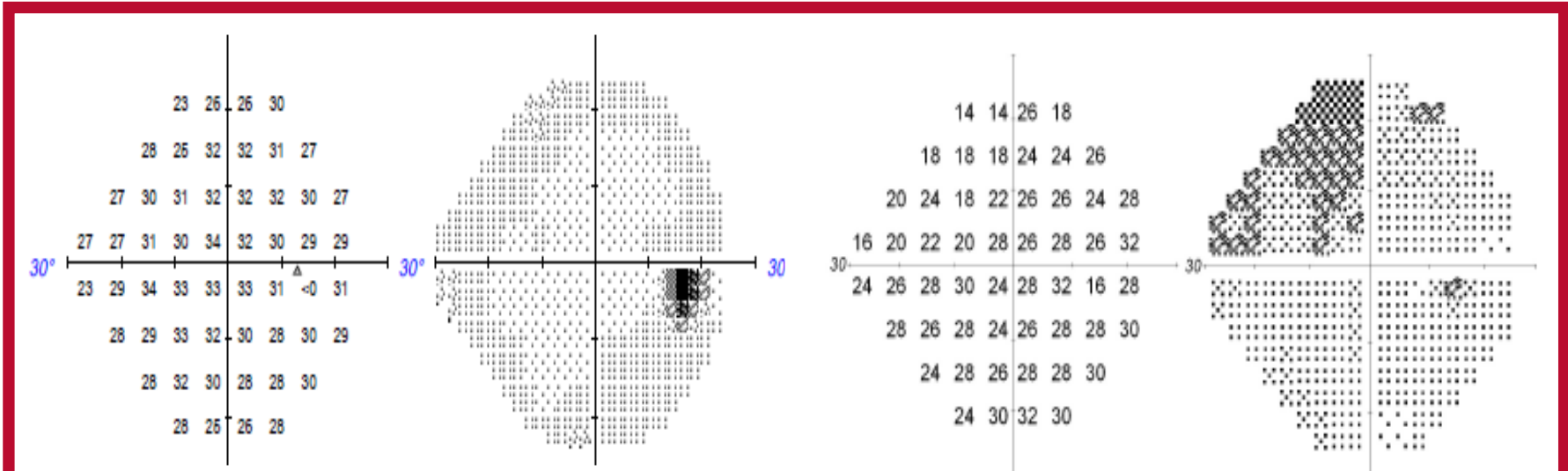


Figure 6. Example where a visual field defect was noted with the GBVF device (right), but no defect was noted with the HFA (left). Sensitivity and grayscale plots are shown.

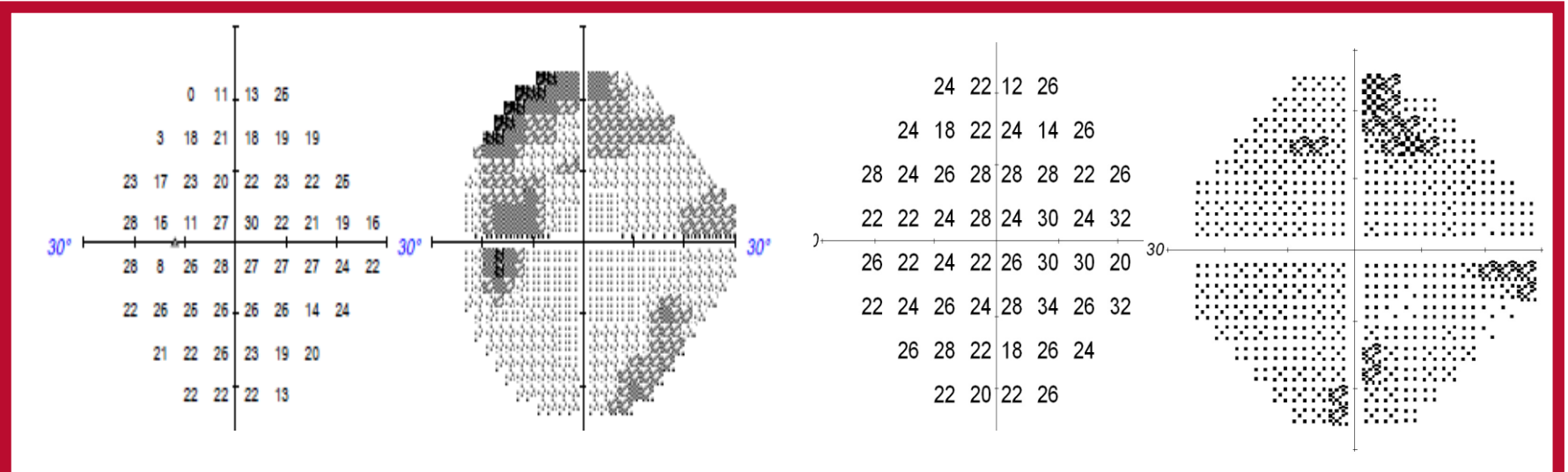


Figure 7. Example where a visual field defect was noted with the HFA (left), but no defect was noted with the GBVF device (right). Sensitivity and grayscale plots are shown.

CONCLUSIONS

For both the group with no previously diagnosed VF defects and for the eyes with VF defects, the GBVF and HFA devices produced similar testing results in the quadrant analyses. There was a significant difference between the instruments only for the point-by-point comparison for the right eyes with VF defects. Slippage of the goggle-based device or undetected changes in ocular fixation with the GBVF device may have accounted for the mild differences between the devices noted in one point-by-point analysis.

ACKNOWLEDGEMENTS

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