Virtual Reality Perimetry with Eye Tracking Compared with Standard Automated Perimetry

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Purpose

To determine the age-adjusted reference values of the Visu***ALL*** **ETS** (*Eye Tracking System*) Perimeter and its correlation with Humphrey Field Analyzer (HFA) parameters.

Methods

- This prospective clinical study protocol was approved by the Institutional Review Board of Wills Eye Hospital.
- Participants:
    - Control group: 25 (50 eyes) healthy subjects.
    - Glaucoma group: 26 (52 eyes) glaucoma patients.
- The control group were recruited from hospital personnel and volunteers with a normal eye examination, normal Humphrey visual filed, and no prior eye surgery.
- The glaucoma group were mild or moderate glaucoma patients who had reproducible HVF tests.

Figure-1: The Visu***ALL*** headset and the WebApp.

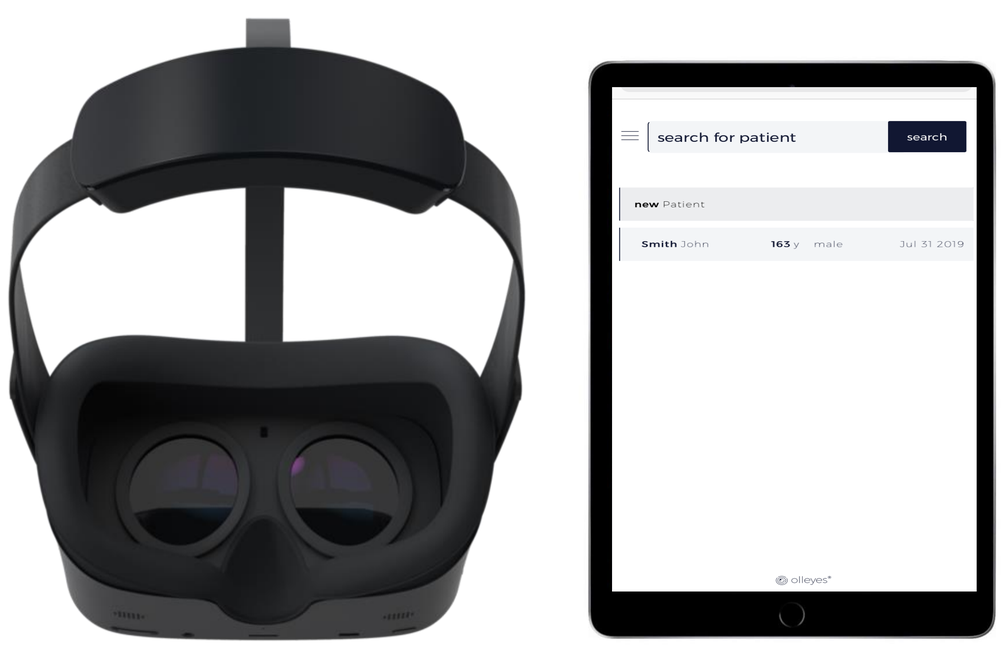


Table-1:The demographic characteristics of control and glaucoma groups.

	Control group	Glaucoma group
Participants	25	26
Eyes	50	52
Age (years)	53.96 (30-79)	66.04 (23-86)
Sex (F/M)	17/8	13/13
Caucasian African-American Hispanic Asian	13 8 3 1	13 13 - -

- The Visu***ALL*** system (Olleyes, Inc. Summit, NJ) is composed of a Virtual Reality (VR) headset and the WebApp installed on a cell phone, tablet, or computer (Figure-1)
- The VR headset weighs 520g and includes a Wide Quad High Definition Organic Light Emitted Diode (WQHD OLED) display with a resolution of 2560x1440 pixels with a refresh rate 70Hz. The display is divided in two halves (one for each eye) with a resultant resolution of 1280x1440 pixels on each half subtending a field of view up to 100 degrees.
- The ETS includes 2 eye-tracking system includes infrared cameras with a frame rate of 120fps. The eye-tracking system has a resolution of less than 1 degree.

Results

- The demographic characteristics are presented in Table-1.
- The study included 36 eyes with mild and 16 eyes with moderate glaucoma.
- The results of Receiver Operating Characteristic (ROC) curves are presented (Figure-2). Visu***ALL*** mean sensitivity (A) had greater ROC than HFA mean sensitivity (B), indicating a better discrimination between healthy and glaucomatous eyes.
- The global mean sensitivity of the Visu***ALL*** and the HFA correlated significantly in both control (r=0.54, *P*<0.001) and glaucoma (r=0.77, *P*<0.001) groups (Figure-3). The mean sensitivity of all quadrants also correlated significantly in the control (SN r=0.47, *P*=0.003; IN r=0.33, *P*=0.04; ST r=0.39, *P*=0.01; IT r=0.58, *P*<0.001) and glaucoma groups (SN r=0.65, *P*<0.001; IN r=0.76, *P*<0.001; ST r=0.62, *P*<0.001; IT r=0.67, *P*<0.001).

Figure-2: Receiver operating characteristic (ROC) curve of the mean sensitivity of VisuALL (A) and HFA (B) of 0.98 and 0.93 respectively.

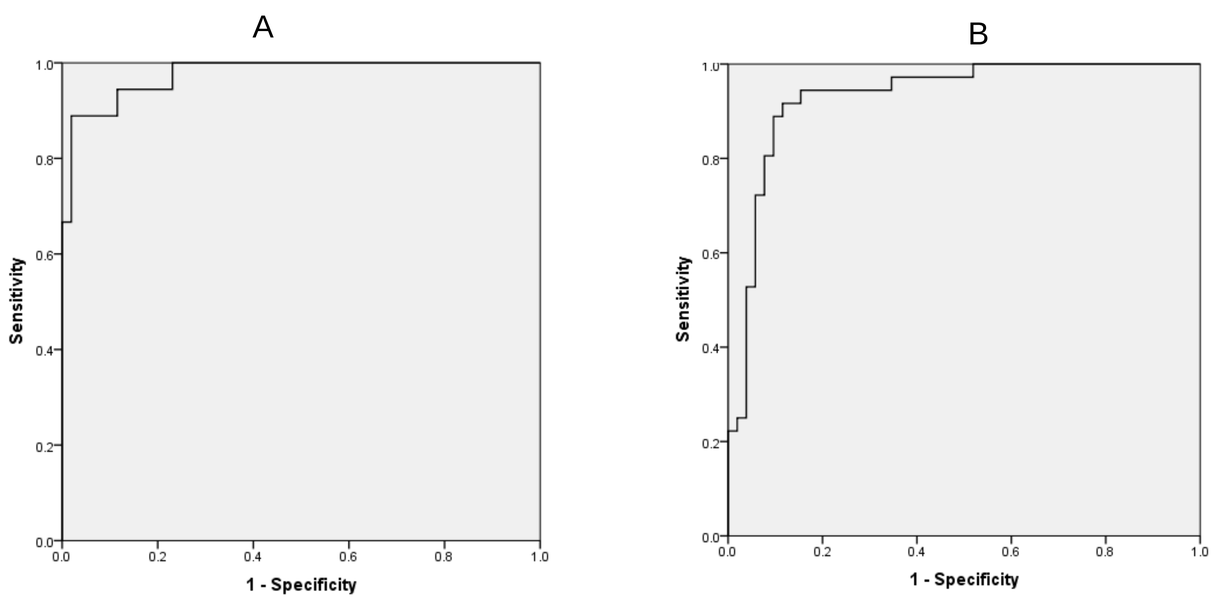
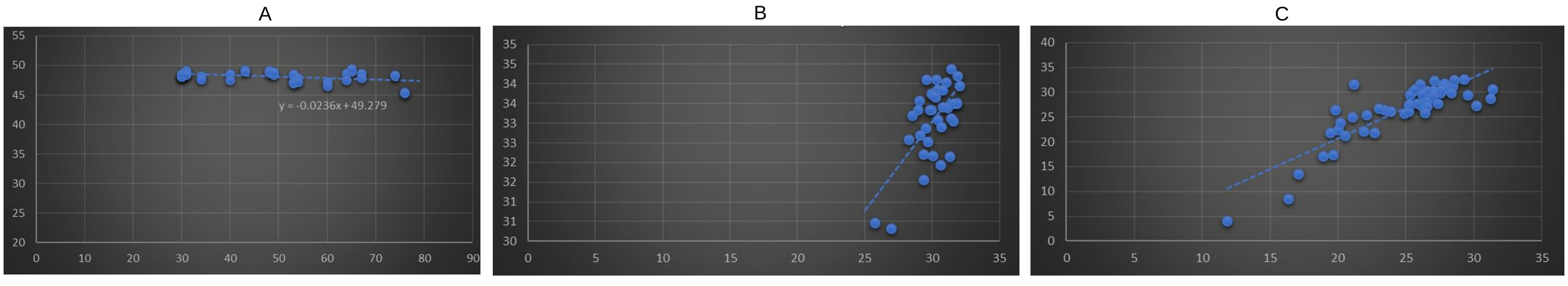


Figure-3: Age effect on Visu***ALL*** mean sensitivity (A); Correlation between Visu***ALL*** and HFA mean sensitivity in the control (B) and glaucoma groups (C).



Discussion

In this study, the assessed parameters of Visu***ALL*** **ETS** and HFA were well correlated. The Visu***ALL*** promises several advantages. The patient can be tested in virtually any position, the head can be freely moved during the test, the VisuALL efficiently controls the testing environment luminance and this VR-based perimetry does not require a dedicated room or technician support and could be performed outside the doctor's office.

Conclusion

The perimetric results of the Visu***ALL*** and the HFA were correlated. The Visu***ALL*** has the potential to be an effective and versatile clinical perimetry device.

References

1- Wu Z, Medeiros FA. Recent developments in visual field testing for glaucoma. Curr Opin Ophthalmol. 2018 Mar;29(2):141-146.
2-Wroblewski D, Francis BA, Sadun A, Vakili G, Chopra V. Testing of visual field with Virtual Reality Goggles in Manual and Visual Grasp Modes. BioMed Research International. Feb 2014.

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